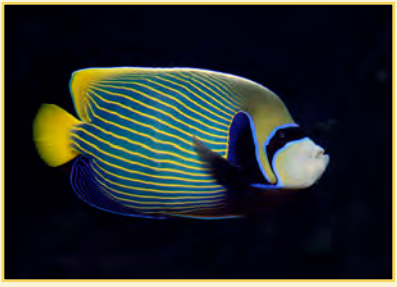
THE STEINHART AQUARIUM






A VIEW FOR AND BY DOCENTS

CALIFORNIA
ACADEMY OF
SCIENCES

THE STEINHART AQUARIUM

A FIELD GUIDE FOR AND BY DOCENTS

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FOREWORD AND ACKNOWLEDGMENTS

The Steinhart Aquarium, a central part of the California Academy of Sciences since 1923, two years ago opened a complex of exhibits as innovative and exciting as the institution that houses it. With the Steinhart's spectacular return to Golden Gate Park, docents, who everyday share their passion and insight with the public, needed access to useful information specifically about the ever-growing and changing Aquarium collection of live animals. This Field Guide along with the photo IDs of the inhabitants of multispecies tanks hopes to fill an important part of that need.

This digital guide, easy to update, is well suited to track the on-going diversification of Aquarium animals. Ideally, the Field Guide will be a resource improved and updated by information and suggestions from our Academy family—curators, staff, docents, guides and other volunteers, and all who love our finny, tentacled, slithering, gliding, flying, arboreal, aquatic, terrestrial denizens—all 38,000 of them.

This is a book created by volunteers for volunteers; contributors and advisors were many and appreciated!

Researchers and Writers: Maureen Aggeler, Ellen Barth, Roberta Borgonovo, Susan Crocker, Susana Conde, Pat Dal Porto, Steve Doherty, Arville Finacom, Ann Hardeman, Sandy Linder, Ted Olsson, Will Meecham, Alan Pabst, Owen Raven, Mary Roberts, Maggie Scott, Alice Settle, Elizabeth Shultz. Peter Schmidt earns a special star for the original conception of a field guide and for writing well over half of the entries, even more if the first two editions are counted.

Photography: Nearly all the pictures within these pages were taken by Ron DeCloux, whose skill and commitment add an important visual component to our understanding. See his complete portfolio at http://www.flickr.com/photos/cas_docents/collections.

Support: The Aquarium staff answered many questions almost more quickly than we could frame them, especially Tom Tucker, Bart Shepherd, Dave Chan, Nicole Chaney, Charles Delbeek, Jim Evans, Frank Glennon, Brenda Melton, Kristen Natoli, Rich Ross, Pam Schaller, Matt Wandell, Seth Wolters, Nick Yim, and others.

This is actually the fourth edition of a Steinhart Guide for and by docents. Many curators and other staff members have given us help along the way. We hope their patient explanations are reflected in these pages. Any inaccuracies are due to the our interpretations, and most certainly not to the information received.

Special thanks to Kathleen Lilienthal, Manager of Docent and Guide Services, for her unfailing support.

The Docent Materials Group
Sandy Linder, Coordinator
April, 2009

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Ron DeCloux

FISH FAMILIES

CARCHARINIDAE (REQUIEM SHARKS)
12 genera 50 species

Requiem sharks are probably the largest family of living sharks with worldwide distribution in all tropical and temperate waters. Many migrate long distances and some enter brackish and freshwater. Most are small, relatively harmless species; a few are large, dangerous patrollers of coastal and open water. Better known species include the oceanic whitetip shark, sandbar shark, bull shark, blacktip and whitetip reef sharks, and tiger shark. All have five gill slits, which, like all sharks, lack a cover (operculum).

Their streamlined body shape and behavior make the group the one people think of as "typical" sharks. Most are strong active swimmers and deadly hunters, well-equipped for finding and attacking prey. Like all sharks, they possess special sensing organs called ampullae of Lorenzini, gel-filled sensory pits on the snout so acute they are able to detect the electric charge produced by the nerves of another animal's body, an incredible prey-honing system! Requiem sharks, unlike many other shark species, also have exceptionally good eyesight, comparable to human vision.

Their teeth are typically serrated and bladelike with a single cusp. Sharks as a group may have from 6 to 20 rows of teeth, depending on the species. Usually only the first two rows of teeth are used for feeding. The others are replacement teeth that move forward in conveyor-belt fashion when older teeth are broken off. Sharks may replace teeth every few days, thus keeping the functional rows razor sharp.

All are viviparous except the ovoviviparous tiger shark. In this group, viviparous females have a placenta, in the form of a yolk sac, carries nourishment from the mother's body to the young after the pups have exhausted the food supply in their eggs.

How dangerous are these sharks. Statistics show about 50 shark attacks on humans occur each year, resulting in about 5 deaths. At least half these attacks are from requiem sharks, most notably the tiger, oceanic whitetip, and bull shark. As unsettling as those numbers seem, we are more likely to choke to death on a fish bone than be killed by a shark!

MURAENIDAE (MORAY EELS)
15 genera 200 species

Mostly marine and found worldwide in tropical and temperate seas, this diverse group is noted for large mouths with numerous sharp teeth. Most species lack pectoral and pelvic fins; the anal and dorsal fins extend along much of the body and are continuous with the caudal fin. Gill openings are small and roundish, situated on the side of the head.

Often secretive during the day, morays feed mostly at night on crustaceans, cephalopods, and small fishes. Their fanglike teeth are designed to tear rather than hold or chew, and can inflict painful wounds on humans. A second set of jaws in the pharynx can be thrust forward into the mouth to grasp prey. Like all true eels, their leptocephalus larvae are distinctive and characteristic.

CYPRINIDAE (CARPS, TRUE MINNOWS, AND THEIR RELATIVES)
210 genera 2,010 species

The Cyprinidae, found on all continents except South America, Australia, and Antarctica, is the largest family of freshwater fishes. Best known species include the goldfish (*Carassius auratus*) and the common carp (*Cyprinus carpio)*, which from the 18th century has been bred in Japan in the ornamental variety known as koi.

Cyprinids as a group have a single dorsal fin, abdominal pelvic fins, a lateral line, and cycloid scales. They lack teeth in the mouth, but have 1–3 rows of pharyngeal teeth for grinding food against an opposing horny pad. All cyprinids are egg layers; most species do not guard the eggs.

SYNGNATHIDAE (PIPEFISHES, SEAHORSES, AND SEADRAGONS)
52 genera 215 species

Pipefishes, seahorses and seadragons are characterized by long tubular snouts and elongate bodies encased in rings of bony plates. The head of pipefishes is in line with the body axis, while the head of seadragons and seahorses is bent downward from the body's main axis. Fin configuration depends on the group; however, all syngnathids are slow-moving species that depend on cryptic behaviors. Seahorses also possess a prehensile tail that lacks a caudal fin.

All members of the family feed on minute invertebrates sucked into the long snout. Because they lack teeth and a true stomach, digestion is somewhat inefficient, and syngnathids need to feed almost continuously on their tiny prey.

Reproductive habit is highly unusual in that parental care is mostly left to the male. Seahorse males possess a ventral brood pouch where eggs are fertilized and incubated after deposition by the female. Male pipefishes may have a brooding pouch or a simple patch of spongy material where eggs adhere. Seadragon males carry eggs on an adhesive brood patch under the tail.

SCORPAENIDAE (SCORPIONFISHES AND ROCKFISHES)
23 genera 172 species

A large family of mostly marine fishes found in all tropical and temperate seas, the scorpionfish family takes its name from the venomous spines that adorn nearly all its members. Other characteristics include a compressed body, and most have spines on the head as well as near and on the operculum. The dorsal fin, while usually single, is often notched and supported by stout spines. Spines on the dorsal, anal, and pelvic fins have venom glands at their bases that, when compressed, deliver a toxic cocktail to would-be predators or careless humans.

Scorpaenidae is the largest family of fishes along the California coast, where at least 65 species, including 60 kinds of rockfishes, are known. Rockfishes possess relatively mild toxins, but should still be handled with care. Fertilization is internal. Some species lay eggs; others give live birth, including all rockfish species

William Eschmeyer, Curator Emeritus of the Academy, is one of the world's leading experts on scorpionfishes.

SERRANIDAE (SEA BASSES, GROUPERS, AND BASSLETS)
62 genera 449 species

Serranidae is a large family of marine fishes. They are usually found over reefs, in tropical to temperate waters.

The basslets, small, colorful planktivores that in the wild feed primarily on tiny crustaceans and fish eggs floating in the upper levels of reef waters, are the common serranids found in the Philippine Coral Reef Exhibit. Like other serranids, basslets are protogynous hermaphrodites; in other words, they are born female, and a few change sex to become dominant males as breeding needs arise. They produce large quantities of eggs and their larvae are planktonic, generally at the mercy of ocean currents until they mature into adults.

APOGONIDAE (CARDINALFISHES)
22 genera 207 species

Found in the Atlantic and Indo-Pacific oceans, cardinalfishes are primarily marine, though some are found in brackish waters and a few in freshwater streams. Many species inhabit reef flats, lagoons, and seaward reefs to 60 feet (18 m).

The family is characterized by two separate dorsal fins, large eyes, and a large mouth. The name derives from the red coloration of some well-known species, though many are drab or striped.

Most remain hidden during the day, and then disperse over the reef at night to feed on zooplankton and small benthic invertebrates, always remaining close to the substrate. Males of many species are mouth brooders.

CHAETODONTIDAE (BUTTERFLYFISHES)
10 genera 114 species

Butterflyfishes, with their bright colors, distinctive shape, and interesting behaviors, are among the most recognizable coral reef fishes. Nearly all are found in tropical waters with the highest concentration of species occurring in the Indo-West Pacific. All species have a deep, laterally compressed body with a continuous dorsal fin and distinctive rounded anal fin. Many have a band across the eye and/or a false eyespot, patterns that may lure a predator to attack the tail rather than the head.

The mouth is small, terminal, and protrusible with small brushlike teeth. The shape and size of the jaw varies among species and correlates with the type of prey taken. Some butterflyfishes prefer small invertebrates, others nibble on coral polyps or graze on algae, and still others feed on zooplankton. The length of the jaw, which in some species may be quite elongate, allows partitioning of resources, with some species able to reach a meal unavailable to another.

POMACANTHIDAE (ANGELFISHES)
9 genera 74 species

Brightly colored, large, and elegant, the angelfishes are among the most spectacular of reef fishes. The family is circumtropical in distribution. Most are found in the tropical Indo-Pacific, mainly on coral reefs in relatively shallow water.

Like their close relatives the butterflyfishes, they have a deep, laterally compressed body, a single, unnotched dorsal fin, and a small mouth with brushlike teeth. The most observable difference between the two families is the long spine at the corner of the preopercle common to angelfishes. Many angelfishes also have extensions, often long and graceful, on the back end of the dorsal and anal fins.

Diet varies among species, ranging from algae, detritus, and plankton to sponges and small, benthic invertebrates. Typically, they spend daylight hours near the bottom in search of food, and shelter near boulders or in caves and crevices at night.

Some species are noted for dramatic changes in color and pattern from juvenile to adult. Breeding groups are haremic, with a single dominant male and several females. If the male dies, the dominant female can change sex, sometimes within a matter of days.

CICHLIDAE (CICHLIDS)
105 genera 1,300 species

The Cichlidae is a family of primarily freshwater fish species with worldwide distribution. One of the largest fish families, at least 1,300 cichlid species are known and probably many others are yet to be discovered (some estimates suggest 3,000 total species may exist). Greatest cichlid diversity is found in Africa and South America. Substantial numbers are found in Central America and a few as far north as Florida and southern Texas.

As a group, cichlids are highly variable in body size, from species as small as 2.5 cm such as the kribensis (*Pelvicachromis pulcher*) displayed in Staff Picks, to those approaching 1 meter, such as the peacock bass (*Cichla ocellaris*) on display in the Amazonian Flooded Forest tank. Cichlids live in almost every conceivable freshwater habitat, and their diets range from other fish, to fish scales and parasites, algae, and everything in between.

Perhaps their most striking characteristic and an adaptation for success is the remarkable degree of parental care they invest in eggs, fry, and juveniles, care that may last for weeks or even months. See various species descriptions for examples. Many cichlids, such as the tilapias, are important food fishes; others such as the peacock bass, are prized as game fish.

Cichlids have been called the Darwin's finches of the water world. To the evolutionary biologist, their most intriguing characteristic is their rapid rate of speciation. For example, a few ancestors are thought to have invaded Lake Malawi about 700,000 years ago, and from this small number some 700 known species populate the lake today, each with a seemingly unique set of characteristics that prevent it from competing directly with others. Madagascar has a variety of cichlid species only distantly related to those of Africa, from which it separated over 100 million years ago. Knowledge of the distribution and evolutionary divergence of cichlid species worldwide has added to our understanding of the movement of Earth's tectonic plates over time.

EMBIOTOCIDAE (SURFPERCHES)
13 genera 24 species

With the exception of one freshwater species, most surfperches are found in coastal waters of the North Pacific, and are common along the California coast. Members of the family are laterally compressed with oblong or elliptical bodies, a forked tail, and a continuous dorsal fin with a scaled ridge along its base. Most are silver, and many species are barred or striped. Many form schools or loose aggregations.

All are livebearers. Internal fertilization is aided by the thickened front part of the male's anal fin. Young are nourished within the female. Many are born relatively quite large, and some are capable of reproducing immediately after birth.

POMACENTRIDAE (DAMSELFISHES, CHROMIS, AND ANEMONEFISHES)
28 genera 321 species

The Pomacentridae is a large family with worldwide distribution. Most species inhabit tropical seas, though a number are found in temperate seas as well. The garibaldi, the California State Fish, is a member of the family. The majority of species inhabit the Indo-Pacific, and many are common on Philippine coral reefs. Anemonefishes, better known as clownfishes and well represented in our exhibit, are damsels that live in association with sea anemones.

While a few are drab, most family members are often brightly colored in shades of green, orange, yellow, red, even neon blue. Mostly small and laterally compressed, damselfishes often occur in high population densities and, though there are always exceptions, as a group are known for their territoriality and aggressiveness, expressed in both feeding and reproductive behaviors. Size doesn't deter members of this feisty group that regularly take on a much larger fishes.

Damselfish pairs establish a territory and defend it vigorously. Eggs are laid on the substrate, fertilized, and stoutly guarded by the male, who may also fan them with his fins to keep them cool and oxygenated. Many damsel species are capable of sex change, starting life as male and later becoming female.

CIRRHITIDAE (HAWKFISHES)
9 genera 32 species

A family of small and usually colorful species, hawkfishes are found in tropical waters of the Atlantic, Indian, and Pacific oceans. The group is characterized by thickened and elongate pectoral fins, a single continuous dorsal fin, and numerous short filaments at the tip of each dorsal spine that look like pom poms.

All are carnivores that feed on small benthic crustaceans and fishes. The common name derives from their habit of perching on coral heads or other advantageous sites, using their large pectorals for purchase. The family lacks swim bladders, an adaptation for their benthic lifestyle.

Species studied are protogynous hermaphrodites. Dominant males are territorial and maintain a harem of females.

LABRIDAE (WRASSES)
60 genera 500 species

Wrasses are a marine family found in tropical and temperate waters of the Atlantic, Indian, and Pacific oceans. The second largest family of marine fishes, wrasses are particularly abundant and conspicuous on tropical reefs worldwide.

Wrasses are most easily identified by their pointed snouts and prominent canine teeth that protrude in front of the jaw. Other common characteristics include their form of propulsion, which depends mostly on the winglike motion of the pectoral fins with only an occasional burst of speed provided by the caudal fin. Typically diurnal, many wrasses bury themselves in sand or seek crevices at night.

Size, shape, and color are quite diverse as are habitat, diet, and reproductive strategy. Males, females, and juveniles often sport different colors and shapes, adding to the challenge of identifying a given species. Food preferences vary, depending on species, from fish, mollusks, worms, corals, echinoderms, plankton, vegetation and other choices in between. Some, such as the cleaner wrasse *Labroides dimidiatus*, are famous for their habit of removing mucus, parasites, and scales from larger fishes.

Like a number of other fish families, many species of wrasses may change sex with age. In some species, males may be primary (the initial sex) or secondary (females that have undergone sex change). In others, such as the cleaner wrasse, all individuals are born female and some change sex as necessary.

BLENNIIDAE (BLENNIES)
53 genera 345 species

Blennies are found worldwide in tropical, subtropical, and temperate seas. Blennies are bottom dwellers with blunt heads and long anal fins. They often possess cirri, branching appendages on the head. Most have small comblike teeth for feeding on algae, but some steal bites of fins, scales, or skin from other fish. Most lay adhesive demersal eggs that are often guarded by the male.

Because of their small size and elongate bodies, blennies and gobies are often confused with one another; however blennies are distinguished by their single, long continuous dorsal fin, their pelvic fins situated in front of their pectorals, and their habit of resting on the bottom with curved bodies. Gobies have two-part dorsal fins and rest with straight bodies.

GOBIIDAE (GOBIES)
212 genera 1,875 species

Members of a huge family, gobies are found in salt, brackish, and fresh waters, mostly in the tropic and subtropics, but are well represented in temperate waters as well. They are typically found in shallow coastal areas and around coral reefs. The Gobiidae has more marine species (probably more than 2,000) than any other fish family.

Gobies are small, usually less than 10 cm (4 in). They have distinctive two-part dorsal fins, and the pelvic fins are fused together to form an adhesive disk used to maintain purchase on the substrate in strong currents. Most species possess two separate dorsal fins; lateral line is absent. Like bottom-dwelling blennies, gobies lack a swim bladder. Most are carnivores on benthic invertebrates; some feed on plankton.

Though reproductive variations are numerous, gobies typically spawn over a nest prepared by the male, who clears a small area where eggs are deposited and subsequently guards the eggs.

SIGANIDAE (RABBITFISHES AND SPINEFOOTS)
2 genera 25 species

Mostly marine and ranging widely in the tropical Indo-Pacific and eastern Mediterranean, siganids are highly compressed, relatively deep-bodies fishes. They have small terminal mouths, minute scales, and venomous spines on dorsal, anal, and pelvic fins that can inflict painful wounds to both divers and unwary aquarists.

The common name "rabbitfish" comes from their voracious appetites as diurnal herbivores on algae as sea grasses. All are open-water spawners. Some species are highly valued as food fishes; colorful species are sought for the aquarium trade.

ACANTHURIDAE (SURGEONFISHES)
6 genera 72 species

Acanthurids are exclusively marine dwelling and are found in all tropical and subtropical seas, except the Mediterranean. Typically found on offshore coral reefs, surgeonfishes have deep, compressed bodies with small mouths and close-set teeth efficient for nibbling and scraping small organisms from rocks and coral.

Their distinguishing feature is a modified scale on the caudal peduncle which forms a scalpel-like blade often covered with toxic slime. These spines are used for species recognition, defense, and competition for mates. Surgeonfishes are unusually long-lived, with many known to exceed 30 years of age.

Acanthurids are grazers and planktivores. Those that feed on filamentous and leafy algae perform an important service to the reef, keeping thick mats of vegetation from smothering corals. Unicornfishes are diurnal planktivores, often seen hovering above the reef gleaning nutritious morsels. Because of their elaborate coloration, intriguing behaviors, and coral-protecting feeding habits, surgeonfishes are a favorite of both visitors and aquarists.

BALISTIDAE (TRIGGERFISHES)
11 genera 40 species

Mostly found on coral reefs in relatively shallow water, triggerfishes have a highly compressed body and close-fitting scales that provide a flexible armor. They are mobile, but not fast swimmers noted for providing propulsion by the undulations of the second dorsal and the anal fins, with an occasional boost from the pectorals. The caudal fin is mostly used as a rudder. Like their close relatives the surgeonfishes, they sport spines on the caudal peduncle used to intimidate potential intraspecific competitors and others. Their small eyes on top of the head can be rotated independently.

The common name comes a unique interaction between the large first dorsal spine and the smaller second one behind. When the posterior spine is erect, it locks the strong first spine in place, wedging the fish into a protective space, perhaps a hole or under a rock, where a predator can rarely extract it. When the posterior spine is depressed, the anterior spine folds back easily, like taking a lock off a trigger.

Most are solitary, diurnal predators that feed on various invertebrates. The upper jaw contains both sharp teeth for capturing prey and flattened, plate-like teeth used to crush shells, or an occasional careless human finger!

OSTRACIIDAE (BOXFISHES)
14 genera 33 species

Found in the Atlantic, Indian, and Pacific oceans mostly in tropical or subtropical waters, boxfishes are named for the armor-like carapace of bony polygonal plates that encompass the head and body, like a shell. This body covering has gaps for the mouth, eyes, gill openings, anus, and fins when present. Pelvic fins are absent and the upper jaw is non-protrusible. Ridges on the surface of the plates are often armed with prominent spines.

These slow moving, diurnal species feed on a variety of small sessile invertebrates and algae, depending on their armor for protection. Some species secrete a highly toxic substance which may be lethal to other fishes and even themselves if confined to small areas in an aquarium.

Species studied to date are haremic. A dominant male defends a territory containing females and subordinate males. Other common names are trunkfishes and cowfishes.

Ron DeCloux

USING THE STEINHART FIELD GUIDE

The Steinhart Field Guide (SFG) is designed to give species specific information about nearly all of the denizens of Steinhart Aquarium, including the Rainforest, in a user-friendly format. Depending on interest or need, a reader can find an overview of a particular species or simply look up a piece of information about a species that answers a visitor's question. The Guide isn't meant for cover-to-cover reading or memorization, but rather as a reference handbook. When conflicting testimony was discovered in the literature, information in this guide tends to agree with the most recently published papers.

Resources used for the Field Guide were extensive. The total bibliography, which is available to anyone with an interest, runs several pages, and includes books, journals, select websites, and first-hand information from Academy scientists and Aquarium staff.

SYSTEMATIC ORGANIZATION

The SFG is organized systematically, according to highly respected studies and reviews, including the *Catalogue of Fishes*, a review of the estimated 25,000 - 28,000 extant known species of fish undertaken by Academy curator William Eschmeyer, the *Systematic List of Octocoral Genera* by Academy curator Gary Williams, and *Hexacorallians of the World*, a classification by Daphne Fautin, Fellow and former curator of the Academy.

EXPLANATION OF VARIOUS CATEGORIES

Note: if no information was available, a category is omitted.

Name:

The common name assigned to a species in the Steinhart Aquarium is taken primarily from FishBase, an internationally recognized resource that depends heavily on names suggested in occasionally by other accepted common names (aka = also known as). These aliases are often referred to in scientific literature or recognized by the public. According to *www.fishbase.com* there are currently more than 28,500 valid fish species with more than 188,700 common names. In the FG the species name is followed by the scientific name of its family and the English language name of the family.

Distribution:

Recorded geographical distribution, per literature consulted.

Habitat:

Ecological environment. May include notes concerning diurnal versus nocturnal location and activity. Also may include information on individual vs. colonial behavior, etc.

Appearance:

A general description, typically of adult, juvenile and/or larva, from the literature consulted. Length and weight statistics are maximum size reported in the literature.

Diet:

What an organism eats.

Reproduction and Development:

Information on how a species reproduces and grows. This information is lacking for some species on exhibit at the Howard Steinhart.

Mortality/Longevity:

Big fish eat smaller fish. That cliché aside, little seems to be recorded in the references consulted as to causes of mortality. Longevity records proved to be the most elusive data to track down. The SFG provides species-specific information, and so does not include general items such as the fact that one sea anemone lived more that 50 years in captivity, since the reference did not cite the species. One important point is that many longevity records are for captive individuals not subject to predation, as well as having the benefits of veterinary care and a constant supply of adequate nutrition. Lifespan in the "real world" may be far shorter.

Conservation status:

Information in this section comments on the status of a particular species in nature and usually includes a status rating by the IUCN (International Union for Conservation of Nature and Natural Resources), occasionally includes a CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendix number as well as comments about unregulated exploitation and illegal trade. Repetitious information, for example that coral reefs, coral reef fishes and the invertebrates dependent upon those coral reefs are at risk due to global warming, habitat destruction, etc. (see *Coral Reef—An Overview*) was not included. However, docents should be aware of such threats.

The IUCN issues a regular bulletin as to that organization's opinion as to the status of the taxon that it is tracking. It is important to note that the IUCN is not monitoring the status of all species. Following is a categorization of the IUCN terms:

EXTINCT (EX) - A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW) - A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual.

CRITICALLY ENDANGERED (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria described below.

ENDANGERED (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria as described below.

VULNERABLE (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

LOWER RISK (LR) - A taxon is Lower Risk when it has been evaluated, but does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable.

DATA DEFICIENT (DD) - A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required

and acknowledges the possibility that future research will show that threatened classification is appropriate.

NOT EVALUATED (NE) - A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

The IUCN Criteria for Critically Endangered, Endangered and Vulnerable can be accessed at *www.redlist.org* by clicking on the Categories and Criteria menu.

Other remarks on conservation status refer to CITES. The convention was concluded in 1973 in Washington, D. C., and by 1986 had more than 80 nation states as members.

CITES seeks to regulate the trade in threatened wildlife (live, dead or parts; *e.g.,* elephant ivory) by cooperation between exporting and importing countries. The species subject to regulation are listed in three appendices:

Appendix I includes "all species which although threatened with extinction which are or may be threatened by trade. Trade in specimens of these species must be subject to particularly strict regulation in order not to further endanger their survival and must be authorized in exceptional circumstances."

Appendix II includes "all species which although not necessarily threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation . . . ." Controls on species similar in appearance to threatened species are also listed in this appendix.

Over 2000 species of coral, including all black corals (Order Antipatharia), blue corals (Order Coenothecalia), stony corals (Order Scleractinia), fire corals (Milleporidae spp., Stylasteridae spp.), and organ-pipe corals (Tubiporidae spp.) are listed in Appendix II of CITES.

Appendix III includes species given strict national protection, for which party states seek international cooperation in enforcement. Appendix III is rarely used.

The Convention is implemented by licences issued in member states, and no species listed in CITES can be legally traded without some sort of documentation.


Ron DeCloux

A FIELD GUIDE TO SPECIES OF THE STEINHART AQUARIUM

ALGAE

GREEN (DIVISION CHLOROPHYTA)

Sea Lettuce
Ulva spp. (Ulvaceae)

Distribution: *Ulva taeniata:* Oregon to Point Dume, California. Other *Ulva* spp. more widespread.

Habitat: Intertidal and shallow subtidal.

Appearance: Thin thallus, colored leafy green.

Reproduction and Development: Undergoes a cyclic alternation of generations between the sporophyte (spore-producing alga) and gametophyte (gamete-producing alga). Both types appear identical macroscopically. Mobile flagellated zoospores are produced by meiosis. The zoospores disperse and attach to a hard substrate, where they grow into a haploid male or female (the gametophyte), which produces and releases sperm or eggs by mitosis. Fertilization produces the diploid zygote, which settles, attaches and grows to become a diploid sporophyte.

Conservation status: Tolerant of organic and metal pollution (although there are limits). Most likely will increase in population numbers as their more sensitive tide pool mates die off. Grow rapidly and produce vast quantities of spores and gametes, thus a true sea "weed."

Remarks: A popular "sea vegetable" for human consumption.

Moss Ball
Aegagropila linnaeim (Cladophoraceae)
Filamentous Green Algae

Distribution: The free-floating spherical forms are known only from Austria, Iceland, Scotland, Japan, and Estonia.

Habitat: Lake balls, as they are sometimes called, are restricted to a few freshwater lakes.

Appearance: Velvet-green rounded shape. Known to grow to 30 cm (i.e., larger than the tank it presently inhabits).

Diet: Produces nutrition through photosynthesis.

Reproduction and Development: Size of balls increases from vegetative growth.

Conservation Status: A number of the lakes where these enigmatic balls once formed no longer support their growth, perhaps due to eutrophication and in some cases the use of the lakes for timber transportation, a practice that blocked sunlight to the plants. The plant's limited dispersal capabilities may also increase the effect of local habitat degradation.

Remarks: The moss ball is a species of filamentous green macroalgae (Chlorophyta). A moss ball is a rare growth form.

The moss ball is called "Marimo" in Japan. A mari is a soft bouncy play ball; "Mo" refers to

aquatic plants. They are not related to moss!

Mythology from the Iloklaido district of Japan, where the few lakes with moth balls are found, tells the story of a young couple who drowned in a local lake and their hearts turned into moss balls. In 1952, Marimo were declared a Special Japanese Natural Treasure.

One adaptation suggested for the spherical shape: When silt or other fine debris collects on the upper surface, gravity causes the plant to rotate and the debris to fall off, leaving the plant able to collect more sunlight.

BROWN (DIVISION PHAEOPHYTA)

Rockweeds

Fucus distichus, F. serratus, F. vesiculosus (Fucaceae)

Distribution: Oregon to Point Conception, California.

Habitat: Middle to upper tidal zone.

Appearance: Dichotomously branched, murky green to dark brown algae. Length to 25 cm.

Reproduction and Development: The tips of the blades become swollen and covered with small bumps when reproductive. *Fucus* can produce diploid zoospores asexually.

Remarks: The Latin word *fucus* was originally applied to "seaweeds" in general.

Feather Boa Kelp

Egregia menziesii (Alariaceae)

Distribution: Pacific Coast of North America, Alaska to Baja California.

Habitat: Low to subtidal rocky outcrops along moderately exposed coasts; usually found in dense stands.

Appearance: Olive green to dark brown thick strap-like blade called "fronds," fringed with short lateral blades and studded with pneumatocysts (gas-filled cells promoting buoyancy); blades surmount stubby stipe attached to fleshy, cone-like holdfast; length 5–7 meters.

Reproduction and Development: Reproduce by spores; rapid growth.

Mortality/Longevity: Perennial.

Remarks: Common name comes from the feather boa, a style accessory worn draped around the neck; harvested commercially as nitrogen-rich "dressing" for agricultural land.

Processed for algin, a gelatinous substance widely used as a thickening, stabilizing, emulsifying, or suspending agent in industrial, pharmaceutical, and food products, such as ice cream.used in inks and ice cream.

Natural underwater habitat for many small species, mostly invertebrates; when uprooted by storm surge and cast onto the shore above the high tide line, degenerating kelp becomes habitat for numerous small land creatures.

Oar Weed

Laminaria spp. (Phaeophyceae)

Distribution: North Atlantic and northern Pacific; also the Mediterranean Sea and off Brazil.

Habitat: Low intertidal to subtidal areas along the coast, from 8–30 m. This genus is so characteristic at this depth, the zone is known in some schemes as the *Laminaria* zone.

Appearance: Stout holdfast attaches to solid substrate to anchor its long, limber stipes and deeply incised blades.

Diet: Photosynthetic.

Remarks: *Laminaria* species, as well as other brown algae, are commercially grown for the extraction of iodine and algin. Algin is used in the food industry as a thickening agent and as a mold-making material in dentistry and prosthetics. These kelp are also used as fertilizer and stock feed in some areas

Macrocystis aka Giant Kelp

Macrocystis pyrifera (Lessoniaceae)

Distribution: Pacific coast of North America from central California to Baja California.

Habitat: Grows in extensive beds or forests in cool coastal waters where hard substrate is available for attachment. Restricted to shallow depths where young plants receive sufficient light for growth.

Diet: Kelps photosynthesize, using the energy of sunlight to convert carbon dioxide, water, and nutrients into the organic compounds that sustain their growth. Unlike terrestrial plants, kelp absorb nutrients directly from the water; holdfasts, though they have a root-like structure, function solely for attachment.

Reproduction and Development: Develops from microscopic spore that grows into a small male or female gametophyte. Gametophytes produce sperm and egg that join and

subsequently grow into the familiar kelp, which when mature sheds spores to repeat the process.

Mortality/Longevity: Relatively few herbivores graze directly on living kelp, abalone and sea urchins being notable exceptions. Most of its energy enters the food chain as detritus, bits of dead organic matter dissolved in the water that are taken up by a variety of filter feeders. The plant is a perennial. Holdfasts may survive 4 to 10 years, fronds from 6 to 12 months.

Conservation Status: An increase in the population of sea urchins, probably caused by the indiscriminate hunting of the sea otter, which preys heavily on urchins, may have been a prime reason for the disappearance of large expanses of kelp forests along the Pacific Coast in the recent past. Now protected, sea otters have increased in number, and the kelp forests again cover their historic ranges.

Remarks: Kelp forests provide food and shelter for many kinds of invertebrates and fish as well as a few species of birds and marine mammals, such as otters and seals. Holdfasts are home for a variety of small snails, worms, and other organisms.

Giant kelp is the fastest growing organism known, adding almost .6 m a day to its length under optimal conditions!

Kelp beds along the Pacific Coast are the most extensive and richly populated in the world, supporting millions of organisms representing some 1,000 species.

RED (DIVISION RHODOPHYTA)

Encrusting Coralline Algae

Corallina *spp. (Corallinaceae)*

Distribution: Widespread in all the world's oceans.

Habitat: Common on intertidal rocky shores and coral reefs.

Appearance: Their crustose growth form can range from just a few micrometers to several centimeters thick. May present a few pink to grayish pink patches on rocks or reefs, or cover nearly 100% of an area. Some species may be purple, yellow or blue. The structure is hard, strengthened by calcareous deposits within the cell walls.

Diet: Create their own food through photosynthesis. Like all red algae, they contain phycoerythrin, a pigment which reflects red light and absorbs blue light. Blue light penetrates water to a greater depth than most other wavelengths, allowing red algae to photosynthesize in deeper water than most other algal groups.

Remarks: Some 1600 species of encrusting coralline algae have been described. The family also includes articulating corallines (see below).

Thick encrusting corallines provide microhabitat for a number of invertebrates, some of which also feed on the algal film that grows on the coralline.

Encrusting corallines are especially significant in the ecology of coral reefs: their calcium carbonate structure helps cement the reef together, and they are important sources of primary production.

Articulating Coralline Algae

Corallina spp. (Corallinaceae)

Distribution: Aleutian Islands to the Galapagos Islands *(Corallina vancouveriensis). Corallina officinalis* has an even greater distribution, and the variety *chilensis* occurs along the entire California coast and beyond.

Habitat: *Corallina vancouveriensis* forms dense tufts and mats in the middle to lower intertidal zone. *Corallina officinalis* var. *chilensis* occurs from tide pools to the subtidal.

Appearance: Both are red (Rhodophyta) articulated calcareous algae with pinnate branching. Armored segments much more robust on *Corallina vancouveriensis.*

Reproduction and Development: Alternation of generations. The sporophyte and gametophyte plants appear similar.

Remarks: Heavy calcification of the outer part of the cell wall is an effective defense against herbivory.

Generic name means "little coral."

Corallina officinalis is the medicinal algae of the ancients, named by Linnaeus for its use as a vermifuge (to expel parasites from the intestinal tract). Linnaeus erroneously believed the corallines were coral-like animals.

In 1837 it was discovered that corallines were algae, not animals.

Turkish Towel
Gigartina spp. (Gigartinaceae)

Distribution: California coast (and beyond).

Habitat: Lower intertidal to subtidal zones.

Appearance: Oval, generally undivided blades to width of 20 cm. Apex is blunt. Open coast algae are thick; algae of this species in calm water are thin and crisp.

Diet: Photosynthesize.

Reproduction and Development: Alternation of generations. The sporophyte and gametophyte plants appear similar.

Remarks: Common name derives from prominent papillae.

Some *gigartina* spp. are grown commercially for the extraction of carrageenan, a gel used in many food products as a thickening and stabilizing agent.

Iridescent Red Algae
Iridaea spp. (Gigartinacea)

Distribution: Along the Pacific Coast from British Columbia thru northern California.

Habitat: Rocky intertidal and subtidal.

Appearance: Characterized by a glistening iridescence caused by the reflection and refraction of light off the multiple layers of its cuticle and cell walls. Colors change with the angle of incident light, which in turn changes with the movement of the thallus (leaf-like structure) in the currents.

Diet: Photosynthetic.

Reproduction and Development: Most reds have a complex three-stage life history.

Remarks: Some species are a dark red, others almost green or black. Color differences are due to more or less red-producing phycoerythrin pigment in the cells.

Sea Sacs
Halosaccion glandiforme (Palmariaceae)

Distribution: North Pacific; Alaska to Point Conception, California.

Habitat: Exposed rocky habitats in the mid-intertidal zone.

Appearance: Small green-yellowish sacs, usually filled with seawater and air; young algae have purple pigmentation characteristic of red seaweeds. Anchored by short, circular holdfasts.

Remarks: Water and air-filled sacs protect the seaweed from overheating and drying during periods of exposure. Air bubbles keep the sacs upright during submergence.

Sacs may contain small crustaceans that take advantage of protected living space.

PLANTAE

ANGIOSPERMAE (FLOWERING PLANTS)

Saltgrass
Distichlis spicata (Poaceae)
Grasses

Distribution: Endemic to Western Hemisphere; found in most of the contiguous United States as well as Hawaii.

Habitat: Coastal strand above all but highest tide line; upper reaches (landward edges) of tidal and seasonal wetlands; alkali basins.

Appearance: Semi-erect, low-growing grass with wiry, stiff green leaves; c 30 cm in height but normally drooping, often prostrate; tiny, but conspicuous purplish-yellow flowers in spring and early summer; salt crystals often visible on stems and leaves.

Reproduction and Development: Angiosperm. Asexual reproduction by cloning year-round along scaly rhizomes; seeds germinated along spikelets viable but success rate low due to harvesting by birds and marsh mammals.

Mortality/Longevity: Perennial.

Remarks: Halophyte. Roots absorb salt water from which the salt crystals are visibly secreted along blades and stems. Spikiness unpleasant on bare feet.

Can be weedy and invasive. Currently being studied for its potential to reclaim saline saturated soils.

Cordgrass aka Pacific Cordgrass
Spartina foliosa (Poaceae)
Grasses

Distribution: Endemic to Central and Southern

California into Baja; introduced successfully into Del Norte County; hybrids prevalent in Alameda County.

Habitat: Salt-laden, tidal wetlands in coastal estuaries, especially partially submerged channels; tolerates deep submersion (half its height) for up to half a day (two high tides).

Appearance: Stout, coarse-grained, hollow. oxygen-filled stalks up to 39 cm in height; leaves may be 10 mm broad at base; flowers appear along stalks.

Reproduction and Development: Angiosperm. Asexual, self-regenerative, reproduction by cloning year-round along buried runners (rhizomes); seeds able to germinate but success rate low.

Mortality/Longevity: Perennial.

Conservation Status: Endangered wherever marshes are drained for shoreline development. Threatened by spread of introduced *S. alterniflora*, a native of the U.S. Gulf and Atlantic coastlines which competes and hybridizes easily with *S.foliosa*; since *S. alterniflora* is a soil accreting agent (*S. foliosa* is not), its spread threatens the continued existence of coastal wetlands.

Remarks: Halophyte. Able to exclude some salts from sea water as it enters root system; remaining salts excreted through vegetative glands; nitrogen fixing nodules on roots. Keystone species of tidal marshes. Efforts underway to plant reclaimed wetlands with taller growing specimens to restore clapper rail habitat. Few animals equipped to eat cordgrass; it contributes directly to the health of the marsh ecosystem as detritus which is processed by microorganisms that return its nutrients to the life cycle.

Water Chestnut Tree

Pachira aquatica (Bombacaceae)

Distribution: Tropical America from southern Mexico to Guyana and northern Brazil.

Habitat: Prefer a site that is flooded much of the time, along the edges of a swamp or river. Best suited to areas with a wet/dry season, since growth is fastest when the water recedes and oxygen is available to the roots. Grow at altitudes up to 1280 m, average temperature of 25° C, and 100–200 cm of precipitation a year.

Description: Showy evergreen tree which in the wild can grow to 18 m. Trunk is thick with a cylindrical shaft. In flooded sites trees develop stilt roots and buttresses. In cultivation trees may be more shrub-like. Shiny, dark green palmately compound leaves 20–25 cm in length. Buds open into large creamy white flowers. Although showy, flowers may be hidden by dense foliage. The capsular fruit is similar to cocoa bean, a football-shaped woody pod, up to 30 cm in length and 12 cm in diameter, olive-yellow green in color. Globular, dark brown nuts.

Remarks: Nuts are edible, tasting somewhat like peanuts; can be eaten raw, roasted, or fried. Toasted seeds can be ground and reportedly "can be prepared as a chocolate that tastes good but smells repulsive."

Young leaves and flowers are cooked and used as vegetables.

Leaves are soaked in water to produce a liquid used by indigenous people for protection against poisoning and as an antidote for bites of poisonous animals.

Red Mangrove

Rhizophora mangle (Rhizophoraceae)

Distribution: Native to tropical New World, Atlantic and Pacific coastlines plus Galapagos Islands; Western coast of Africa; numerous Pacific islands.

Habitat: Salt-saturated sand or mud, inundated twice daily, along tropical seacoasts, river and estuary margins; often adjacent to coral reefs.

Appearance: Ranges in height from 6–15 m; has multiple prop roots descending from widely spreading branches; reddish-brown. Ridged, scaly bark; tough, broad, smooth-edged leaves, dark green on top, pale beneath, 5–15 cm long. Small, yellowish-white flowers produce small reddish-brown conical berries in November.

Reproduction and Development: Vivipary (germination of seeds while still attached to mother plant); after a tap root from 15–30 cm in length develops, seedlings detach, fall onto mud or into water and float horizontally on the tide to random destinations.

Mortality/Longevity: Perennial.

Conservation Status: Endangered where shoreline is cleared for fish and shrimp farming or industrial and recreation uses.

Remarks: Halophyte; semi-succulent; lenticels in bark provide aeration of roots and stems.

"Mangal," mangrove groves or stands, are important breeding, feeding and nursery grounds for fish and birds; decomposed leaf litter sustains the system.

Mangroves are being used in tropical shoreline reclamation worldwide.

Brazilian Beauty Leaf

Calophyllum brasiliense (Clusiacea)

Distribution: Natural range extends from Mexico throughout Central America to northern South America. It also grows in the West Indies.

Habitat: A canopy tree of humid tropical rainforests with annual rainfall above 300 cm. Prefers temperatures between 24°–30 °C, and elevations below 1500 m. Frequently found in coastal areas and in plains of rivers, creeks, or marshes.

Description: Upright evergreen trees that can reach heights of 30–45 m. Bark is grey to black with longitudinal furrows. Leaves are simple, elliptic or oval, and about 10 cm long. They are shiny, dark green above and light dull green below. Numerous white fragrant showy flowers, 5–10 cm diameter on stems with 2–20 flowers per stem. White male flowers have clusters of 40–50 orange stamens. Fruits are golf-ball size globular berries, turning from greenish yellow to brown as they mature. They are poisonous, and contain chemical compounds that may relieve pain and have anticancer and antiviral properties.

Remarks: Timber is resistant to termites, and has been used for external buildings.

A brown dye is made from the bark.

Latex has been used in Central American folk medicine to reduce fevers and heal cuts. In the Brazilian Amazon it is used to control diabetes.

Leaves are used for anti-inflammatory effects and in infusions to control asthma and digestive problems.

Recently, studies suggest the roots, flowers and fruits have been found to contain compounds more potent than aspirin or acetaminophen in relieving pain and inflammation as well as having other antifungal and antiviral properties. Derivatives might prove useful against some cancers and Epstein Barr virus.

Black Olive Tree aka Oxhorn Bucida

Bucida buceras (Combretaceae)

Distribution: *Bucida* are native to Yucatan peninsula and the coast of Mexico, Central America and northern South America. Have been planted as shade and ornamental trees in Florida and West Indies. Grown for timber in Puerto Rico.

Habitat: Along streams, on coastal margins and on hummocks of mangrove swamps. Tolerate salt spray, and grow well in coastal areas. Best at lower elevations, temperature of 24°–30° C, and 75–200 cm of rainfall a year, but are drought tolerant once established.

Description: Mature trees are 12–15 m evergreens with a smooth trunk and strong wind-resistant branches. Pyramidal shape when young, but develops full, oval crown with age. Leaves: dark bluish green, rounded or oval at the apex and tapering toward the base, blades 5–10 cm long and clustering at the branch tips. Flowers: small inconspicuous greenish yellow in 10 cm spikes, may be male or complete. Fruit: small black-olive shaped fleshy fruits containing one seed; non-edible and highly tannic, messy and stains when it drops.

Remarks: Wood is used as a fuel and makes excellent charcoal. It is heavy and difficult to work due to the high silica content. Resistant to dry and subterranean termites, the wood is used for decks, pilings, bridges and ship timbers.

In Haiti a bark and leaf decoction is used to treat fevers.

An unidentified mite is responsible for a horn-shaped gall, thus the common name Oxhorn Bucida.

West Indian Mahogany

Swietenia mahogani (Meliacae)

Distribution: Native range is southern Florida, Bahamas, and West Indies. Because of its value as wood only few large trees remain, except in preserves.

Habitat: Grows on a wide variety of sites. Requires a mean rainfall between 9–21 m per year. Can colonize areas with salt spray.

Description: A medium to large tree with a broad dense crown and a straight trunk, often buttressed. Can be 22 m tall with a diameter greater than 0.6 m. Semi-deciduous: loses

leaves as new ones replace them. May be without leaves for a few weeks if weather is unfavorable. Leaves are compound with 3–4 leaflets arranged like the veins of a feather. There is no leaflet at the tip. Flowers are small and inconspicuous. Both male and female flowers are on the same tree. Brown egg-to-pear shaped fruit up to 13 cm long. Produce multiple winged seeds about 5 cm long, which are dispersed by the wind. Seeds are collected for "plantations" to provide 2nd growth forests for harvest of wood.

Remarks: *Swietenia mahogani* is known as the best source of superior wood for furniture. Its color is deeper red and the grain more even than other species of mahogany. It is now rare and the major source of mahogany wood is *Swietenia macrophylla*. Since the 1600s the primary use of West Indian mahogany has been as a cabinet wood for fine furniture. A carpenter, sailing with Sir Walter Raleigh in 1595, first described its characteristics. The first recorded piece of furniture from mahogany was a chair made in 1661. It is now in Trinity Hall Museum in Aberdeen, Scotland. In 1704 a severe frost killed many of the walnut trees in Europe and mahogany furniture became even more in demand. In 1721, English parliament repealed a heavy duty on timber imports from the colonies. Since then the popularity of mahogany has threatened its survival.

Fanciful uses: In a lexicon of Magic, Harry Potter's James had a wand made of mahogany. It was "excellent for Transfiguration." J.K. Rowling said if she had a wand it would be mahogany with a phoenix feather core.

Peach Palm

Bactris gasipaes (Palmae)

Distribution: Indigenous to Amazonian areas of Colombia, Ecuador, Peru, and Brazil. Cultivated widely since pre-Colombian times and distributed throughout the Neotropics.

Habitat: Grows on a variety of tropical sites. Optimal rainfall: between 200–380 cm per year, rather evenly distributed the year round.

Description: There are many cultivated varieties with different characteristics adapted to local conditions. Can attain a height of 20–30 m. Most have stiff black spines in circular rows from base to summit. A few have minimal spines, which is desirable, since it makes it easier to harvest. Leaves are 2.5–3.5 m long with many linear pointed leaflets up to 0.6 m long and 3 cm wide; dark green above and pale below. Inflorescence is about 30 cm and may contain up to 30,000 flowers, both male and female, but primarily male. Flowers are pollinated by 2 species of beetles, which have a tight biologic association with the palm. Great variation in color, size, shape and quality of fruit, usually in clusters of 50 to 100 individuals. Some varieties are seedless and some have a single brown seed.

Remarks: Peach palm is a source of hearts of palm. It is sold as a commercial crop in an expanding global market. Terminal buds can be cut; lateral shoots will maintain the plant and sustain the plantation.

Native people eat the fruit as a source of protein, carbohydrate, and fat. On average peach palm fruit is 8% protein, 15% fat, and 70% carbohydrate. The oil is 60% unsaturated and 40% saturated. The flavor of peach palm fruit has been described as like maize or potatoes, as slightly sweet, or as resembling a European chestnut. The fruit is also made into flour similar to maize or cassava and used for cakes and bread. After the oil is extracted, the mesocarp yields a high quality meal that is used both by humans and as animal feed.

PHYLUM CNIDARIA

CLASS HYDROZOA

Fire Coral

Millepora sp. (Milleporidae)

Distribution: Pantropical.

Habitat: Shallow reefs.

Appearance: Colored brownish, greenish or grayish, often with a yellow hue and light tips. Skeleton calcareous with diverse growth-forms from fine branching, to domes, encrusting, or sheet-like. May form extensive colonies to 2 m diameter.

Diet: Microplankton; zooxanthellae also provide nutrition.

Reproduction and Development: Sexual reproduction, with both medusa and polyp

stages; asexual reproduction via budding. Note Anthozoan corals have only a polyp stage.

Conservation Status: All coral reef species are threatened due to global warming.

Remarks: Fire corals are important reef-building organisms, though they are not closely related to the most common group of reef-building hard corals (Scleractinians), which belong to an entirely different class (Anthozoa).

Unlike octocorals or hexacorals, fire corals possess polyps so small they are almost microscopic. One type is armed with nematocysts for food-capture and defense; the other type is capable of sexual reproduction.

Potent nematocysts are also used to clear the coral of organisms that might shade zooxanthellae and can inflict a painful, burning sting to humans, hence the common name.

Fire corals can outcompete many other corals by growing large quickly. and dominating the available space.

CLASS ANTHOZOA

SUBCLASS OCTOCORALLIA

ORDER HELIOPORACEA (BLUE CORAL)

Blue Coral

Heliopora coerulea (Helioporidae)

Distribution: Red Sea, east Africa; western and central Indo-Pacific.

Habitat: Normally lives in shallow reef waters, tidal to 18 m; frequently exposed at low tides. Prefers strong light and currents.

Appearance: Colonies up to 1 m across; have sturdy, thick, slate-like branches. Growth forms and colony shapes are variable (sheets, plates and branching columns). Living coral is brown, the color of its zooxanthellae.

Diet: Feeds on products of its zooxanthellae, and extends feeding tentacles at night for plankton capture.

Reproduction and Development: Sexes separate; a brooder with fertilization and larval development taking place within female polyps. Larvae are released when almost fully developed and settle immediately.

Remarks: *H. coerulea* is the sole member of its genus.

Though it looks like a stony coral, it is the only octocoral that has a massive calcium carbonate skeleton. much like hydrocorals or hard corals. Blue coral can be an important reef builder.

The common name comes from the powder-blue color of the skeleton, which is impregnated by an oxidized iron salt manufactured by the coral and not visible when the animal is alive.

Has been called a living fossil as its morphology has shown little change in some 150 million years.

ORDER ALCYONACEA (SOFT CORALS AND GORGONIANS)

Organ Pipe Coral

Tubipora musica (Tubiporidae)

Distribution: Tropical Eastern Indo-Pacific and Red Sea.

Habitat: Shallow water to about 15 m.

Appearance: Thickly-set tubes are joined by calcareous shelves that often form multi-level platforms. Colonies form rounded clumps 2–30 cm. in diameter. Tubes and platforms are reddish-purple; tentacles are greenish, golden-brown or gray.

Diet: Polyps encased in the hard tubes emerge to feed nocturnally. Microcarnivore of plankton.

Reproduction and Development: Polyps arise from a creeping mat or stolon.

Remarks Popular in the aquaria trade.

Cladiella

Cladiella spp. (Alcyoniidae)

There are at least 40 species in this genus.

Distribution: Indo-Pacific, Red Sea.

Habitat: Tropical coral reefs. Zonation varies by species, intertidal to 30 m.

Appearance: Colonies may be encrusting or rise from a broad and short stalk, with a knobby lobed upper surface. Many species bear brown tentacles on white stalks. When polyps expanded the colony looks brown, when they contract, the colony is white. Diameter varies

by species, 10–30 cm.

Diet: Microcarnivore of plankton. Algal endosymbionts photosynthesize.

Remarks: *Cladiella* is difficult to distinguish from *Ancyonium*.

Lobophytum

Lobophytum spp. (Alcyoniidae)

Notes apply to entire genus comprised of at least 47 species.

Distribution: Indo-Pacific, Red Sea.

Habitat: Tropical coral reefs. Zonation varies by species, intertidal to 30 m.

Appearance: Typically colored yellowish brown, some ridged leather corals colored green by their algal endosymbionts. Ridged leather corals often encrusting or low and spreading. Upper surface with ridges and crests. Some colonies to 1 m in diameter. Lobed leather corals often encrusting or low and spreading. Upper surface with rounded or finger-like lobes. Usually no real stalk; colony often grows out from a low platform. Large polyps distinctly spaced from one another..

Diet: Microcarnivore of plankton. All with algal endosymbionts.

Remarks: Like *Sarcophyton*, to which it's closely related, *Lobophytum* has two distinct types of polyps, one quite small, the other larger. *Sinularia* has only one.

Sarcophyton aka Mushroom Leather Coral

Sarcophyton spp. (Alcyoniidae)

More than 35 species in genus.

Distribution: Indo-Pacific, Red Sea.

Habitat: Tropical coral reefs. Zonation varies by species, intertidal–30 m. Most often found in shallow-water reef flats in turbid water wwith gentle current..

Appearance: The largest species in the genus reaches a height of 1 meter. It is the largest species in the family Alcyoniidae. Colors vary among species: white, grey, yellowish-green, green. Colonies mushroom, funnel, or cup shaped, often with a folded margin. Typically have a thick, rubbery appearance with tentacles that extend from the large, often convoluted upper surface. Main stalk, often visible, bears no polyps.

Diet: Microcarnivore of plankton and algal photosynthesis.

Reproduction and Development: Typically reproduces asexually by budding or fragmentation.

Mortality/Longevity: Some species are fed upon by nudibranchs and snails.

Remarks: Many of the mushroom leather corals produce toxic terpenoid compounds. Some may prove beneficial for cancer treatments or other medical uses.

Sinularia

Sinularia spp. (Alcyoniidae)

Comments apply to genus of ~110 species.

Distribution: Indo-Pacific, Red Sea.

Habitat: Tropical coral reefs. Zonation varies by species, intertidal to at least 25 m., but most abundant in shallow lagoons.

Appearance: Highly variable by species, as can be gleaned by common names.

Flat Leather Coral (9 species) spreading and plate-like or upright and funnel-shaped, central polyp-bearing portion without lobes or ridges, margin thin and undulating or lobed, polyps dense or thickly set;

Slimy Leather Coral (3 species) long, slender, tube-like lobes which can be flabby and extremely slimy;

Digitate Leather Coral (majority of species in the genus) can be low, flat, and encrusting with a very short stalk, or tall and erect with well-developed stalk, colonies may be soft and flaccid, or a tough, leathery texture, upper surface with numerous finger-like lobes that may be singular, bifurcated, or branching;

Knobby Leather Coral (many species) broad stalk, upper surface covered with short lobes or low rounded knobs.

Diet: Nutrition from algal symbionts; also microcarnivore of plankton.

Reproduction and Deveolopment: Separate sexes; broadcast spawners. Also reproduce asexually by fission. Aborescent forms regularly drop tips of branches that subsequently attach to rocks or other hard surfaces.

Remarks: Species of *Sinularia* can only be accurately identified by microscopic examination of the skeletal sclerites.

Chemical products such as various cytotoxic diterpenes have been isolated from some *Sinularia* species. Such compounds are being studied for

their toxic effects on human cancer cells.

Tree Coral

Capnella sp. (Nephtheidae)

Distribution: Indo-Pacific.

Habitat: Reef slopes in clear water with strong currents. Also on coral rubble in shallow water close to shore.

Appearance: Cream, gray, brown, pink to green. Has a thick trunk, like a tree, with many branches; small, but conspicuous polyps are crowded on the upper branches; polyps are non-retractile.

Diet: Phytoplankton and microfauna; also harbors zooxanthellae and can, if necessary, thrive without active feeding.

Reproduction and Development: Reproduces both sexually and asexually. Most often in aquaria reproduce by dropping tips of small branchlets that become new colonies. Colonizes aggressively.

Remarks: Like most leather corals, *Capnella* species shed a mucous coat on a regular basis to clear themselves of algae and debris. Such cleansing activity is less frequent when coral is situated in a high current area.

Waving Hands Polyps

Anthelia spp. (Xeniidae)

Distribution: Red Sea, Indo-Pacific, and east to Hawaii.

Habitat: Shallow water with high light intensity,usually in areas exposed to strong tidal currents.

Appearance: Have polyps with one or more rows of long pinnules along each tentacle edge that are readily moved by water currents, thus the common name. Each stalk contains one "hand" with eight "fingers." Color white, gray, brown, or pale blue. Non-retractile polyps. Usually grow in mat- or crust-like colonies that may cover large areas of the reef. Height: 2–10 cm.

Diet: Nourishment primarily from products of symbiotic zooxanthellae.

Reproduction and Development: Asexual by means of creeping mat that forms stolon-like fingers. Also sexual reproduction. This mat-like base from which the polyps rise on slender stalks distinguishes *Anthelia* from other coral look-alikes, such as *Xenia* (see below).

Remarks: Unlike some *Xenia* species, *Anthelia* do not move rhythmically of their own accord.

Pulsing Xenia

Xenia spp. (Xenidae)

Distribution: Red Sea, Indo-Pacific.

Habitat: Many reef locations.

Appearance: Usually form small colonies with a diameter of about 10 cm. Most species develop mushroom-shaped colonies with polyps which make pumping movements in their upper parts. Polyps, each on a delicate stem 3–5 cm tall, rise colonially from a sturdy stalk some 8 cm long.

Diet: Nutrition primarily from their zooxanthellae, but may also absorb organic compounds through their body tissue.

Reproduction and Development: Sexual; internal brooders. Colonies also propagate by splitting in two.

Remarks: Purpose of the pumping action is unknown; it may promote water circulation for the colony that benefits feeding or gas exchange.

Green Star Polyps

Briareum sp. (Briareidae)

Distribution: Indo-Pacific.

Habitat: Outer reef slopes and in lagoons and bays. Attach to solid reef structures or coral rubble at 4.5–30 m. Usually carpet the area in the form of mat-like communities—occasionally so compact that the individual polyps are difficult to distinguish.

Appearance: Central mouth with elongated tentacles on the perimeter. Completely extended and flattened disc reveals distinctive, spoke-like orientation of tentacles. Usually colored greenish overall, may be brownish, yellowish, orangish or blueish.Polyps often extend from an encrusting sheet. Colors may fluoresce. Disc up to 3.5–5 cm.

Diet: Most nutrition provided by symbiotic algae; also capture microplankton.

Reproduction and Development: Colonial; primarily reproduce asexually by polyp budding from thin runners, or stolons; capable of rapid spreading.

Conservation status: Global warming puts all coral reef-associated species (and terrestrial species too!) at risk.

Remarks: Can retract polyps individually in response to attack.

Finger Sea Fan

Diodogorgia nodulifera (Anthothelidae)

Distribution: Western Atlantic Ocean.

Habitat: Hard surfaces on low profile reefs in deep water, 25 m or more.

Appearance: Two color variations: bright yellow-orange with red and white polyps, and red to purple with white polyps, like those on display. Sclerites support the smooth, stiff branches.

Diet: Lacking zooxanthellae, this sea rod feeds exclusively on zooplankton, and must be feed by hand in an aquarium setting.

Reproduction and Development: Most often, brittle branches fragment and form new colonies.

Remarks: This handsome gorgonian is popular in aquaria, but requires expert care.

Encrusting Gorgonian

Erythropodium caribaeorum (Anthothelidae)

Distribution: Caribbean, south Florida and Bahamas.

Habitat: Reefs, especially shallow fringe, patch and back reefs, 1–30 m.

Appearance: Colonies form encrusting tan-colored mats. Extended polyps and tentacles are fine and hair-like. When polyps retract, surface is smooth and leathery. Size 7.5–90 cm.

Diet: Nutrition primarily from zooxanthellae. As in many gorgonians, tan color a result of endosymbiotic zooxanthellae.

Remarks: Able to kill stony corals and other gorgonians by encrusting. Its nematocysts (stinging cells) can kill most stony corals by their touch.

Gorgonians are far more common in the Caribbean than in the Philippines.

A different species of *Erythropodium* is found in the Indo-Pacific.

Warty Sea Rod aka Swollen-knob Candelabrum

Eunicea mammosa (Plexauridae)

Distribution: Southern Florida, Bahamas and Caribbean.

Habitat: Shallow, turbulent hard substrates, patch reefs, outer reefs, wall lips. Depth range is 1.5–27 m.

Appearance: Light yellowish brown candelabrum shaped colonies. Colonies compact with stout branches. Close-set, tubular calyces that give a knobby appearance when polyps are closed. Colonies to 30 cm. height.

Diet: Microcarnivore. Like most gorgonians, the zooxanthellae in the tissue of the polyps aid in nutrition.

Among gorgonians, the Plexauridae is one of the largest families

Sea Rods

Plexaura spp. (Plexauridae)

Distribution: South Florida, Bahamas, Caribbean.

Habitat: Clear water patch reefs from 1.2–45 m depth.

Appearance: Some *Plexaura* sea rods may grow in flat, vertical planes with only occasional dichotomous branching when small, becoming bushy with age. May grow to 1.2 m or more. When polyps are retracted, area around apertures is flat or protrudes only slightly. Colors variable.

Diet: Feed mainly on the products of zooxanthellae.

Reproduction and Development: Reach maximum size in 10–30 years.

Remarks: *Gorgo* is Greek for "grim, fierce, terrible," a reference to the myth of three sisters, the Gorgons (Medusa being the most famous of the siblings), with snakes for hair.

Plexaura homomalla, common in the Caribbean, has been found to contain high levels of prostaglandin, which may induce vomiting and subsequent learned aversion in predators. This steroid is more usually found in mammals; in humans it controls contraction and dilation of blood vessels, protects the lining of the stomach, and reduces inflammation.

Slit-pore Sea Rod

Plexaurella spp. (Plexauridae)

Distribution: Southern Florida, Bahamas, Caribbean.

Habitat: Clearwater patch and fore reefs at depths of 9–50 m.

Appearance: Similar in appearance to *Plexaura* spp., but usually somewhat slimmer. Colonies

are bushy with club-tipped branches growing in several planes. Color tends toward pale brown or yellowish, polyps a darker brown. Slit-like openings of retracted polyps are visible on well-separated, raised mounds that dot the surface of branches.

Diet: Nutrition from symbiotic zooxanthellae; also may feed on microplankton.

Porous Sea Rods
Pseudoplexaura spp. (Plexauridae)

Distribution: Caribbean Sea, southern Florida, and the Bahamas.

Habitat: A common coral on Caribbean reefs.

Appearance: Grow into bushy forms with short stems and thick, finger-shaped branches, up to 2 m high. The genus is recognized by the oval or round openings that can be seen as pores when the polyps are retracted.

Diet: Feed on the products of their symbiotic zooxanthellae; also may feed on microplankton.

Remarks: The 4 species in the genus are very similar, identified only by detailed examination.

Golden Gorgonian
Muricea californica (Plexauridae)

Brown Gorgonian
Muricea fruticosa (Plexauridae)

Distribution: Caribbean Sea including south Florida and the Bahamas; southern California to Panama.

Habitat: Shallow water with suitable light for photosynthetic symbionts.

Appearance: Usually grow densely branched and laterally in several planes. Medium-sized:15–45 cm high.

Diet: Nutrition primarily from symbiotic zooxanthellae.

Remarks: Members of the genus are called Spiny Sea Fans, so described because of the sharp terminal spikes on the calyces, or coral cups, that cover their branches.

Rough Sea Plume
Muriceopsis flavida (Plexauridae)

Distribution: Caribbean and southern Atlantic; common off Brazil.

Habitat: In shallow reef communities with vigorous currents.

Appearance: One of two common species in the Caribbean. Different from most *Pseudopterogorgia,* in which secondary branches are pinnate (grow from opposing sides); *Muriceopsis* secondary branches originate on all sides of the main stem and are thicker. Colonies may reach 1.5 m tall. Color is a pale tan tinged with pink.

Diet: Nutrition from zooxanthellae and filter feeding.

Red Gorgonian
Leptogorgia chilensis (Gorgoniidae)

Distribution: Monterey Bay, California to Isla Cedros, Baja California.

Habitat: Depth from 15–60 m.

Appearance: Red branches with white polyps. Branch length to 90 cm. Branches not in a single plane.

Diet: Microcarnivore.

Mortality/Longevity: Preyed upon by some nudibranchs The zoanthid anemone *Parazoanthus luciferus* often colonizes this gorgonian which results in the death of most or all of the colony's polyps.

Remarks: Most gorgonian polyps are expanded during the daylight rather than at night, a habit noticeable in the Southern California tank.

Sea Plumes
Pseudopterogorgia spp. (Gorgoniidae)

Distribution: Caribbean Sea, including the Bahamas and Southern Florida, south to Brazil.

Habitat: Moderately deep patch reefs in clear water.

Appearance: Various growth forms. Some develop into very large, bushy colonies to 2 m tall. Most have pinnate branches with polyps arranged in rows.

Diet: Nutrition from zooxanthellae and filter feeding.

Purple Sea Plume *aka* Bipinnate Sea Plume
Pseudopterogorgia bipinnata (Gorgoniidae)

Distribution: Southern Florida, Bahamas, Caribbean.

Habitat: Patch reefs. Depth range 1–12 m.

Appearance: Colonies made up of hundreds of individuals usually grow in a single plane with broadly spread primary and secondary

branches. Paired branchlets extend from branches at regular intervals. Coloration is purple-violet, occasionally whitish to brilliant yellow. Height to 60 cm.

Diet: Possess zooxanthellae and also filter feed on plankton.

Mortality/Longevity: Commonly preyed upon by the flamingo tongue snail (*Cyphoma gibbosum*). This snail leaves a dark trail of exposed gorgonian skeleton where it has scraped away the soft tissue.

Purple Frilly Sea Plume

Pseudopterogorgia elizabethi (Gorgoniidae)

Distribution: Western Atlantic Ocean; Florida, Caribbean.

Habitat: Inshore and patch reef flats and slopes.

Appearance: Usually less than 1 m tall. Side may be pinnate (paired on opposite sides of the main branches) but sometimes are not.

Diet: Nutrition from zooxanthellae and supplemental filter feeding.

Remarks: Compounds that possess non-steroidal anti-inflammatory and analgesic properties have been isolated from this species and are the subject of active research,

Pacific Gorgonian

Rumphella sp. (Gorgoniidae)

Distribution: Widespread in the Indo-Pacific.

Habitat: Lagoons in areas of bright light and surge. Also on reef slopes or in sand adjacent to reef.

Appearance: Medium- to large-sized colonies, often bushy with large, slender, rounded branches. Grey, light yellow or light brown.

Diet: Mainly products of their zooxanthellae. One of the few Pacific gorgonians to have zooxanthellae.

Remarks: While this genus is widely recognized, more needs to determined about its biology and systematics.

ORDER PENNATULACEA (SEA PENS)

Giant Sea Pen

Ptilosarcus gurneyi (Pennatulidae)

Distribution: Gulf of Alaska to southern California.

Habitat: Shallow subtidal to 70 m on sand and mud substrates in areas of strong current that aids feeding. Sessile, benthic. Often found in large beds with many individuals.

Appearance: A primary polyp is modified to form the body, which includes a base that extends into the sediment and a stalk (the rachis) that rises between the feathery extensions. Large adults may extend 60 cm out of the sediment with another 30 cm extending into the substrate. Color from pale cream to deep orange-red.

Diet: Filter-feeder on particulate organic matter, larvae, and other small zooplankton.

Reproduction and Development: Each polyp in the colony is either male or female; each spawns its gametes into the water column where fertilization occurs. Larvae eventually settle on sand and metamorphose into a founder polyp that becomes the stalk and from which other colony polyps arise by asexual proliferation.

Mortality/Longevity: Preyed upon by several nudibranchs including *Hermissenda crassicornis*, as well as various sea stars, including the sunstar (*Pycnopodia helianthoides*) and the leather star (*Demasterias imbricata*). May rapidly burrow into sediment to avoid predation.

Remarks: Besides the primary polyp, sea pens have other specialized polyps. Feeding polyps with feathery tentacles can be seen on the rachis or its lateral extensions. Embedded in the rachis' surface are "pumping" polyps that use cilia to draw water into the colony's body. Cilia lining water channels work with larger muscular contractions of the body to deliver nutrients throughout the body.

Giant sea pens typically inflate when they feed, and then deflate to a much smaller size. Sometimes they completely bury in the sediment.

Many sea pen species are extremely abundant, forming vast fields on deep-sea abyssal plains.

SUBCLASS HEXACORALLIA AKA ZOANTHARIA

ORDER ZOANTHINARIA (ZOANTHID ANEMONES)

Zoanthid Colony Polyps
Palythoa spp. (Zoanthidae)

Distribution: Common in tropical seas worldwide.

Habitat: Tropical coral reefs on ledges and slopes.

Appearance: Polyps joined by common basal tissues with enrusting growth form. Numerous, broad, flattened disc-like polyps up to 3 cm diameter. Stalks inconspicuous. Colored tan to brown, basal tissue lighter. Colonies often huge.

Diet: Most energy from symbiotic algae. Also capture micro- and macroplankton. Polyps open day and night.

Reproduction and Development: Most commonly reproduce by budding.

Remarks: Like corallimorpharians, zoanthids are anatomically more similar to stony corals than to any other group; however, they do not make a hard skeleton.

Zoanthid Colony Polyps
Protopalythoa spp. (Zoanthidae)

Distribution: Common in tropical seas worldwide.

Habitat: Tropical coral reefs. Form large aggregations, especially in fore reef and shallow reef zones.

Appearance: Olive green to brown color. Aggregate in large mats, each individual with a prominent stalk. Polyps have flattened oral disks up to 3 cm in diameter. Color of stalk and oral disc are the same. Tentacles may be long or short but are always thin with pointed tips.

Diet: Energy from symbiotic algae; also microcarnivore of plankton.

Remarks: *P. grandis,*found in the Caribbean tank, is noted for its gigantic polyps, usually 5 cm or more in diameter; thus the name.

Zoanthid Colony Polyps
Zoanthus spp. (Zoanthidae)

Distribution: Tropical marine.

Habitat: Typically shallow depths in tropical coral reefs. Particularly abundant on the back side of shallow reef flats. Forms carpet-like mats over extensive areas of dead coral.

Appearance: Polyps reach 5 cm in height. Often "two-toned." Colors highly variable, even within a species. Tentacles short and blunt; oral disc and tentacles often of contrasting colors.

Diet: Microcarnivore of plankton as well as energy from symbiotic algae.

Remarks: The polyps are connected with branching stolons.

ORDER CORALLIMORPHARIA (FALSE OR MUSHROOM CORALS)

Club-tipped Anemone aka **Strawberry Anemone**
Corynactis californica (Corallimorphidae)

Distribution: British Columbia, Canada to Baja California.

Habitat: Colonies abundant from the low rocky intertidal to 30 m.

Appearance: Typically red or orange-pink, occasionally purple, yellow, buff, brown or nearly white. Captive specimens usually a washed-out pale pink. Height and diameter about 1 cm, expanded tentacular crown to 2.5 cm in diameter.

Diet: Carnivorous: copepods, nauplius larvae, other zooplankton.

Reproduction and Development: Asexual by longitudinal fission.

Remarks: *Corynactis* and other members in the Order Corallimorpharia more closely resemble true stony corals than sea anemones, but lack a calcareous exoskeleton.

Discosoma
Discosoma spp. (Discosomatidae)

Distribution: Widespread in Indo-Pacific; also common in the Caribbean.

Habitat: Tropical coral reefs, typically in dense aggregations.

Appearance: Unlike *Rhodactis* spp., most *Discosoma* spp. have smooth disc surfaces that lack obvious tentacles, though some may have small or rudimentary tentacles that are visible as rows of knobs. The warty corallimporharian, in the Caribbean Reef, is one of the exceptions. Color and size vary by species. Diameter to 8–15 cm.

Diet: Microcarnivore of plankton; may also possess zooxanthellae.

Reproduction and Development: Sexual and asexual, mostly through budding and pedal laceration.

Remarks: Aquarists commonly use the generic term *Actinodiscus.*

Rhodactis

Rhodactis spp. (Discosomatidae)

Distribution: Tropical marine.

Habitat: Tropical coral reefs.

Appearance: 10 cm diameter. Numerous small branched tentacles on the central portion of the oral disc. Rim is covered with small, unbranched tentacles and is greatly expanded nocturnally.

Diet: Mostly photosynthetic; also takes microplankton.

Reproduction and Development: Sexual and asexual, mostly through budding and pedal laceration.

Remarks: Like other species in this order, lacks a hard skeleton.

Bullseye Mushroom

Rhodactis inchoata (Discosomatidae)

Distribution: Indo-Pacific.

Habitat: Areas of tropical reef with moderate light and low-energy water movement.

Appearance: Varied colors, most often a violet to blue; mouth often red or pink. Tentacles form cauliflower-like clusters on the central disk. The area around the mouth is typically bare, giving the species its common name. Usually 4–5 cm, but may grow to 8 cm.

Diet: Feeds primarily on nutrients provided by zooxanthellae. Also snares zooplankton with its tentacles or occasionally captures even larger food items by folding the oral disc around them.

Reproduction and Development: Reproduce primarily by longitudinal fission,

Remarks: Like most *Rhodactis* species, *R. inchoata* is semi-aggressive and placed some distance from other species.

Ricordea Mushroom

Ricordea spp. (Ricordeidae)

Distribution: Pan-Pacific. Found in both Philippines and Caribbean.

Habitat: Often hundreds of polyps of a species, all genetically identical, cover rocky substrates and coral rubble on reefs to 30 m. May also live as solitary individuals.

Appearance: Spherical; short, non-retractile, knob-like tentacles cover oral surface. Colors vary within species (tentacles greenish, greenish-brown, blue-gray with base often a different color). Colors may fluoresce. Mouth and outer row of tentacles may be colored differently than other tentacles.

Diet: Most if not all nutrition provided by zooxanthellae; may also consume plankton, food particles, and small invertebrates.

Reproduction and Development: Sexually and asexually (by longitudinal fission, pedal laceration, or budding).File

Conservation Status: Have become locally abundant (Monterey Bay peninsula, California) during the past 50 years due to rising ocean temperature.

Remarks: *Ricordea* spp. cannot retract the tentacles that cover the disc.

Florida Ricordea

Ricordea florida (Ricordeidae)

Distribution: Tropical western Atlantic Ocean, southern Florida south to Brazil; also in the Caribbean and Gulf of Mexico.

Habitat: Shallow, turbid waters in large colonial aggregations, also solitary in deeper waters on hard substrates.

Appearance: Rounded, grape-like tentacles on the oral disc. Color intensities may vary from white to near black; others exhibit bright, even florescent colors including orange, green, yellow, blue, and purple with some having blue, purple, or orange rings surrounding a contrasting middle color. Max. diameter: 5–7.5 cm.

Diet: Most nutrition from symbiotic algae. Also feed on small particulate matter.

Reproduction and Development: Reproduce by fission.

Remarks: Genetic material that produces R. floridas's fluorescent colors has been isolated, introduced into the freshwater zebrafish (Danio rerio). Under blue light they fluoresce brilliant green, orange, or blue, like the Ricordea polyps from which the pigments were derived. Perhaps parents of on-the-move teenagers will

be the next to group to place orders!

These (and other) ricordea can warp their surfaces, changing the water flow that passes over them to direct particular matter to their mouth.

In the wild, R. florida is known to change colors seasonally or in response to specific events such as hurricanes.

Ricordea Mushroom

Ricordea yuma (Ricordeidae)

Distribution: Indo-Pacific.

Habitat: Coral reefs on rubble or dead coral, at various depth and often in turbid water.

Appearance: *R. yuma*, more muted than *R. florida*, presents soft pinks, browns, or greens, with short, club or berry-shaped protuberances (verrucae), though some color variations, particularly those produced through captive breeding, can be strikingly vibrant. Single mouth is upraised and surrounded by tentacles. Average diameter: 2.5–4 cm.

Diet: Some nutrition from products of photosynthesizing zooxanthellae; additionally captures plankton, other particulate matter, and an occasional small invertebrate. *Ricordea* spp. can warp their surfaces to change the water flow over them and direct food particles toward their mouths.

Reproduction and Development: Both sexual and asexual, the latter usually by longitudinal fission of the parent colony.

ORDER SCLERACTINIA (STONY CORALS)

Cauliflower Coral

Pocillopora damicornis (Pocilloporidae)

Distribution: Widely distributed throughout the Indo-Pacific.

Habitat: Able to thrive in varied habitats ranging from exposed reef fronts to protected lagoons and lower reef slopes.

Appearance: Growth form varies considerably depending on depth and currents. Colonies may be solid and dome-shaped, like many on exhibit. Others have branches either flattened and blade-like or fine and irregular. Color is cream to tan, green or pink.

A distinguishing feature of the family: wart-like growths, called verrucae, which cover the colonies. The verrucae of *P. damincornis* are less prominent than those of many other species. Corallites are immersed in the skeleton and, in the wild, appear only at night. In captivity, they may also extend during the day.

Diet: Feed on microplankton, mostly at night. Significant nutrition provided by photosynthetic zooxanthellae.

Reproduction and Development: Sexes separate. Their wide distribution is probably related not only to their ability to thrive under many conditions, but to the species' multiple methods of reproduction. They brood both sexually and asexually produced planula larvae, the latter a feat rare among coral species. They also reproduce asexually by fragmentation, a process common in many hard corals: when a piece of the coral is broken off by wave action or contact and settles in a suitable location, a new colony may thrive and grow. Also, pocilloporids are known to practice "polyp bailout." In this strategy, found less commonly in corals, a living polyp ejects itself from the skeleton, drifts in the current, and may settle successfully to found a new colony. Bailouts usually occur in response to stress. All of these reproductive methods occur regularly in captivity.

Mortality/Longevity: Colonies are thought to live no longer than 7–8 years in the wild.

Remarks: Pocilloporidae are second only to *Acropora* spp. as contributors to reef growth.

Are known as "coral guinea pigs" because they survive well in laboratory conditions and are among the most studied coral species.

P. damicornis is said to thrive of a greater variety of conditions than any other coral.

Its common name is derived from the tight clusters of branches topped with fuzzy polyps.

Bird's Nest Coral

Seriatopora histrix (Pocilloporidae)

Distribution: Indo-Pacific.

Habitat: Upper reef slopes, lagoons, deep fore-reefs in areas with pronounced currents.

Appearance: Easily identified by its sharp-pointed, tapering branch tips and polyps lined up in straight rows. Colors: brown, tan, pink, green purple yellow.

Diet: Nutrition chiefly from zooxanthellae and

extends feeding tentacles at night in search of plankton and other organic particles.

Reproduction and Development: In the wild, is a hemaphroditic brooder. Also produces asexually, both in the wild and in captivity, by polyp "bailout" like *Pocillopora* spp. (see above).

Remarks: *Hapalocarcinus marsupialis*, a species of gall-forming crab, has a most unusual relationship with *Seriatopora* spp. The female takes up residence within the branches of the coral, and with her chelae, influences the growing tips to grow a gall, or cage, that effectively encloses her. Protected there for life from most predators, she filter feeds on minute particles and may also feed on the coral's mucus and/or tissue. The much smaller male crab can enter the "bars" of her cage to mate. *Pocillopora* and *Stylophora*, also pocilloporids, are hosts to this crab as well.

Stylophora Coral

Stylophora sp. (Pocilloporidae)

Distribution: Red Sea and eastern African coast and the Indo-Pacific.

Habitat: Prefer reef fronts in high light and strong currents, but found in many other locations.

Appearance: Forms round clusters of thick branches, usually with round, blunt ends. Polyps are small, but easily seen. Colors range from pink, green, purple to tan, and branch tips are often a paler or contrasting color.

Diet: Depend on the products of their zooxanthellae. Also, extend polyps to feed at night in the wild; polyps may be visible day and night in captivity.

Reproduction and Development: Like other pocilloporids, is a hermaphroditic brooder (though sperm and eggs develop at different times). When mature larvae are released, they can adhere to floating objects and develop into new colonies that produce still more larvae, a practice that accounts from the wide distribution of some *Stylophora* species.

Remarks: *Stylophora*'s fast growth and ability to thrive in many conditions make them good research species. Because they have been found to produce allelopathic chemicals, they have been widely studied in immunological research.

Some damselfish species are known to shelter within the branches of *Stylophora*. The fish gains protection and the coral receives nutritional benefit from the fish's waste, shown by increased growth and reproductive rates by corals engaged in this mutualistic relationship.

Montipora Coral

Montipora spp. (Acroporidae)

Distribution: Indo-Pacific. A wide distribution with a very large number of species, perhaps 70–80.

Habitat: Adaptable to a variety of habitats; commonly found in the wild in shallow turbid lagoons, reef crests, and deep waters. Their tolerance for a variety of conditions seems to make them a hardy group.

Appearance: Many growth forms, including columnar, branching, encrusting, and plating. Also a wide range of colors, including bright pinks, oranges, purples, greens, and blues. They are typically very small-polyped corals.

Diet: Nutrition mostly provided by zooxanthellae.

Reproduction and Development: Sexual and asexual.

Remarks: A relatively passive coral that is best situated some distance from more aggressive corals, such as *Euphyllia* spp.

Staghorn, Elkhorn and other Acropora Coral

Acropora spp. (Acroporidae)

Distribution: Indo-Pacific, Caribbean.

Habitat: Most commonly found in shallow reef environments with bright light and relatively strong currents. Often dominate shallow parts of the reef, especially the surf zone.

Appearance: Growth forms extremely variable: slender branched fingers, broad antlers, table-like plates are common. Among the most colorful of reef-building corals; may be cream, yellow, blue, green, purple, pink, even fluorescent. Polyps small; set along the branches.

Characterized by light-colored polyps at the tips of branches where budding and growth take place, fueled by the energy produced by zooxanthellae in lower parts of the branch that give it color.

Diet: Feed on microplankton, mostly at night; significant nutrition provided by photosyn-

thetic zooxanthellae.

Reproduction and Development: Most *Acropora* species are broadcasters, a few are brooders; also readily reproduce asexually by budding and fragmentation. Fast growing.

Remarks: *Acropora* spp. are particularly susceptible to bleaching when stressed by pollution, warm water temperatures, or excessive sediment or nutrient runoff.

The most numerous and widespread genus of the stony corals (Order Scleractinia); over 360 named species known. A major contributor to reef structures worldwide.

The crown-of-thorns starfish (*Acanthaster planci*) is a major staghorn predator.

Porites Coral

Porites spp. (Poritidae)

Distribution: Pan-tropical, Caribbean and Indo-Pacific.

Habitat: Found in a variety of reef habitats, especially shallow, sheltered areas.

Appearance: Form variable; may be rounded, flat, branching, column-like, or encrusting. Some species produce extremely large colonies, over 10 m across. Like many stony corals, they are morphologically plastic, capable of considerable variation in form in response to environmental conditions, such as current, light, and habitat.

Diet: Most nutrition provided by photosynthetic zooxanthellae.

Reproduction and Development: *Porites* spp. belong to the approximately 15% of corals that reproduce by "brooding": the mature sperm, when released from a polyp, swims through the water, finds a conspecific that has ripe eggs, and, entering through the mouth, fertilizes the eggs internally. The larvae, known as planulae, mature within the maternal polyp. Most other corals are broadcasters: sperm and egg are released synchronously; after fertilization, planula larvae drift in the current until settling.

Remarks: *Porites* spp. provide habitat for a number of organisms that are dependent on them.

Along with *Acropora* and *Pocillopora*, are important contributors to reef structures worldwide.

Daisy Coral aka Flowerpot Coral

Alveopora sp. (Poritidae)

Distribution: Red Sea, Indian Ocean to central Pacific.

Habitat: Various, from protected turbid environment to crystal clear water on reef slopes.

Appearance: Usually branching but sometimes forms massive or encrusting colonies. Polyps are large and most extend from long tubular columns. Each polyp has 12 tentacles, usually with blunt tips. Tentacles usually extended both day and night.

Diet: Nutrition from zooxanthellae and perhaps additional phytoplankton.

Remarks: *Alveopora* have proved difficult to maintain in captivity by the beginner or intermediate aquarist.

Clownfish have been known to take up residence in *Alveopora*, perhaps because its longer tentacles are similar to those of an anemone.

Cactus Coral

Pavona spp. (Agariciidae)

Distribution: Indo-Pacific.

Habitat: Lagoons and outer reefs, typically in relatively shallow water with strong currents and bright light, though capable of thriving in less than intense light.

Appearance: Massive, laminar, or foliaceous colonies with corallites on both sides of the leaves or plates. Like all members of the family, have small, fine tentacles that create a fuzzy appearance or the coral's surface. Colors: mostly brown to green with white or cream margins.

Diet: With such highly reduced tentacles, receive a higher percentage of their nutrition from photosynthesis of symbionts than most other zooxanthellate corals.

Reproduction and Development: Asexual reproduction by fragmentation is common, often hastened by the activity of boring sponges. Easily fragged in captivity.

Remarks: Though lacking effective feeding tentacles, sweeper tentacles are numerous and powerful, maintaining the coral's territory.

Lettuce Coral

Agaricia sp. (Agariciidae)

Distribution: The Caribbean Sea.

Habitat: Shallow reefs with strong wave energy.

Appearance: Various growth forms include chalices, encrusting sheets, thick leaves and flat plates. Can grow to about 2 m diameter.

Diet: Most nutrients supplied by symbiotic zooxanthellae.

Reproduction and Development: Hermaphroditic brooders. Shed planula larvae year round.

Mortality/Longevity: Life span: over 50 years.

Remarks: Their common name comes from the fact they resemble underwater lettuce plants.

A primary reef-building coral of the Caribbean..

Leptoseris Coral

Leptoseris sp. (Agariciidae)

Distribution: Mostly known from the tropical Pacific, though one species in found in the Atlantic.

Habitat: Ledges and overhands in deeper water; prefer reduced light and current areas.

Appearance: Genus consists of delicate, leaflike species. Mostly foliate and laminar, sometimes encrusting. Colors range from green, brown, to cream, often with contrasting striations and margins.

Diet: *Leptoseris* spp. are among deepest-water symbiotic corals known.

Remarks: The genus is fairly uncommon in the aquarium trade, though successful captive breeding is making them more available.

Mushroom Coral

Fungia spp. (Fungiidae)

Distribution: Indo-Pacific from the Red Sea and east Africa, west to Hawaii in tropical and subtropical latitudes.

Habitat: Among other coral, rubble, or on sand.

Appearance: Genus noted for short, tapering tentacles and a very large mouth opening. The structure is home to a single polyp. Many septa stretch from the central mouth to sides of the polyp. Form may be nearly circular or elongate. Diameter to 28 cm.

Diet: Nutrition from photosynthetic algae. *Fungia* corals have been observed eating jellyfish, which may be a primary food source for some and a good "fit" for their large mouths.

Reproduction and Development: Sexual or asexual reproduction. In either mode, a vase-shaped polyp gradually grows into a flattened disc, attached to the substrate by a stalk, which later dissolves. A scar on the underside of the adult skeleton marks the position of the stalk.

Mortality/Longevity: Life span of some long-lived species (by one estimate): 24–46 years.

Conservations Status: All corals are threatened, *Fungia* perhaps more than some as it is valued in both the live and dead coral trade, where it is used for jewelry and other ornaments.

Remarks: Rather than forming colonies like most corals, *Fungia* corals are usually solitary and free-living. Because they are unattached, *Fungia* can be easily moved by waves, and so are most often found in protected places, often at depths where wave action is reduced.

Their typical inverted cap-gilled mushroom-like appearance gives these corals their common name.

Are able to produce a mucus that damages tissues of other corals and so prevents overgrowth. Mucus also facilitates food capture.

By inflating the body cavity, mushroom corals are able to upright themselves after being overturned.

Cycloseris, also a genus often on display, is closely related to *Fungia*. However, *Cycloseris* tends to be more perfectly round and often domed toward the center. The skeletons have differnt features (all diffiuclt to determine by casual observation), and *Cycloseris* spp., because they are not attached to the substrate as juveniles, lack the stalk scar typical of *Fungia.*

Slipper Coral

Polyphyllia sp. (Fungiidae)

Distribution: Indo-West Pacific.

Habitat: Shallow water in protected areas. Common on soft, muddy bottoms; also on sand and rubble.

Appearance: Elongated, slipper-shaped solitary coral with many mouths. Color: usually brown, but occasionally green or cream. Tentacles brown with white tips, about 2 cm long and occasionally forked at the ends; extended during the day.

Diet: All species in the Fungiidae bear endosymbiotic algae and also extend feeding tentacles to capture zooplankton.

Reproduction and Development: Reproduce sexually by broadcast spawning. Asexually, by bits that grow and break off the parent, eventually developing into full-grown, free-living coral polyps.

Remarks: Like their relatives the *Fungia*, *Polyphyllia* juveniles are usually attached to a rock or coral and detach as they mature. The closely related *Cycloseris* genus is always free-living.

Peaceful toward other fungids, *Polyphyllia* maintains its territory by extending a mucous net capable of causing necrosis in unrelated corals.

Galaxy Coral

Galaxea fascicularis (Oculinidae)

Distribution: Red Sea and east Africa coast; Indo-Pacific to the Fiji Islands and Samoa.

Habitat: Occurs from shallow to deep water and in clear or turbid, calm or exposed areas.

Appearance: Grows in many different forms: small encrusting types to dome shapes, from large columnar colonies to small irregular branches. May form colonies several meters in diameter.

Diet: Nutrition provided by symbiotic zooxanthellae augmented by active plankton capture. Tentacles nearly always extended, even during the day.

Reproduction: Coral reproduction can be a complex phenomenon. *G. fascicularus,* for example, may have female colonies that produce only eggs or hermaphroditic colonies that produce both eggs and sperm.

Remarks: Like others in their genus, has corallites with a ring of pointed septa that gives them a star-shaped appearance.

Has very long "sweeper" tentacles with powerful nematocysts that discourage encroachment from other coral species as well as conspecifics, and so needs careful positioning in an aquarium setting.

Chalice Coral

Echinophyllia spp. (Pectiniidae)

Distribution: Western Central Pacific.

Habitat: Tropical reefs at depths 3–35 m.

Appearance: Most often forms convoluted plates, though some growth may be encrusting within the same colony. Color varies and commonly includes fluorescent reds, pinks, green and blue. Spiky or bumpy surface.

Diet: Most nutrition from zooxanthellae, but also extends feeder tentacles at night.

Remarks: This genus has only recently been described, and is relatively new to aquarium display.

Placement requires care as *Echinophyllia* has exceptionally long sweeper tentacles and can be aggressive towards nearby corals.

Chalice Coral

Oxypora sp. (Pectiniidae)

Distribution: Indo-Pacific.

Habitat: Reef slopes in shallow water, with limited water movement. Colors may be light brown, cream, or green, with contrasting centers of brown, green, pink, or red centers.

Appearance: Usually laminar or foliaceous in growth form, often with thin plates. Corallites always visible and often large.

Diet: Nutrients provided by photosynthetic zooxanthellae during the day. Polyps with long, transparent feeding tentacles appear at night.

Reproduction and Development: Hermaphoditic broadcast spawner.

Remarks: Sweeper tentacles have a powerful sting that can damage other species of corals nearby.

Some *Oxypora* species have a superficial resemblance to *Mycedium* and *Echinopora* species, and may be easily misidentified.

Mycedium Coral

Mycedium elephantotus (Pectiniidae)

Distribution: Red Sea, Indo-Pacific.

Habitat: Shallow fore reef areas and even more common on reef slopes and overhangs.

Appearance: Forms foliaceous (leaf-like), plate, cup-shaped or semi-encrusting colonies that may exceed 2 m in diameter. Most are brown with pink or greenish tinges and often brightly colored green or red oral discs. Protuberant, inclined corallites texture its surface.

Diet: Nutrition provided by symbiotic zooxanthellae; feeds supplementally on plankton.

Reproduction and Development: Like most corals, reproduction may be either sexual or asexual.

Remarks: Its scientific name and a popular common name "elephant nose coral" are somewhat imaginative references to the raised shapes of the corallites.

Acanthastrea

Acanthastrea spp. (Mussidae)

Distribution: Indo-Pacific.

Habitat: Found from shallow water to about 20 m, though some known from greater depth. Thrive in conditions from strong to subdued lighting and wave action from strong to mild.

Appearance: May form colonies of only a few polyps to encrusting colonies several meters across, depending on the species and water conditions. Some colonies may reach 3 m across; ours are much smaller.

Diet: Nutrition from zooxanthellae; extends tentacles at night to feed on microplankton and small invertebrates and can also, like many corals, absorb dissolved organic matter through their tissues.

Reproduction and Development: Hermaphrodites; reproduce sexually by spawning, asexually by fragmentation and fission.

Remarks: A favorite today among collectors, *Acanthastrea* is a relatively large genus (perhaps 15-17 species) in the family Mussidae. They resemble and are often difficult to distinguish from other mussid corals such as *Symphyllia* and *Lobophyllia,* and are even confused with species of the family Favidae.

A fairly aggressive coral that can extend long mesenterial filaments from the stomach that can kill or devour other coral polyps by a process similar to digestion. Aquarists take care placing other valued corals out of reach!

Meat Coral

Acanthophyllia deshayesiana (Mussidae)

Distribution: Indo-West Pacific.

Habitat: Protected reef environments, often attached to rocks under overhangs or on soft substrates; prefers gentle currents.

Appearance: Large, fleshy polyps. Unlike its lookalike, *Cynaria lacrymalis*, *A. deshayesiana* has opaque rather than translucent polyps, and has skeletal features that differ from other mussids. Color may vary from red-brown to bright green or red, and, in some cases, specimens may be striped or mottled with another color. Like other mussids, when the soft tissue expands, it drapes dramatically over the edges of the skeleton, often covering it completely.

Diet: Nutrition derived mainly through photosynthesis performed by symbiotic zooxanthellae, but also feed on small invertebrates and other organic items.

Reproduction and Development: Hermaphrodites, reproducing in the wild by spawning.

Remarks: The common name "Meat Coral" refers to the polyps' fleshy appearance and common red coloration.

The name "button coral" refers to at least 5 genera of solitary polyps of the family Mussidae, including *Acanthophyllia* and *Cynarina* and *Scolymia*, all on display in the Steinhart Aquarium.

This species was formerly identified as *Cynarina deshayesiana* or *Scolymia* species, but has recently (2009) been reclassified as a member of its own genus. *A. deshaesiana* is flatter and larger than *Scolymia* corals and not as transparently fleshy or "bubbly" as *Cynarina* corals.

Pineapple Coral

Blastomussa merleti (Mussidae)

Distribution: Indo-Pacific: Indonesia.

Habitat: Reefs, especially turbid environments on lower reef slopes.

Appearance: Color: commonly dark red with conspicuous green oral discs. Also pink, orange, brown or dark grey with white margins. Some aquacultured specimens are quite colorful. Tentacles have fleshy mantles extended during the day that hide the colony structure below. *B. merleti* have much smaller corallites that are less closely packed together than those of *B. wellsi*.

Diet: Majority of nutrition comes from products of photosynthetic zooxanthellae; supplemented by microplankton.

Reproduction and Development: During their early growth, individual corals extend from a common center, creating a dome covered with closely spaced corallites. Sometimes, however, these corals lose their connections and become cloned solitary individuals.

Remarks: "Blastos" used to be rare in the

aquarium trade because of the difficulty of collecting them in deep, turbid water. However, they are easily bred in captivity and are becoming more common.

Blastomussa Coral
Blastomussa wellsi (Mussidae)

Distribution: Tropical Indo-Pacific.

Habitat: Lower reef slopes in areas of low to moderate currents.

Appearance: Has large, fleshy polyps that, when extended, cover the skeleton. May be blue, brown, red or green. Usually grow in small colonies of no more than a dozen polyps, but more often 3–5.

Diet: Depends on photosynthetic zooxanthellae for nutrition; also microplankton.

Mortality/Longevity: No known predators, but butterflyfishes and angelfishes typically feed on large polyp corals such as these.

Remarks: A highly desirable and fairly rare species in the aquarium trade.

Button Coral
Cynarina lacrymalis (Mussidae)

Distribution: Tropical Indo-Pacific.

Habitat: Common and widespread on deep reefs, shallow lagoon reefs, and soft bottoms in relatively calm, turbid water.

Appearance: A single-polyp coral. Tissue is distinctly translucent with skeletal septa visible; color variable, but commonly brown or gray with green fluorescent markings. The diameter of the skeleton is rarely more than 7.5 cm, but expanded polyps may extend 30 cm. Most often solitary, but occasionally found in small clusters. Septa of skeleton is toothed, thus a common name, "tooth coral."

Diet: Products of photosynthetic symbionts; also microplankton, small crustaceans, even small fish.

Remarks: The name is derived from the Greek word *kinaria* (artichoke), a form it mildly resembles. One of the largest single-polyp corals.

Lobed Brain Coral
Lobophyllia spp. (Mussidae)

Distribution: Indo-Pacific.

Habitat: Some species fairly common along the reef rim and fore reef slope.

Appearance: May form colonies of loosely joined individuals or be solitary. Living coral is covered by fleshy mantle that covers the skeleton. Living tissue usually green or brown, sometimes pinkish or red, with a variety of textures.

Reproduction: Hermaphroditic broadcast spawners.

Diet: Nutrition from zooxanthellae; also extends tentacles at night to feed on microplankton, detritus, and other organic particles.

Button Coral
Scolymia sp. (Mussidae)

Distribution: Indo-Pacific and Caribbean.

Habitat: Generally restricted to reef slopes, particularly in areas without large populations of reef-building corals.

Appearance: Wide range of forms from small solitary corals to large colonial groups. Solitary more common. May be flattened, rounded, or slightly irregular in shape with a single oral opening. Often colored green with a more or less clear purple-colored crown around the polyp edge; may also be red or pink. A fleshy mantle, often ruffled in shape, covers the skeleton. Usually distinguished from *Lobophyllia* by flatter shape.

Diet: Nutrition from zooxanthellae; extends tentacles at night to feed on microplankton and small invertebrates.

Closed Brain Coral
Symphyllia spp. (Mussidae)

Distribution: Indo-Pacific.

Habitat: Shallow and deep water, in turbid lagoons and in clear outer reef zones, usually partially shaded.

Appearance: Very similar to *Lobophyllia* spp., but with meandering lobes which radiate from the center and form a flat colony. Also distinguished by a distinct groove running along the top of the tissue walls.

Plating Hydnophora aka **Horn Coral**
Hydnophora spp. (Merulinidae)

Distribution: Widely distributed in the Indo-Pacific.

Habitat: Common in variety of reef habitats.

Appearance: Colonies may be massive, encrusting, or branched; usually brown,

greenish, or yellowish. Conical protuberances over the entire colony's surface. Tentacles often partially extended during the day.

Diet: Nutrition mostly provided by symbiotic zooxanthellae, but also take other food sources, such as plankton

Reproduction: Hermaphroditic, probably broadcast spawners.

Remarks: *Hydnophora rigida* is by far the most common species of the genus.

Hydnophora *aka* Horn Coral

Hydnophora rigida (Merulinidae)

Distribution: Widely distributed in the Indo-Pacific.

Habitat: Common in variety of reef habitats. Often found in lagoons or on protected reef slopes.

Appearance: Colonies may be massive, encrusting, or branched; usually cream or green. Conical protuberances, called hydnophores, cover the entire colony's surface, and are formed where adjacent corallite walls meet and fuse. *Hydnophora rigida* is by far the most common species of the genus. Though usually branched and often found in brown and bright to fluorescent green, the species in captivity may form large, encrusting colonies of more neutral shades.

Diet: Nutrition mostly provided by symbiotic zooxanthellae, but also capture plankton and absorb dissolved matter. In captivity, feeding tentacles are often partially extended during the day.

Reproduction and Development: Hermaphroditic broadcast spawner.

Remarks: *Hydnophora* species are aggressive, extending stinging sweeper tentacles and mesentarial filaments, and usually winning encounters with other corals.

Trumpet Coral

Caulastrea sp. (Faviidae)

Distribution: Indo-Pacific.

Habitat: Prefer sandy substrate at shallow to mid depths in areas protected from heavy wave action.

Appearance: Plump, circular polyps cluster on branched stalks. Septa of skeleton are distinct and usually visible through the polyp tissue.

Diet: Rely on products of photosynthetic zooxanthellae as well as microplankton.

Reproduction and Development: Hermaphroditic broadcast spawners in the wild; also propagate asexually in the wild and in captivity by fragmentation and budding.

Remarks: One of many corals that extend long sweeper tentacles as a defense against encroachment by other coral colonies. The tentacles nematocysts can damage tissue of corals that venture too close.

Caulastrea species are a favorite of aquarists for their success in captivity and ease of propagation.

The branches below the polyps offer refuge to commensal sponges, mollusks, and other invertebrates, including other small coral species.

Diploastrea Coral

Diploastrea heliopora (Faviidae)

Distribution: Red Sea and east Africa; Indo-West Pacific.

Habitat: Occasional on most reefs, especially upper slopes or in areas exposed to swell or currents.

Appearance: Colonies are dome-shaped and may grow very large, up to 2 m high and 5 m across. Individual polyp skeletons (corallites) are mound-like and densely situated on the colony's surface. Usually cream or grey, sometimes greenish. Color morphs, such a bright green corallites with purple center, are common.

Diet: Nutrition from zooxanthellae; feeding tentacles extended at night.

Remarks: Very dense skeleton discourages boring organisms.

Their skeletal density, slow growth, long lifespan (up to 700 years, perhaps longer), and wide distribution have made *Diploastrea* useful for climate change studies. Oxygen isotopic profiles from skeletons have tracked variations in sea surface temperature to the fineness of seasons and decades, providing useful information about paleoclimate in the tropical Indo-Pacific.

D. heliopora is the single species in the genus.

Brain Coral

Diploria sp. (Faviidae)

Distribution: Endemic to the tropical Atlantic-Caribbean.

Habitat: Offshore reefs, usually at depths between 1–30 ft.

Appearance: Brown or yellow, usually hemispherical or plate-shaped stony coral. Surface is deeply convoluted, reminiscent of a human brain. May grow to 2 m.

Diet: Most nutrition from products of photosynthesizing zooxanthellae. Also extends feeding tentacles to capture zooplankton and bacteria.

Reproduction and Development: Hermaphroditic brooder, a common coral reproductive strategy in which the egg is fertilized within the polyp and released to the sea as a more mature larvae that will spend less time in the plankton and be of larger size, both factors that reduce predation and increase the prospects of successful settlement. Asexual reproduction by division of pre-existing polyp as well as formation of new polyps in the space between the tentacles of pre-existing polyps. The latter method is called extratentacular budding and is common in faviids and many other reef-forming corals as a means of increasing colony size.

Echinopora Coral

Echinopora lamellosa (Faviidae)

Distribution: East Africa to the Red Sea; the Indo-Pacific east to Samoa and the Marshall Islands, south to Great Barrier Reef.

Habitat: A variety of coral reef habitats from reef slope to sheltered areas.

Appearance: Like most *Echinopora* spp., *E. lamellosa* grows in a variety of forms from foliaceous (leafy) to scroll-like, branched, or even semi-encrusting, depending on location and currents; however, does not form the typical faviid brain-shaped colony. Distinct corallites, which are usually separated by several mm and look like small, spiky hillocks, cover the upper surface. Colony usually brown or green, sometimes with yellow or pinkish tinges.

Diet: Nutrition from symbiotic zooxanthellae; active feeder when tentacles extended.

Reproduction and Development: Like the majority of stony corals, a hermaphroditic broadcast spawner.

Favia Coral (Moon Coral, Brain Coral)

Favia spp. (Faviidae)

Distribution: Widely distributed in the Pacific and Atlantic Oceans.

Habitat: Various locations on coral reefs.

Appearance: Most species of the genus *Favia* have massive and rounded colonies, though some are encrusting. Usually brown or green, but occasionally white or yellow. Corallites have their own walls and are separated from their neighbors by a groove, a feature that distinguishes them from *Favites* spp., which have shared corallite walls. Septa numerous and visible.

Diet: Nutrition from symbiotic zooxanthellae. Also active plankton feeders; *Favia* extend feeding tentacles only at night.

Remarks: Faviidae is the second largest stony coral family, after Acroporidae. If extinct species are also counted, Faviidae, a major player in reef building during the Mesozoic and early Cenozoic eras, is the most species-rich of all coral families.

Commonly known as Brain Coral, because many species of faviid corals have a corallite pattern that looks like the structure of a human brain.

Goniastrea Coral

Goniastrea sp. (Faviidae)

Distribution: South Pacific, Indo-Pacific.

Habitat: Shallow water areas on reef flats and fringes, rocky shores, or harbor backwaters.

Appearance: Massively round or dome-shaped with a honeycomb appearance. Colors range from shades of yellow, green, brown, and pink. May grow to 1 m in diameter.

Diet: Products of photosynthetic zooxanthellae; also extends tentacles at night to feed on microplankton.

Reproduction and Development: Sexual by mass release of sperm and eggs, and asexually by budding.

Remarks: As a species that often grow in shallow water, they are unusually capable of surviving violent water movements, intense sunlight, and exposure to air at low tides.

Maze Coral

Platygrya sp. (Faviidae)

Distribution: Indo-Pacific, including the Red Sea and around Australia and Southeast Asia.

Habitat: Inhabits a variety of reef locations, including reef flats, back reefs, and deeper waters.

Appearance: Colonies can be massive, encrusting, dome-shaped or flattened. Corallites form meandering walls of brown, green, or gray surrounding contrasting valleys of cream, pink, gray, or even fluorescent green. Easily confused with *Goniastrea* and *Leptoria* species.

Diet: Primary nutrition received from the photosynthesis of symbiotic zooxanthellae. Supplemental diet from capture of microplankton by stinging tentacles.

Reproduction and Development: Hermaphroditic. Reported to spawn once a year, between July and August, releasing sperm and eggs during the new moon.

Conservation Status: Like all coral species, *Platygyra* spp. are listed on Appendix II of the Convention on International Trade in Endangered Species (CITES), meaning international trade in the species should be carefully monitored and controlled.

Open Brain Coral

Trachyphyllia geoffroyi (Trachyphylliidae)

Distribution: Indo-Pacific, Red Sea.

Habitat: Prefers soft sand or muddy substrates on sheltered reef slopes or in lagoons.

Appearance: Name comes from Gr: *trachys* (rough) and *phylon* (leaf) as it looks like a leaf lying on the substrate. *Trachyphyllia* are secondarily free-living, usually beginning growth as a single polyp attached to a hard surface. Later it breaks off, and is found detached on sandy or muddy bottoms. Color may vary with depth or substrate: pink to red, brownish, gray, green, or blue, even multi-streaked and iridescent. Fleshy polyps extend well beyond the margin of the stony skeleton.

Diet: Nutrition from photosynthetic zooxanthellae; also microplankton and other small food bits. Tentacles extended in low light or at night to capture plankton.

Remarks: A popular species in the aquarium trade.

Elegance Coral

Catalaphyllia jardinei (Caryophylliidae)

Distribution: Indo-Pacific.

Habitat: Found to depths of 40 m, but do especially well in shallower, lagoon habitats and sandy or muddy areas between reefs with sea grasses where they bury into the soft substrate. Prefer areas with gentle currents.

Appearance: The cone shape of their skeleton's base allows *Catalaphyllia* to burrow into soft substrates, and the large polyps of *C. jardinei* are conspicuous and easily recognized by their colorful oral discs and long tentacles that make it look deceptively like an anemone. Colors are varied and striking.

Diet: Receives nutrition from the photosynthesis of symbiotic algae. May also capture small invertebrates and even fish in feeding tentacles, armed with unusually powerful nematocysts. Like many stony corals, they also capture planktonic organisms, organic particles, and can absorb dissolved organic matter directly through the body wall.

Reproduction and Development: Broadcast spawner. Not propagated in captivity, but may reproduce by budding under optimal conditions. Also a portion of a polyp may become detached from the skeleton and form a new colony.

Conservation: Though not listed by IUCN or CITES, the popularity of *C. jardenei* in the aquarium trade is cause for concern about overharvesting.

Mortality/Longevity: Strong stinging tentacles are used for defense and the capture of small prey.

Remarks: The ability to expand its tissue with water allows the coral to lift itself out of accumulating sediments to avoid burial in its muddy habitat.

Strong nematocysts and long tentacles require this potential bully to be placed some distance from other corals. Only *Euphyllia ancora* seems to dominate this aggressive species.

Tentacles are known to raise welts on the skin of unwary aquarists.

Frogspawn and Anchor Corals

Euphyllia spp. (Caryophylliidae)

Distribution: Indo-Pacific.

Habitat: Prefer shallow environments with moderate wave action, especially on protected horizontal substrates or rocky outcrops.

Appearance: These are large polyp corals (LPC). Polyps expand during the day. Often mistaken for a soft coral because large polyps hide the hard, cone-like calcium carbonate skel-

etal base and six-fold symmetry that identify *Euphyllia* as hard corals (scleractinians). Colors: various shades of brown, green, yellow, and gray. Tips of tentacles usually a different color.

Diet: Most nutrition provided by zooxanthellae; take small meaty foods in captivity and probably in the wild as well.

Reproduction and Development: Sexes separate. Sexual reproduction by broadcast spawnjng, asexual by budding.

Remarks: Most *Euphyllia* spp. are aggressive and are capable of powerful stings. At night, they can extend sweeper tentacles a foot or more, most often to target other corals living too close, attacks that can irritate or kill. They are more tolerant of corals in the same family. Stings can cause allergic reaction in humans.

Euphyllia species of the Steinhart:

Anchor Coral (*Euphyllia ancora*) - Polyps have large tubular tentacles with anchor, hammer, or T-shaped tips. Color blue-grey, tan, to orange with cream or green outer borders on the tentacles.

Frogspawn Coral (*Euphyllia paradivisa*) - Named because of the colony's resemblance to a mass of fish or frog eggs. Color green to brown to tan.

Fox Coral

Nemenzophyllia turbida (Caryophylliidae)

Distribution: Red Sea and east coast of Africa; Malaysia, Indonesia, Philippines, and north New Guinea.

Habitat: Turbid or sheltered areas on sand or muddy bottoms to 35 m.

Appearance: May be colonial or free-living. Polyps a translucent white, green or pink, and quite large, totally covering the skeleton when extended during the day.

Diet: Nutrition from symbiotic zooxanthellae; lacks visible feeding tentacles.

Remarks: When the polyp is expanded and covers the thin skeleton, the fox coral looks like a corallimorpharian in shape, size, and smooth surface without tentacles.

Brown Cup Coral

Paracyathus sternsi (Caryophylliidae)

Distribution: British Columbia to Baja California.

Habitat: Lower sides of rocky reefs; depth: 10– 35 m. A dominant sessile invertebrate at deeper sites with low water motion.

Appearance: Color ranges from light brown to a deep brownish purple; tentacles clear.

Diet: Small organic particles and zooplankton. Prey is killed or disabled by stinging tentacles and then entrapped and carried to the mouth by specialized sticky cells on the tentacles. Cup size: c. 4 cm.

Reproduction and Development: Sexes separate. Fertilized eggs brooded in the female's gastrovascular cavity.

Remarks: More likely to occur singly than in groups like the orange cup coral (*Balanophyllia elegans*).

Bubble Coral

Plerogyra sinuosa (Caryophyllidae)

Distribution: Indo-Pacific and Australia region.

Habitat: Turbid bays and lagoons, on reefs in deep water or under overhangs.

Appearance: Colonial corals often covered with clusters of bubble-like structures (thus the common name), each over 1 cm in length. Colored gray, bluish, greenish, brownish or rich cream.

Diet: Light-capturing bubble-like vesicles extend during the day to support the photosynthesis of the algal symbionts. Tentacles extend at night to capture small prey.

Remarks: This is a stony coral, despite the soft appearance the "bubbles" give during the day.

Orange Cup Coral

Balanophyllia elegans (Dendrophylliidae)

Distribution: British Columbia to Baja California; common especially in southern California.

Habitat: Found on wharf pilings, under shaded rocks and ledges from the low intertidal zone to about 200 m.

Appearance: Generally orange, but yellow morphs are not uncommon. Tentacles typically transparent and covered with warty knobs that store nematocysts. Up to 25 mm in diameter.

Diet: Small animals, organic particles. Captures prey with both stinging and sticky nematocysts. Feeds mostly at night.

Reproduction and Development: Sexes separate; eggs fertilized and developed in

female's gastrovascular cavity. When released, larvae settle nearby.

Mortality/Longevity: Polyps (the living animal) can retract almost completely into its protective cup.

Remarks: Unlike tropical corals, cup coral does not form reefs. Instead it builds only its own cuplike limestone base, cements it to rock, and lives a solitary life. Groups of individuals may live in close proximity.

Whisker Coral

Duncanopsammia axifuga (Dendrophylliidae)

Distribution: Australia, New Guinea and eastern Indonesia.

Habitat: Deeper water, attached to hard objects near sandy or muddy substrate.

Appearance: Normally green, blue-gray, or brownish. Polyps are extended day and night, and the long tentacles can obscure the distinctive tubular corallites that support the colony.

Diet: Photosynthetic products of zooxanthellae as well as zooplankton and small invertebrates by captured by tentacles.

Reproduction and Development: Sexual; asexual by budding. Is captive grown. Until recently was relatively unknown in the aquarium trade.

Remarks: A relatively unaggressive coral without sweeper tentacles that grows best in fairly open space.

Orange Cup Coral

Tubastrea sp. (Dendrophylliidae)

Distribution: Circumtropical distribution; widespread in the Indo-Pacific.

Habitat: Often found in entrances to caves and on underhangs where they take advantage of concentrated nutrient levels.

Appearance: Polyps may be brilliant yellow or orange (like most of those on display) as well as bright green, olive green, brown or blackish depending on species, the last two colors also on display.

Diet: Zooplankton, such as small crustaceans and fish larvae. Lack zooxanthellae; polyps typically emerge at night when the reef's plankton content is high.

Reproduction and Development: Sexual reproduction by release of planular larvae; also asexual reproduction by budding of new polyps from extensions of the skeleton. Readily release new polyps in captivity. Note their growing colonies in Matt Wandell's Staff Picks tank.

Remarks: Because they lack zooxanthellae, *Tubastrea* are not reef-building corals and in aquaria must be hand fed, usually twice a day, a tricky balancing act between offering enough food to keep the corals healthy but not so much that water quality deteriorates.

One of the first coral genera shown to produce bioactive compounds similar to soft corals. One such compound, called tubastrine, has anti-viral properties. *Tubastrea* also produces toxins that discourage competition and settlement of other stony corals.

Turbinaria Cup Coral

Turbinaria sp. (Dendrophylliidae)

Distribution: Throughout the Indo-Pacific.

Habitat: Variable, from shallow turbid water to clear reef flats and deeper reef slopes.

Appearance: May form cup, vase, or spreading scroll-like shapes, depending on light and water conditions. Color yellow, brown, or sometimes green. Corallites separate and distinct.

Diet: Many members of this family lack zooxanthellae and are not reef builders. The genus *Turbinaria* is an exception.

Reproduction and Development: Unlike most stony corals, which spawn in summer, this genus spawns in the fall.

Remarks: When irritated, can produce large amounts of clear mucus which can damage other corals; the mucus is presumed to contain nematocysts or a toxin.

ORDER CERIANTHARIA

Tube Anemone

Pachycerianthus fimbriatus (Cerianthidae)

Distribution: California (total distribution poorly known).

Habitat: Fairly common in soft mud bottoms of bays and harbors and protected sandy substrates of the outer coast. Low intertidal and subtidal in S. California; subtidal only in N. California.

Appearance: Solitary tube to 35 cm long when expanded. The tough, slippery, black, secreted tube projects above the mud substrate. Tentacular crown with two circles of translucent whitish to brown-gold tentacles. The inner circle usually held over the mouth, the outer circle projecting up or out.

Diet: Small invertebrates and plankton..

Mortality/Longevity: The nudibranch *Dendronotus iris* munches on the tentacles, yet predators are not a major threat to this species. Can live longer than 10 years. A Mediterranean species of tube anemone lived in an aquarium for more than 50 years.

Remarks: Resemble sea anemones in a tube.

Unlike sea anemones the anal pore is at the end of the body.

Self-made tubes are composed of mainly discharged nematocyst threads, capsules and mucus.

Tentacles retract very rapidly into the tube if the animal is disturbed..

ORDER ACTINIARIA (SEA ANEMONES)

Giant Plumose Anemone

Metridium giganteum (Metridiidae)

Distribution: Eastern North Pacific: Alaska to southern California.

Habitat: Subtidal, usually 12–75 m, attached to rocky substrate. Individuals usually aggregate in groups on deeper rocky reefs.

Appearance: Erect smooth column up to a meter in height. Color variable from white through cream to tan, brown and orange. Carries short, feathery tentacles in white, brown or gray.

Diet: Plankton—whatever drifts by or is carried in by the tide;.

Reproduction and Development: Unlike the intertidal *M. senile*, which can reproduce asexually and sexually, the giant plumose anemone seems to reproduce only sexually. Reproduction occurs when males release sperm to trigger the release of eggs by females. Unlike *M. senile*, congregations are genetically distinct individuals.

Mortality/Longevity: Predators include *Pisaster* spp. sea star and some species of nudibranchs

Remarks: The family Metridiidae is one of several groups of anemones that have a unique antipredator defense. When attacked, they contract suddenly, extruding specialized nematocysts through the mouth and body wall. These nematocysts, much larger than those found in the tentacles, can deter or even kill predators.

Cloned Plumose Anemone

Metridium senile (Metridiidae)

Distribution: Southern Alaska to Southern California and both Atlantic coasts.

Habitat: Depth to 166 m. *M. senile* lives on rocks, shells, wood pilings and stony breakwaters in bays and harbors in the low intertidal and subtidal zones.

Appearance: *M. senile* is colored white, cream, tan, orange or brown. Height to 50 cm. Tentacular crown diameter to 25 cm, hundreds to thousands of small, slender tentacles give a feathery (plumose) appearance.

Diet: Passive suspension feeders that trap prey in mucus-coated tentacles. Particles delivered to mouth via ciliary action. Primarily eats small zooplankton, copepods, and larvae of decapod crustaceans, bivalves and gastropods; also eats polychaetes and scraps of squid and fish.

Reproduction: The plumose anemone reproduces asexually by "pedal laceration": breaking off and leaving small fragments of its pedal disc. Sexes are separate. When males release sperm, females are stimulated to release eggs. The fertilized eggs transform into planktonic planula larvae. The planulae settle and metamorphose into young anemones.

Mortality/Longevity: The shagrug nudibranch feeds on small plumose anemones. Some sea stars feed on large adults.

Remarks: Plumose anemones crawl slowly along the substrate by muscular waves of the pedal disc.

Aggregating Anemone

Anthopleura elegantissima (Actiniidae)

Distribution: Alaska, USA to Baja California.

Habitat: Rocky surfaces in very low intertidal to mid-intertidal, singly or in dense aggregations, up to several hundred per m^2.

Appearance: Aggregating individuals to 6 cm in column diameter and 8 cm across tentacular

crown. Non-crowded (solitary) individuals to 25 cm tentacular crown width. Column colored white to light green. Tentacles are tipped pink, blue or purple. The wartlike tubercules are branched.

Diet: Copepods, isopods, amphipods and other very small animals. Zooplankton captured with tentacles. Zooxanthellae (dinoflagellates) and zoochlorellae (unicellular green algae) endosymbionts supplement their host's nutrition.

Reproduction and Development: Sexes are separate; reproduce sexually. Sperm released throughout summer. Also reproduce asexually by longitudinal fission. The latter process results in clones of same-sexed individuals in concentrations of several hundred individuals per m^2.

Mortality/Longevity: Like other anemones may decrease in size if starving.

Preyed upon by nudibranchs such as the shag rug, *Aeolidia papillosa* , snails, and sea stars such as the leather sea star, *Dermasterias imbricata*.

Conservation status: Tide poolers often march over and crush colonies.

Remarks: In laboratory conditions, aggregating anemones with endosymbionts move toward or away from light, apparently to maximize optimum light intensity. Anemones kept in darkness for long periods lose all endosymbionts and don't move toward light when light is reintroduced to their environment.

Anemones with endosymbionts expand in moderate light and contract in strong light; anemones lacking endosymbionts do not expand and contract.

Pebbles, shell fragments and bits of sea algae readily adhere to this anemone's flesh when it is above the tideline. This adaptation results in reduced desiccation (sunlight is reflected, not unlike an aluminum roof).

Abutting colonies have "clone wars" with their neighbors. Stinging cells (nematocysts) are used to destroy their enemy's flesh.

Giant Green Anemone

Anthopleura xanthogrammica (Actiniidae)

Distribution: Alaska to Panama.

Habitat: Rocky intertidal, tide pools and wharf pilings; attach firmly to substrate. Usually solitary; in favorable locations can occur in numbers to 14 per m^2.

Appearance: Column to 30 cm tall and 17 cm in diameter; tentacular crown to 25 cm diameter. Contracted animals form a hemispherical mound. Colored green to dark greenish-brown, occasionally white.

Diet: Detached mussels and sea urchins, also take crabs and small fishes. Zoochlorellae endosymbionts supplement host's diet with organic materials produced by photosynthesis. Also have symbiotic zooxanthellae.

Reproduction: Sexual; release sperm and brownish eggs from late spring through summer. Hatched larvae float freely and become widely dispersed before settling.

Mortality/Longevity: Tentacles are chomped by the shag rug nudibranch *Aeolidia papillosa* and the gastropod Tinted Wentletrap *Epitonium tinctum*. The column is consumed by the wentletrap snails *Opalia chacei* and *O. funiculata*, as well as the seaspider *Pycnogonum stearnsi*. Some sea stars also include this giant green species on their menu, especially smaller anemones.

Conservation status: Tide poolers often march over and crush colonies.

Remarks: Green color is due to presence of a fluorescent green pigment in the epidermis, as well as zoochlorellae (symbiotic unicellular green algae.) Anemones in caves and shaded areas may lack endosymbionts and are thus colored very light green or white.

The hermit crab *Pagurus samuelis* often scampers around on the giant green anemone; perhaps the crab becomes so covered with the host's mucus that the anemone can't distinguish itself from the crab. Since hermit crabs ingested into the gastrovascular cavity are released, perhaps there is an as yet to be described symbiosis.

Condylactis Sea Anemone

Condylactis sp. (Actiniidae)

Distribution: Found throughout the Caribbean and Western Atlantic; also Indo-Pacific.

Habitat: Found in lagoons or on inner reefs.

Appearance: Disc size: 10–40 cm.

Diet: Like many other cnidarians, these anemones host zooxanthellae. Also collect small invertebrates and fishes with their tentacles.. The amount of food they eat determines how fast they grow.

Reproduction and Development: Male and female release eggs and sperm into the water.

After fertilization and development, larvae metamorphose and settle out as juvenile anemones. Can also reproduce asexually through splitting and budding.

Remarks: Indo-Pacific *Condylactis* spp. and clownfish do not display symbiotic behavior in the wild. However, aquarists report that if introduced in an aquarium, the anemone may serve as a clownfish host. There are no clownfish species in the Caribbean.

Bubbletip Sea Anemone
Entacmaea quadricolor (Actiniidae)

Distribution: Indo-Pacific.

Habitat: Usually in deep crevices with only the tentacles visible.

Appearance: Tentacles to 10 cm length, often but certainly not always inflated and balloon-like at the tips. The oral disc and column are smooth and brown, green, or occasionally a fluorescent reddish orange.

Diet: Microcarnivores of plankton, supplemented with nutrition from zooxanthellae algal symbionts.

Reproduction and Development: Reproduce sexually by spawning and asexually, mostly by longitudal fission. Have spawned successfully in captivity.

Remarks: Thirteen species of anemonefishes are known to occur in a symbiotic relation with this anemone.

Bubbles inflate during daylight, a response interpreted by some researchers as providing more surface area to gather sunlight for algal symbionts.

Corkscrew Tentacle Sea Anemone
Macrodactyla doreensis (Actiniidae)

Distribution: Ryuku Islands; Philippines; Indonesia; New Guinea and the Coral Sea.

Habitat: Prefers shallow waters with soft substrate of sand and/or mud. Lives with column buried in the substrate and rarely moves unless conditions stress the animal.

Appearance: The base is usually orange; oral disc, if flared, has prominent white radial lines. Long tentacles are up to 15 cm long, often with corkscrew shape. May grow to 50 cm, but more commonly found at 20–30 cm.

Diet: Most nutrition produced by symbiotic zooxanthellae. Also feeds on particulate matter and small organisms.

Mortality/Longevity: Certain angelfish, butterflyfish and seastars eat tentacles.

Remarks: *M. doreensis* is known to host four species of anemonefish on exhibit in the Steinhart Aquarium—the pink, Clark's, and spinecheek anemonefishes and well as Nemo, the false clownfish.

From a Singapore website: "To some (hungry) visitors, the anemone reminds them of a bowl of udon noodles"!

Painted Anemone aka Painted Urticina
Urticina crassicornis (Actiniidae)

Distribution: Alaska, USA to south of Carmel, California; also both coasts of Atlantic.

Habitat: Sides and undersurfaces of rocks, low intertidal and subtidal along exposed rocky shores.

Appearance: Column diameter to 8 cm, height to 10 cm, smooth, lacking adherent material, variably colored red or green, with patches of green, yellow or red. Tentacles short, stocky, patterned variously, tips usually white.

Diet: Carnivorous. Capture prey with nematocysts. (Most reports assert nematocysts are used defensively rather than aggressively.)

Reproduction and Development: In eastern Atlantic populations, eggs are fertilized internally and retained; young are released as well-developed tiny anemones. In Puget Sound, WA this species spawns. Following fertilization, planula larvae often settle on tubes of annelid worms or on stones. Settled planulae rapidly develop into tiny 0.6 mm anemones. After 1 year anemones are 1.0 cm in diameter. Size is determined by available food rather than by age.

White-spotted Rose Anemone
Urticina lofotensis (Actiniidae)

Distribution: Northern Washington state, USA to San Diego, California, circumpolar.

Habitat: Rocks and walls of surge channels, low intertidal to 15 m on exposed outer coast.

Appearance: Column diameter to 10 cm, height to 15 cm. Column bright scarlet or crimson with white warty spots in longitudinal rows; tentacles slender, elongate, scarlet to crimson.

Diet: Carnivorous. According to one resource, capture prey by stunning with nematocysts. Most other reports affirm that nematocysts are used defensively rather than aggressively.

Fish-eating Anemone
Urticina piscivora (Actiniidae)

Distribution: Alaska to southern California.

Habitat: Low intertidal to about 50 m, in areas with rocky attachment sites and at least moderate current.

Appearance: Typically about 25 cm across, though large individuals can grow to 60 cm. Column is red with white, sometimes red, tentacles, and a creamy yellow oral disc.

Diet: Invertebrates and small fishes. These anemones have no zooxanthellae and depend wholly on capturing their food, a strategy aided by their exceptionally virulent nematocysts (stinging cells), which can cause long-lasting lesions on humans. Food items are usually swept into the anemone's tentacles by the current.

Remarks: Painted greenlings (*Oxylebius pictus*), sometimes seek protection among the tentacles of fish-eating anemones as well as on the Tealia anemone (*Urticina lofotensis*). Though the strategy is similar to that of tropical clownfishes, the greenling-anemone association is facultative rather than obligatory as the fish can survive well in areas without anemones.

Leathery Sea Anemone
Heteractis crispa (Stichodactylidae)

Distribution: Red Sea, Indian Ocean to W Pacific Ocean.

Habitat: Among coral reefs and rubble.

Appearance: Very large anemone to more than 50 cm in diameter. Expanded bushy crown of tentacles obscure oral disc and mouth. Tentacles are up to 1 m long, slender and sinuous; often opaque greyish-brown, violet or green, occasionally pink. Tips sometimes blue or purple. Column with tough, leathery texture, usually with fragments of seashells and coral attached.

Diet: Microcarnivore of plankton. Zooxanthellae present.

Remarks: At least 14 species of anemonefishes are symbiotic with the sebae anemone.

Magnificent Sea Anemone
Heteractis magnifica (Stichodactylidae)

Distribution: Indo-Pacific.

Habitat: 1–25 m, often on prominent structures in strong currents or in strong surge locations.

Appearance: Disc to 1 m in diameter. Column, which may be red, purple, or pink, grows to 20 cm. Tentacles are of uniform thickness and do not taper at te tip; tentacles and oral disc are colored alike in shades of magenta-purple, blue, green , red, white or brown.

Diet: Most nutrition from products of zooxanthellae. Also may eat fish and crustaceans.,

Reproduction and Development: Asexual reproduction by longitudinal fission. Sexual reproduction presumed although data are lacking.

Remarks: Host to at least 12 anemonefish species.

When disturbed, *H. magifica* "balls up," showing only the column with only a few tentacles protruding.

Giant Carpet Anemone
Stichodactyla gigantea (Stichodactylidae)
Carpet Anemones

Distribution: Indo-Pacific and the Red Sea.

Habitat: Shallow water so low that the anemone may be exposed at low tide. Usually on sandy surface with pedal disc attached to hard surface below.

Appearance: Deeply folded oral disc, covered with short, slightly tapering tentacles that tend to constantly vibrate. Column ranging from yellowish to pinkish, tan or gray-green covered with blue to maroon warty projections. Tentacles usually brown or greenish, though occasionally a bright purple, deep blue, or striking green. May grow to a meter in 10 years.

Diet: Nutrition mostly from products of photosynthetic zooxanthellae, but also captures invertebrates and small fishes.

Reproduction and Development: Sexes separate; females ingest the sperm and fertilize the embryos internally. Embryos are internally brooded, released from the mouth as miniature copies of the adult, and drift as plankters until settling.

Mortality/Longevity: Life span: At least 10 years, probably much longer.

Remarks: This big fellow has a potent sting and may harm corals and anemones as it moves about. Its sting can also cause a severe reaction in humans.

Sun Anemone
Stichodactyla helianthus (Stichodactylidae)

Distribution: Common to the Bahamas,

eastern and southern Caribbean; rare in the northwestern Caribbean.

Habitat: Shallow reef areas with mild to strong currents; prefer strong light and water flow.

Appearance: A large, green to whitish, carpet-like sea anemone. The oral disc covered by many short tentacles with rounded tips. Max. diameter: 15 cm.

Diet: Nutrition mainly from photosynthetic zooxanthellae. Also actively collect small invertebrates and fish with their tentacles. The amount of food they eat determines how fast they grow.

Reproduction and Development: Sexes separate; release eggs and sperm into the water. Can reproduce asexually through splitting ad budding. May occupy large areas in dense aggregations.

Remarks: Research suggests a peptide molecule found in a toxin produced by the sun anemone may have pharmacological value in the treatment of such various conditions as type-2 diabetes and autoimmune diseases in humans.

Miniature Carpet Anemone

Stichodactyla tapetum (Stichodactylidae)

Distribution: Indian and Pacific Oceans, Red Sea.

Habitat: In rock crevices on fringing coral reefs; also on sand, mud or rock of reef shallows in areas of moderate water flow.

Appearance: Tentacles short, bulbous, densely packed. Often arrayed in fields on the entire disc.

Diet: Primarily by-products of symbiotic zooxanthellae as well as drifting plankton.

Reproduction and Development: Sexual reproduction. Members of this family rarely divide in captivity.

Remarks: Tentacles deliver a potent sting for their size.

Some species of *Stichodactyla* anemones host anemone fish. This species does not.

CLASS SCYPHOZOA (TRUE JELLYFISH)

Moon Jelly

Aurelia aurita (Ulmaridae)

Distribution: Widespread. Atlantic, Arctic, Pacific, and Indian Oceans.

Habitat: Moon jellies are found near coastlines; they can survive over a wide range of temperatures (-6 °C to 31 °C; optimum 9 °C to 19 °C). They can also live in brackish waters. They inhabit both oceans and inshore seas, often in large numbers.

Appearance: Size range between 5 and 40 cm. Delicate coloration. Lack the long, potent stinging tentacles seen in some other jellyfishes.

Diet: *A. aurita* feeds on plankton. A mucous layer traps small organisms on the jellyfish's surface. Flagellae move the food from point of capture along well defined paths to the animal's stomach.

Reproduction and Development: Males and females are distinct and reproduction is sexual. Sexes can be distinguished since females hold the fertilized eggs, which appear as whitish-gray clumps on the manubrium (the conical mass that extends from the undersurface of the jellyfish.) Males may sometimes be seen with long sperm filaments trailing from the oral arms. After fertilization there are several distinct larval forms as the organism develops from egg to adult.

Mortality/Longevity: The death of the organism may follow reproduction, which leaves the gonads open to infection and degradation. Documented predators include the ocean sunfish, the leatherback sea turtle, and a few species of larger jellies. They are also hunted by birds. They are relatively defenseless, since they do not have tentacles that sting. *A. aurita* is a food item in many Asian and Southeast Asian countries.

Upside-down Jellyfish

Cassiopea andromeda (Cassiopeidae)

Distribution: Native to Indo-Pacific, but introduced in Caribbean, southern Florida, Hawaii, and elsewhere.

Habitat: Upon shallow substrates, typically in calm sandy areas, often around mangroves. Intertidal to 10 m.

Appearance: To 30 cm diameter, disc-shaped bell has elaborately fringed oral arms. Coloration is gray, brown or green with triangular white blotches surrounding the bell.

Diet: Symbiotic algae in its tissues provide

nutrition by photosynthesis, thus the upside down posture that allows algae, which live on the ventral surface, to receive maximum sunlight. The rhythmic pulsations create water flow that carries zooplankton over the tentacles to supplement the diet.

Reproduction and Development: Reproduce both asexually (by budding) and sexually.

Conservation Status: Common and widespread, though pressure from coastal development along mangrove shallows may pose a future threat.

Remarks: The sting is relatively mild, but may create an irritating, itchy rash; especially sensitive individuals can experience vomiting and skeletal pain.

Sea Nettle

Chrysaora fuscescens (Pelagiidae)

Distribution: Mostly found along the west coast of North America from Mexico to British Columbia.

Appearance: The sea nettle is a giant, semi-transparent jellyfish, with an amber-colored, swimming bell commonly as large as 30 cm in diameter, with some measuring more than a meter. In addition to four oral arms attached to the underside of the mouth, the sea nettle has 24 long tentacles around the perimeter of the bell that extend up to 4 m.

Diet: Carnivorous; feeds on zooplankton, small crustaceans, comb jellies, fish eggs and larvae. Sea nettles sting their prey with their tentacles, which have millions of microscopic stinging cells that inject toxins to stun or kill tiny animals. The main oral arms then transport food to the heart-shaped gastric pouches in the bell, where digestion occurs. Jellyfish are prodigious predators; they swim and feed continuously.

Reproduction: Like any other jellyfish, the life cycle of sea nettles has both a polyp and a medusa stage. Sexes are separate; egg and sperm are broadcast into the surrounding water during summer. Ciliated larvae develop in the water column, eventually settling on a hard surface and growing into miniature polyps. The polyp lives on the bottom and survives the winter in a dormant state. During May through August, the polyp asexually reproduces tiny sea nettle medusas that bud off and eventually grow into the familiar, large medusa stage.

Mortality/Longevity: In the medusa stage, sea nettles live from 2–6 mos, usually perishing in rough waters or being eaten by predators—ocean sunfish and leatherback turtles are two of the most prevalent jellyfish predators.

Remarks: Question: What has no heart, bones, eyes or brain, is made up of 95% water, and yet is still a remarkably efficient ocean predator? (The jellyfish)

Some jellies commute 1,000 m up and down in the water column daily!

Larval and juvenile cancer crabs may hitch rides on the jelly, dropping off as the jelly comes inshore.

Sea nettle stings can result in extreme localized pain. Fortunately this jelly is not aggressive.

In recent years, tests of a commercially developed sting inhibitor have shown promise in reducing the severity and frequency of stings from sea nettles and other jellies. Reportedly, the inhibitor is chemically based on the mucus coating of clownfish, known to protect against anemone stings.

Sea nettles were first captive bred at the Monterey Bay Aquarium.

The bell of this and other jellies is called a "medusa" because, with its long, fringing tentacles, it resembles the snake-haired Gorgon Medusa of Greek mythology.

PHYLUM ANNELIDA

Featherduster Worms

Sabellastarte sp. and *Protula* sp.

Distribution: Indo-Pacific, Hawaii.

Habitat: Mainly tropical marine areas, with muddy or sandy bottoms.

Appearance: Featherduster worms are sessile marine segmented worms. They form and live in tubes, attached to rocks, coral or sand by their bases. Their plumes extend beyond the open end of the tube to feed. They have primitive eyes and will withdraw the plume if they sense motion. Some species may be shed their plumes if environmental conditions are poor.

Diet: Filter feeders eating plankton, detritus, and bacteria, using the plumes to sweep food toward the mouth.

Reproduction and Development: Simple methods of reproduction. Some species may reproduce asexually at times. Most have separate sexes, with poorly defined gonads. Usually broadcast gametes through excretory openings into the water. In some species the worm may leave the tube to reproduce.

Remarks: Tube worms in the family Sabellidae produce non-calcareous tubes from skin like secretions. Those in the family Serpulidae secrete calcium carbonate into their tubes. The tube mouth is blocked by an operculum when the worm retracts.

The "featherdusters" are tentacles covered with microscopic cilia. The cilia move water past the food groove and capture bacteria and plankton contained in the water. The food groove is lined with mucus producing cells. Food particles get knocked into the mucus, which is thick and gluey on top, but liquid and mobile below. The cilia move the mucus carrying the worm's dinner into the gut. Essentially, the worm has produced a conveyor belt to feed itself.

PHYLUM MOLLUSCA

CLASS POLYPLACOPHORA (CHITONS)

Lined Chiton

Tonicella lineata (Ischnochitoninae)

Distribution: Aleutian Islands, Alaska south to San Miguel Island, California, west to Sea of Okhotsk and northern Japan.

Habitat: On rocky substrates covered with erect or crustose coralline algae in the intertidal zone and subtidal waters.

Appearance: Length to 5 cm. Body is elongate-oval, valve is low, rounded, smooth and shiny. Coloration is typically reddish and marked with sinuous or zigzag lines of alternating colors of blue, red, whitish; occasionally blotched or lacking in color.

Diet: Primarily coralline algae.

Reproduction and Development: Spawning varies by latitude. On San Juan Island, Washington, eggs are released during May or June, while in Oregon and California eggs are released during April. The green-colored eggs exit the female in groups of two or three; intermittent spawning lasts around one and one-half hours. Following fertilization, the trochophore larvae begins development for several days as the foot, mantle and larval eyes form. Larvae settle when they locate an appropriately hard substrate containing crustose coralline algae. The larvae metamorphose into a miniature adult in 12 hours after settlement. The developing shell valves are initially lightly calcified and thus very flexible. By the sixth day the diminutive chiton has all external morphological features excepting its gills. Thirty days after settlement it has a fully-developed radula and is equipped to attack its coralline algae "salads."

Mortality/Longevity: Predators include the sea star *Pisaster ochraceus*.

Remarks: Its coloration blends well with the substrate of coralline algae. Thus its appearance is likely an adaptation against visual predators.

Activity rhythms vary by depth. Individuals in the intertidal zone don't move when exposed during a low tide; they only locomote once immersed by a rising tide.

Mossy Chiton

Mopalia muscosa (Mopaliidae)

Distribution: British Columbia, Canada to Baja California

Habitat: On rocks and in tide pools, middle to lower intertidal in locations with light to moderate surf; also in estuaries, very unusual habitat for a chiton.

Appearance: Length to 9 cm. Shell is dull brown, and frequently eroded and encrusted. The fleshy girdle surrounding the shell plates is densely covered with stiff, reddish-brown bristles; thus the common name.

Diet: Forages exclusively at night. Primarily feeds upon the red algae turkish towel *(Gigartina papillata*) and the green alga *Cladophora* spp. In some studies, mossy chiton's guts contained up to 15% animal matter, a large percentage consumed inadvertently.

Reproduction and Development: Spawn mostly in spring and summer. Eggs and sperm

usually shed in large tide pools. Following fertilization, hatching occurs within a day's time. Free-swimming larvae settle around 11 days. Mossy chitons attain sexual maturity at 2 years of age.

Mortality/Longevity: A popular treat for *Pisaster ochraceus*.

Remarks: A chiton' shell is composed of 8 overlapping plates that can flex over irregular shapes of rocks, allowing the animal to create a tight, secure seal. Most chitons can also roll into a plate-covered ball in response to danger.

Gumboot Chiton

Cryptochiton stelleri (Acanthochitonidae)

Distribution: Northern Hokkaido Island, Japan; Kurile Islands, Japan; Kamchatka, Siberia; Aleutian Islands, Alaska; to the California Channel Islands of San Miguel and San Nicolas.

Habitat: Low intertidal in areas protected from strong surf. Also subtidal in kelp forests. Adults not nomadic; in one study marked individuals remained within 20 m of the release site for over 2 years.

Appearance: Length to 35 cm. Dark brown to "brick" red in color. Mantle thick and leathery.

Diet: Red algae, especially *Gigartina* spp., *Iridaea* spp. and certain coralline algae; also green and brown algae.

Reproduction and Development: Spawning occurs in the spring in California. A gumboot may lose 5% of its body weight at this time. Eggs are laid in gelatinous spiral strings up to 1 m long. The laying of this string triggers the males to release sperm. 0.5 mm larvae hatch 5 days after fertilization. After a 20-hour free-swimming stage, larvae settle.

Mortality/Longevity: Does not affix firmly to the rocky substrate like other chitons. Thus is often washed out of the low intertidal to be stranded on the high beach during storms. Valves are often broken, but are able to mend. Has few predators. The predaceous lurid rock snail rasps pits into the dorsal surface. Largely ignored by sea otters. Live to more than 20 years.

Remarks: This species is the largest chiton on the planet.

The valves of this chiton frequently occur in historic kitchen middens of coastal California Native Americans. Exactly how gumboots were prepared remains unknown. Long, covered-by-lid slow-cooking over a fire might be the answer culinary anthropologists seek.

The commensal inhabitants include the polynoid worm *Arctonoe vittata* and the pea crab *Opisthopus transversus*, which cling to the chiton's gills. They feed on plankton and detritus brought in by the respiratory currents of the gumboot host.

CLASS GASTROPODA (SNAILS AND SLUGS)

Red Abalone

Haliotis rufescens (Haliotidae)

Distribution: Sunset Bay, Oregon to Baja California.

Habitat: Uncommon in the lower intertidal zone in rocky areas with heavy surf. Most now in 6–17 m depth in central California.

Appearance: Shell (to 30 cm) is usually brick red and overgrown with fouling organisms. Shell's color influenced by diet. The red color is from the pigment phycoerythrin consumed in its red algae diet. Brown specimens eat primarily brown algae.

Diet: Algae, especially red and brown species. Drifting pieces of algae are trapped by epipodal tentacles before the foot traps the plant.

Reproduction and Development: After spawning, fertilized eggs sink. Half a day later swimming trochophore larvae develop. About one day later this becomes a veliger larva. After a week or two, depending on water temperature, the larvae settle to the bottom, metamorphose, and begin to graze. Growth slows with increasing size and age.

Mortality/Longevity: Mortality is very high in the planktonic stages. Settled abalone are preyed upon by sea stars, crabs, octopuses, fishes, sea otters and humans. Individuals can live more than 20 years.

Conservation status: Highly endangered. Due to overexploitation by the abalone fishery, the population plummeted in the late twentieth century. Poaching continues to be a problem.

Remarks: The holes in the shell excrete feces, urine, gametes and water that has circulated through the gills.

Red abalone have been used as a laboratory animal in many physiological and biochemical investigations.

Rough Keyhole Limpet
Diodora aspera (Fissurellidae)

Distribution: Alaska to Baja California.

Habitat: Beneath stones or canopy of algae in the lower intertidal zone in its northern range, more common subtidally in the south.

Appearance: Shell to 7 cm long, thick, triangular in profile. Color gray with radiating grayish-brown, or black and white radiating striations.

Diet: Omnivorous. Encrusting bryozoans are consumed in preference to algae.

Reproduction and Development: Spawners. After various larval stages metamorphose, larvae settle to substrate and metamorphose into miniature adults.

Mortality/Longevity: Consumed by sea stars including the sunflower star and the Pacific sea star.

Remarks: Upon contact with sea stars this limpet extends its foot, elevating the shell. The mantle flap divides at its margin into a series of folds, two of which extend greatly to cover the dorsum and ventral surface; thus the starfish lacks a toehold.

Shield Limpet
Collisella pelta (Acmaeidae)

Distribution: Aleutian Islands, Alaska south to Baja California.

Habitat: Rocky reefs, mid-low subtidal zones. Active only when wet or submerged. Associated with brown algae and mussel beds.

Appearance: Ribbed shell to 4 cm in diameter. Exterior color highly variable: brown/green; also colored "checkered" black and white. Variation at least partially caused by dietary differences.

Diet: A wide variety of algae, both microscopic and large. Primarily feeds upon erect algae, especially the reds (*Endocladia muricata*, *Rhodoglossum* spp., *Iridaea* spp.), and the browns (*Pelvetia fastigiata*, feather boa kelp *Egregia menziesii,* and sea palm *Postelia palmaeformis).*

Reproduction and Development: Spawn throughout the year in central California. Young (typically black, with weak shell ribbing) occur on the stipes and holdfasts of the feather boa kelp, *Egregia menziesii*. They move to a rock substrate when about 1 cm long, develop ribbing and change shell color. Reach 3 cm in three years.

Mortality/Longevity: Preyed upon by sea stars including the ochre sea star (*Pisaster ochraceus).*

Remarks: Gives an escape response to its three known sea star predators, but rarely to other predatory sea stars.

Owl Limpet aka Giant Owl Limpet
Lottia gigantea (Acmaeidae)

Distribution: Washington state to Baja California.

Habitat: Cliff faces and rocks of surf-beaten high to middle intertidal. At low tide large individuals occupy a "home scar" in a rock that exactly fits the margin of their shells. Owl limpets aggressively defend their territory.

Appearance: Low, oval shell has an eroded surface; length to 9 cm. Brown shell with white spots.

Diet: During high tide graze upon algal film within their territory (appropriately the size of a large dinner plate; 1000 cm^2).

Reproduction and Development: Breed in autumn and winter in California.

Change sex from male to female.

Mortality/Longevity: Preyed upon by humans as well as shorebirds such as oystercatchers. Can live at least 15 years.

Conservation status: Not on IUCN Red List. However, collection by humans as a food source threatens many populations. Prized as a food in Mexico. Illegally poached in California.

Remarks: Owl limpets push smaller limpets including other *Lottia gigantea,* mussels and sea anemones out of its territory by "bulldozing" (pushing) them with their shell. Small barnacles are rasped off with its goethite (a hard iron compound) -capped radula.

Coastal Native American middens often contain owl limpet shells.

There was once a commercial fishery for limpets, primarily owl limpets, in California. During 1919 and 1920 the limpet harvest was more than 8000 kg.

Black Turban Snail
Tegula funebralis (Trochidae)

Distribution: Vancouver Island, Canada to Central Baja California.

Habitat: Tide pools and on rocks in middle intertidal of protected areas.

Appearance: Shell dark purple to black. Diameter to 3 cm. Males tend to have a pale foot while females have a dark foot.

Diet: Opportunistically grazes upon brown algae, microscopic films, attached macroalgae and wrack. Prefers soft algae such as giant kelp (*Macrocystis)*, bull kelp (*Nereocystis),* and turkish towel *(Gigartina)*. Very young snails graze on the film of microscopic algae on rocks.

Reproduction and Development: Sexes are separate. Females deposit eggs in gelatinous masses, each containing several hundred eggs. Veliger larvae hatch from the mass on the seventh day. Larvae settle one week later.

Mortality/Longevity: Preyed upon by humans, sea otters, the red rock crab (*Cancer productus*), and especially the ochre sea star (*Pisaster ochraceus).* May live to 20–30 years, extremely old for a gastropod.

Remarks: Formerly popular as food with Native Americans.

Brown Turban Snail
Tegula brunnea (Trochidae)

Distribution: Oregon to Santa Barbara Island, California.

Habitat: Rocky shore, low intertidal to subtidal deep tidal lagoon and surge channel subhabitats, often on upper blades and stipes of subtidal kelp.

Appearance: Shell color orange or bright brown. Shell is smooth and rounded, diameter to 3 cm.

Diet: Opportunistically graze upon brown algae including *Macrocystis, Egregia* and *Laminaria.*

Reproduction and Development: Sexes are separate.

Mortality/Longevity: Preyed upon by sea stars of *Pisaster* spp., the crab *Cancer antennarius*, and sea otters.

Blue Ring Top Snail
Calliostoma annulatum (Callistomatidae)

Distribution: Found inshore on brown algae and on rocks; offshore on kelp forests.

Habitat: Found inshore on brown algae and on rocks; offshore on kelp forests.

Appearance: Cone-shaped yellow shell with purple bands along the beaded spiral; foot bright orange or yellow. Diameter to 2.5 cm.

Diet: Hydroids, encrusting bryozoans, detritus, diatoms, dead fish; also known to feed on club-tipped anemones (*Corynactis californica*).

Reproduction and Development: Separate sexes; broadcast sperm and eggs into the sea where fertilization occurs.

Remarks: When attacking an anemone, the blue ring top snail rears up on its foot, lunges, and bites at one of the anemone's tentacles.

The foot regularly discharges a mucous layer on the shell which apparently makes the animal more difficult for predators to grasp.

Blue Top Snail
Calliostoma ligatum (Callistomatidae)

Distribution: Eastern Pacific: Alaska to Baja California.

Habitat: Brown algae inshore on rocks and offshore kelp forests.

Appearance: Cone-shaped yellow shell with purple bands along the beaded spiral; foot bright orange or yellow. Diameter to 2.5 cm.

Diet: Omnivore; feeds on kelp, hydroids, encrusting bryozoans, detritus, diatoms, dead fish.

Reproduction and Development: Separate sexes; broadcast sperm or eggs into the sea where fertilization occurs.

Red Top Snail
Lithopoma gibberosum (Turbinidae)

Distribution: British Columbia to Baja California.

Habitat: Low intertidal rocks and subtidal kelp beds.

Appearance: Squat, cone-shaped, brick-red shell often overgrown by algae or hydroids. Diameter to 12 cm.

Diet: Algae.

Reproduction and Development: Broadcast spawners. Little is known about their biology.

Wavy Turban Snail
Lithopoma undosum (Turbinidae)

Distribution: Eastern Pacific: Point Conception to northern Baja California.

Habitat: Low intertidal zone to sub-intertidal to about 20 m depth.

Appearance: A large marine gastropod. Circular shell with undulating ("wavy") ridges. Max. size: 13 cm.

Diet: Algae.

Remarks: The shell is often covered with algae and other encrusting organism, an effective means of camouflage.

Queen Conch

Strombus gigas (Strombidae)

Distribution: South Florida, Bahamas and Caribbean.

Habitat: Sea grass beds (especially turtle grass *Thalassia testudinum*), sand flats and shallow, sandy lagoons, often around patch reefs.

Appearance: Short conical spire with blunt spikes. Shell's exterior is orangish, often obscured by algal growth and debris. Aperture rosy-pink, with a thickened flared lip. Mottled gray head with large proboscis and long eye stalks. Eye at tip of stalk, tentacles below. Long, claw-like operculum.

Diet: Primarily microscopic algae grazed from the surface of the blades of turtle grass.

Reproduction and Development: Mating occurs in open sandy areas, the two partners lined up fore to aft. Packets consisting of gelatinous strings of eggs are deposited on sandy substrates. Eggs hatch into planktonic larvae. Adult reaches 30 cm length in 2–3 years. After that time shell is thickened by additional layers of calcium carbonate added on the internal surface.

Mortality/Longevity: Juveniles preyed upon by gastropod mollusks, cephalopods, crustaceans and fishes. Adults are consumed by sharks and loggerhead turtles; the latter is capable of crushing the shells of adult queen conchs. Avidly preyed upon by humans as a food source.

Conservation Status: Has become uncommon in many locations, especially in shallow depths, due to overharvesting for food.

Remarks: Locomote by hopping by extending the muscular foot and "pole vaulting." Adults can move vertically with waving motions of the foot and also adhere to substrates.

The conchfish (*Astrapogon stellatus*) spends daylight within the mantle cavity of this conch, and emerges nocturnally to feed.

A conch pearl is formed when an animal or mineral particle trapped beneath the mantle is covered with layers of calcium carbonate until it reaches nearly marble-size.

Marble Cone Snail

Conus marmoreus (Conidae)

Distribution: Red Sea, Indo-Pacific.

Habitat: Shallow water to 90 m depth.

Appearance: Shell length to 10 cm. Flat, noduled spire. Reticulated pattern of black or dark brown with white patches overall.

Diet: A predator of predators; harpoons on other members of its family (Conidae). Its "harpoon" is a single, specialized radula tooth equipped with a spearlike barbed tip. The barbed tooth has a groove through which the snail injects a neurotoxic peptide poison into its victim.

Remarks: Research on cone snail toxins is an active field and has resulted in a new highly effective painkiller recently approved by the FDA that, unlike opium-derived medications, has a low risk of addiction.

Small cone snails pose little danger to humans beyond a beelike sting; however, large cone snails inject enough toxin to be deadly. About 30 human deaths have been attributed to cone snail envenomation.

SUBCLASS OPISTHOBRANCHIA (SEA SLUGS AND THEIR KIN)

White Dorid

Doris odhneri (Dorididae)

Distribution: Alaska to California.

Habitat: Rocky areas, mostly at low intertidal and subtidal depths.

Diet: Sponges.

Appearance: Body of uniform color, usually white. Like all dorid nudibranchs, the rhinophores and gills are retractable into pockets on the mantle. Tubercles on the mantle are especially large around the animal's rhinophores and gill bush to protect these structures. Max. length: 20 cm.

Remarks: Dorids have radulae with smooth, hook-like teeth characteristic of the family. The radula, a file-like organ possessed by all

mollusks except bivalves, is covered with chitinous teeth which the white dorid uses to scrape off its food.

Many species of nudibranchs are identified by the structure of their radular teeth.

Terry Gosliner, Academy Senior Scientist, is one of the world's leading experts on nudibranchs.

Sea Lemon

Peltodoris nobilis (Doridiidae)
Dorid Nudibranchs

Distribution: Alaska to Baja California.

Habitat: Rocky areas, mostly at low intertidal and subtidal depths to about 25m. Often seen on harbor pilings.

Appearance: Color variable: may be pale yellow to a deep rich yellow or orange. Back is covered with tubercules and dark spots; gills are white at the tips. One of the largest of all nudibranchs; max. size: 20 cm.

Diet: Sponges.

Reproduction and Development: Hermaphrodites. The coiled cream-colored egg ribbons, each containing as many as 2 million eggs, are sometimes seen in the exhibit.

Remarks: *P. nobilis* is one several dorid nudibranchs with a fruity, distinct lemon scent usually given off when the animal is handled, thus its common name. When concentrated, the odor repels many predators.

California is well-known for the diversity of nudibranchs found in its coastal waters.

Opalescent Nudibranch

Hermissenda crassicornis (Fabelinidae)

Distribution: Kodiak Island, Alaska to Baja California, Mexico; Japan

Habitat: Tidepools, rocks, pilings, mudflats. Benthic: low tide line to 37 m.

Appearance: Length to 5 cm. Grayish white body with neon blue edges, brilliant orange dorsal pinstripe from front to back. Cerata are burnt umber to brown with orange to white tips.

Diet: Hydroids, sea anemones, sponges, corals, bryozoans, other nudibranchs.

Reproduction and Development: Hermaphroditic (possessing both male and female organs), though rarely self-fertilizing. Egg strings in narrow coils with as little as a few eggs to as many as a million. Eggs mature in from five to 50 days depending on water temperature.

Mortality/Longevity: Less than one year.

Remarks: An encounter between members of this species may result in mutual mating or hostile combat with the victor dining on the loser.

One of several nudibranch species valued in medical research for the study of ganglia and nerves.

A good example of warning coloration; fish have been observed to avoid this brightly colored species whose nematocysts inflict damage to the tissues of unwary consumers. Adults store nematocysts, ingested from their cnidarian prey, in the cerata.

California Sea Hare

Aplysia californica (Aplysiidae)

Distribution: Humboldt Bay, California to Gulf of California.

Habitat: Among seaweed, sometimes in kelp canopy, lower intertidal to over 18 m. Occasionally in sandy areas, mudflats, bottom of bays, estuaries and harbors.

Appearance: A huge (to more than 40 cm long and weighing several kg) sea slug; reddish, brownish and/or greenish (color dependent on diet).

Diet: Herbivore. Feeds primarily diurnally on various algae and the eelgrass *Zostera*.

Reproduction and Development: All adults are simultaneous hermaphrodites. During mating, any individual may perform as a male, or as a female, or as both sexes simultaneously. "Daisy chains" of mating animals are often reported from the field. The designated female lays long, tangled, yellow-green, spaghetti-like egg strings containing up to one million eggs intertidally and subtidally among rocks and algae. The eggs hatch ~two weeks later. Hatched veliger larvae swim for ~one month, settle and metamorphose into juveniles which double their weight every 10 days for 3 months.

Mortality/Longevity: Very few species have been reported as preying on post-larval sea hares, possibly due to their toxic digestive gland. Giant green anemones are

one exception; however, these anemones regurgitate if they consume the digestive gland. Sea hares live one year or less.

Remarks: When alarmed, sea hares exude a dark purple fluid which gets its color from a pigment in the red algae in the slug's diet.

Due to its large nerve cell bodies (in the peripheries of the 9 major ganglia linked by nerve fiber tracts), the sea hare has become a darling of researchers relating overt behavior of animals to the structure and function of cells and the cellular network.

CLASS BIVALVIA AKA PELECYPODA

California Mussel

Mytilus californianus (Mytiloidae)

Distribution: Aleutian Islands, Alaska to Southern Baja California.

Habitat: Abundant clusters attached to substrate and each other with byssal fibers in massive beds. Low intertidal to 40 m deep. Common in surf-swept rocky areas.

Appearance: Shell length typically to 13 cm (25 cm in some subtidal areas). Blue-black exterior, sculpted with ribs and irregular growth lines.

Diet: When submerged, filter-feed nearly continuously on detritus particles and plankton (esp. dinoflagellates).

Reproduction and Development: Separate sexes; broadcast sperm or eggs into the sea where fertilization occurs. Spawn November–May. Larvae are free-swimming ~ 4 weeks. After settling and attachment, grows to full size in about 3 years.

Mortality/Longevity: Preyed on by sea stars, in our area, esp. the ochre sea star (*Pisaster ochraceus*), snails, crabs, birds, and humans.

They create mussel beds—coastal areas densely covered with mussels—which provide habitat for many small worms and crustaceans.

Sea otters have devastated formerly extensive mussel beds in Monterey Bay.

Crocea Giant Clam

Tridacna crocea (Tridacnidae)

Distribution: Malay Peninsula to Australia, New Guinea, Indonesia, Philippines, Okinawa, Fiji and Guam.

Habitat: Lives within small cracks on shallow reef flat corals. This species is a "small" giant clam; maximum length is 10 cm. Valves have very short fluted concentric sculpture on the tests.

Diet: Filter feeds but majority (perhaps approaching 90%) of nutrition is a result of the activities of endosymbiont zooxanthellae.

Reproduction and Development: Uses valves of shell to bore into substrate.

Conservation status: Not yet on the IUCN Red List. Exploited by humans as a food source.

Remarks: The colorful pigments in the mantle tissue probably reduce light intensity to protect zooxanthellae.

Giant Clam

Tridacna derasa (Tridacnidae)

Distribution: Cocos Keeling atoll to Australia; Fiji, Solomon Islands, New Guinea, Palau, Indonesia and Philippines.

Habitat: Quiet waters, often associated with sandy or silty habitats in shallow reef flats. Some occur deeper, to 30 m in clear water.

Appearance: Unmistakable, the common name says it all. *Tridacna derasa* is second largest species in genera, length to 50 cm. *T. gigas* is the largest (to 1.37 m) bivalve in the world. *T. derasa* weigh to more than 500 kg. Mantles are typically mottled deep blue, green or turquoise due to pigments that probably reduce light intensity.

Diet: Intercellular symbiotic zooxanthellae photosynthesize and produce food for their host clam. The gape of all tridacnids is directed upwards, allowing maximum exposure to sunlight for their algal symbionts. Like most bivalves, a giant clam pumps water and planktonic items into its mantle cavity with its incurrent siphon. This allows for filter feeding with its elaborate gill structures, as well as gas exchange. Expels with its excurrent siphon.

Reproduction: Broadcast spawners; release sperm and eggs into open waters. Fertilized eggs develop into planktonic larvae that settle and attach with byssal threads to the substrate.

Mortality/Longevity: Humans have harvested this tasty bivalve for years. The giant clam *Tridacna gigas* is reputed to live to 200 years.

Conservation Status: Rare in many areas due to overharvesting as a food for humans.

Commercial propagation shows promise of success and may offset some taking of natural populations.

Remarks: Despite seafarers' tales of fellow crew members being caught in this clam's trap-like valves, it is unlikely that this could occur.

Giant Clam

Tridacna gigas (Tridacnidae)

Distribution: Found throughout the tropical Indo-Pacfic.

Habitat: Benthic on rocky or sandy substrate of coral reefs and lagoons to depths of 20 m.

Appearance: *T. gigas* is the largest and heaviest of all living mollusks. The pale or clear spots on the mantle, known as "windows," allow sunlight to enter and stimulate the photosynthesis of symbiotic algae (zooxanthellae). The two holes in the mantle are the siphons, one is fringed with tentacles for the intake of water for food and oxygen, the other tube-like for the discharge of large volumes of water if the clam's shell closes rapidly

Diet: Zooxanthellae provide most of the clam's nutrition as well as a ready supply of oxygen. In turn, the clam provides protection and access to light for the zooxanthellae. Like other clams, also uses gills to filter small food particles from the water and to carry out gas exchange.

Reproduction and Development: *Tridacnas* are broadcast spawners, releasing sperm and eggs into the open water in great numbers. Fertilized eggs develop into planktonic larvae that settle and attach to the substrate with byssal threads. Byssal threads become less necessary as increasing weight holds the animal in place.

Mortality/Longevity: Very long-lived. One resource suggests 100-year lifespan, another 200 years!

Conservation Status: Listed as vulnerable by the IUCN. The giant clam is declining in numbers, and is extinct in many parts of its former range. In Southeast Asia and the Pacific islands, the flesh is considered a delicacy. In China, the adductor muscle is believed to be an aphrodisiac and sells for large sums. Recently, commercial propagation shows some promise of success.

Remarks: Giant clams have sometimes been called "killer clams," with stories of humans caught and drowned by sinister attacks on arms and legs. Fortunately for divers, these tall tales are untrue. The most common injury associated with giant clams are hernias, back strains, or broken toes, self-inflicted on people trying to lift these huge animals from the water!

Maxima Clam aka Small Giant Clam

Tridacna maxima (Tridacnidae)

Distribution: Has widest range of giant clam species. Indo-Pacific coastlines from east Africa to China, Southeast Asia, Australia, and Pacific islands.

Habitat: On reefs or sand, often embedded in coral in shallow water.

Appearance: Aptly named, the *small* giant clam is less than a third the size of *T. gigas*. Grows to 40 cm. Mantle is usually bright blue, green, or brown, but may be orange or lavender. Shell has distinctively furrowed edges.

Diet: Nutrients from photosynthesis of zooxanthellae and from filter-feeding.

Reproduction and Development: Broadcast spawner. Like other *Tridacnas*, juveniles are males when first sexually mature, but later become hermaphrodites. Sperm and eggs are released at different times to avoid self-fertilization.

Mortality/Longevity: *Tridacna* clams, especially the mantles, are preyed upon by mantis and cleaner shrimps, various snails, crabs, wrasses, triggerfishes, and angelfishes.

Conservation Status: Classified as Lower Risk – conservation dependent on IUCN Red List; also Appendix II of CITES.

Squamosa Clam

Tridacna squamosa (Tridacnidae)

Distribution: South Africa; Red Sea to Samoa, Tonga and Marshall Islands.

Habitat: Shallow reef flats to depths of about 20 m. Live vertically oriented with the hinge side down.

Appearance: Width to 40 cm. The rows of large leaflike flutes on the surface of the valves are diagnostic. Like all *Tridacna* giant clams the mantle color of individuals is highly variable due to the presence of zooxanthellae as well as pigments of brilliant green, blue, red, violet, or brown in the mantle tissue.

Diet: Filter feeds but majority (perhaps approaching 90%) of nutrition is a result of the activities of intercellular endosymbiont zooxanthellae that live in blood sinuses within the mantle.

Reproduction and Development: Initially attached to substrate with byssal threads. Grow very rapidly during the first 2 years.

Mortality/Longevity: May reach adult size when 30 years old.

Conservation status: IUCN listed as Threatened. *Tridacna* clams are being heavily exploited as a food item for humans. The meat of a single conspecific individual (*T. gigas*) was recently poached and sold (for $3.00 *vs*. the $300.00 retail rate) in Papua New Guinea.

Remarks: The pigments in the mantle probably reduce light intensity to protect zooxanthellae from overexposure.

Scallop aka **Swimming Scallop**

Chlamys spp. (Pectinidae)

Distribution: Gulf of Alaska to San Diego.

Habitat: Mostly subtidal, or sometimes intertidal, at depths of 2–150 m.

Appearance: Up to 6 cm in length. Convex valves with ribs radiating from umbo (prominence near the hinge) to ventral edge, and covered with prominent spines or ruffles. Usually has sponges encrusting on its surface.

Diet: Filter feeds about 4 liters of water per gram per hour, using their ctenidia (or gills) to collect microscopic food and oxygen.

Reproduction and Development: Sexes are separate. Veligers (free swimming, planktonic larvae) arise 50 hours or so after eggs are fertilized. Shells form annual growth rings.

Mortality/Longevity: This scallop lives about 6 years (at least in Southern British Columbia.) A variety of sea stars prey on this mollusk. Also, is parasitized by *Odostomia columbiana,* the clam sucker snail, so called because it uses its eversible proboscis to suck body juices from its host.

Remarks: Escapes predators by swimming, forcing water out as a jet near the bivalve's hinge. Encrusting sponge and scallop are in a mutualistic relationship. The sponge repels sea star predators, possibly by chemical secretions; the scallop's movement may reduce sediment accumulation on sponges.

Has several hundred eyes at edge of mantle; these detect light and dark, but do not form images.

Giant Rock Scallop

Crassedoma giganteum (Pectinidae)

Distribution: Common from British Columbia to Baja.

Habitat: In or on rock crevices, pilings, and floats; intertidal to 50 m.

Appearance: Typical scallop shape. While most scallops grow to c. 18 cm, this giant can reach 30 cm in diameter. Females larger than males.

Diet: Filter feed on plankton and suspended organic particles.

Reproduction and Development: Protandrous hermaphrodites. Usually spawn in spring, April to mid-June depending on latitude. Larvae are planktonic.

Mortality/Longevity: Live to 25 years.

Remarks: Juveniles can swim. At about 2.5 cm diameter, individuals cement to rock or other hard surface with byssal threads.

Humans gather rock scallops and consume the adductor muscle, raw or fried.

CAS displays casts of the real thing, as they are extremely difficult to maintain in captivity.

CLASS CEPHALOPODA

Chambered Nautilus

Nautilus pompilius (Nautilidae)

Distribution: Eastern Indian Ocean to Fiji.

Habitat: 60–750 m. Rise to shallower depths each evening.

Appearance: Snail-like shell lined with alternating wavy brown and white lines. Circumference to 20 cm.

Diet: Migrate to shallower waters each evening to feed. Benthic scavenger and predator. Prey located visually. Preferentially eat decapod crustaceans, such as crab, also carrion.

Reproduction and Development: Males have a modified arm which functions to transfer a sperm packet. Fertilization occurs much later when the eggs are deposited. Mature at one year.

Mortality/Longevity: Eaten by carnivorous fishes.

Conservation status: Collected for the shell

trade. Consumed in its range by humans. Not on IUCN Red List.

Remarks: Only extant genus of cephalopods with an external shell.

Internally the shell is divided by transverse septae into chambers; only the last chamber is occupied by the animal.

To "swim," the nautilus draws water into its mantle cavity and then expels if forcefully through a siphon, which can be moved to change the animal's direction. Though the nautilus is able to adjust its neutral buoyancy much like a submarine, by adding to or reducing the amount of liquid in its chambers, its water jet provides the propulsion for its often daily migration from the cool depths it prefers in the daytime to the nighttime shallows where it feeds.

Flambuoyant Cuttlefish

Metasepia pfefferi (Sepiidae)

Cuttlefish

Distribution: From Indonesia, the Philippines, Papua New Guinea, to Australia.

Habitat: Shallow, low-energy tropical marine waters (3 to 85 m) with mud, sand, or coral rubble substrate.

Appearance: The mantle and head are covered with flap-like, fleshy protuberances (papillae), and a V-shaped fleshy ridge runs along the underside. Yellow fins flutter along the sides to propel the animal slowly though the water or along the substrate. Max mantle length: 6–8 cm.

Diet: Active diurnal foragers on a variety of foods, especially fish and crustaceans, including "hard-hitting" mantis shrimp. Encircling the mouth are 8 purplish, blade-like arms with rows of suckers used to manipulate prey and 2 flattened, retractable tentacles which can be rapidly extended to catch prey. Use camouflage to stalk their prey; also blow jets of water through the funnel to uncover prey in sand or mud.

Reproduction and Development: After display by the male, copulation occurs face-to-face. The male uses a modified arm to insert his sperm under the female's mantle, where eggs are fertilized then laid, usually in a protected space, such a crevices or even coconut shells, unreachable by predatory fish.

M. pfefferi has never been successfully bred and raised in captivity, until the Steinhart took on the challenge. Steinhart Biologist Rich Ross in 2010 was the first person to successfully breed and hatch *M. pfefferi* in captivity. He was also the first to cultivate the dwarf cuttlefish *Sepia bandensis* a year earlier.

Mortality/Longevity: Life span: c. 1 year.

Remarks: When disturbed, **M. pfefferi** earns its common name by quickly changing from a dark base color to a rippling pattern of black, dark brown, and white, with yellow patches around the mantel, arms and eyes. Arm tips may be bright red. From birth, juvenile **M. pfefferi** are capable of the same camouflage patterns as the adults.

This fellow's flamboyance may also carry a warning message. One researcher recently claimed this species to be the only cuttlefish known to be toxic, asserting that muscle tissue of this species possesses a toxin as deadly as that of its cephalopod relative, the blue-ringed octopus! Aquarists beware, certainly until further substantiation.

Cuttlefish swim by undulations of the fin that passes around the body, and can also move quickly, like other cephalopods, by "jet-propulsion," forcefully expelling water from the body cavity through the funnel.

Other cuttlefish species maintain buoyancy by regulating the gas-to-liquid ratio in a porous, internal structure, made of aragonite ($CaCO_3$) and called a cuttlebone. Without the cuttlebone, the animal, because of the weight of its tissues, would be about 4% denser than sea water and sink. *M. pfefferi* has an extra trick. Its cuttlebone is so small that it cannot maintain buoyancy and regularly sinks to the substrate. Instead of swimming, it uses its tentacles to crawl along the bottom like an octopus!

The cuttlefish maintains buoyancy by regulating the gas-to-liquid ratio in a porous, internal structure, made of aragonite ($CaCO_3$) and called a cuttlebone. Without the cuttlebone, the animal, because of the weight of its tissues, would be about 4% denser than sea water and sink.

All cephalopods, with the exception of nautiluses and a single group of octopods, produce and release sepia ink, a dark pigment used to confuse and escape from predators. Cuttlefish have brown ink (sepia) and octopuses generally produce blank ink. Ink is produces

in sacs located between the gills, mixed with mucus, and spread through the water by a jet of water from the funnel.

Recent studies have shown that cephalopod ink is toxic to some cells, including cancer cells.

Dwarf Cuttlefish

Sepia bandensis (Sepiidae)

Cuttlefish

Distribution: The Indo-Pacific region, including the Philippines, Indonesia, and Papua New Guinea.

Habitat: Shallow coastal waters near or on coral reefs or sandy substrates.

Appearance: Length: 5 cm–10 cm. It has 8 arms with rows of suckers along each and 2 feeding tentacles. The animal moves by the undulation of lateral fins that surround the body.

Diet: Crustaceans and fish. The feeding tentacles shoot out to capture prey with suckers and , along with arms and a parrot-like beak, hold the prize while the cuttlefish radula scrapes off digestible parts. Active diurnally.

Reproduction and Development: They mate at 2–4 months of age, a time when the male changes colors to black and white and displays aggressive behavior to other males. Viable eggs may take up to a month to hatch.

Mortality/Longevity: Life span: 6 mos. to 3 yrs.

Remarks: The cuttlefish isn't a fish at all–it is a cephalopod, closely related to octopuses, squid, and nautiluses.

Cuttlefish have an internal shell within their bodies that they can fill with more or less gas to create neutral buoyancy. Cuttlebone is often collected and used as a calcium supplement, beak sharpener, and all-purpose toy for caged birds.

Like most cephalopods, cuttlefish have 3 hearts. Two hearts pump blood to the gills, and a central heart pumps oxygenated blood to the body.

Masters of camouflage, cuttlefish and most cephalopods can change their colors, shapes and textures in seconds to avoid predators and blend into their surroundings. They have keen vision, but are color blind.

They also produce large amounts of ink, both as a decoy and foul-tasting deterrent. Known as sepia ink, after the genus name of cuttlefish, it was a dye once prized by artists.

The Steinhart Aquarium is the first institution in the U.S. to breed dwarf cuttlefish. To date, (2010) more than 350 have hatched at the Academy, most of which have been sent to other aquaria and research institutions.

Quote from Rich Ross, Academy biologist and cuttlefish breeder extraordinaire: Over time, [cuttlefish] learn to recognize and respond to you, and will often greet you when you walk into the room (or maybe they just know you bring the food). They are smart, beautiful and unusual, and unlike certain other eight-armed cephalopods (think octopus), they don't try to escape from your aquarium!

Giant Pacific Octopus

Enteroctopus dofleini (Octopodidae)

Distribution: Range throughout temperate Pacific waters, from southern California north to Alaska, west to the Aleutian Islands and Japan.

Habitat: Occur in intertidal zones and to depths up to 750 m.

Appearance: Large bulbous "head" (mantle) with 8 tentacles bearing suckers. Very large specimens can have a tentacle span of more than 9 m from tip to tip, and weigh more than 45 kg.

Diet: Mostly crustaceans (shrimps, crabs, scallops,) and mollusks (abalones, clams); fish and other octopuses are also eaten. Shells of prey that are difficult to pull or bite open can be "drilled" in order to gain access to the soft tissue: salivary secretions soften the shell, and a tiny hole is created with the radula (a toothed, hardened "tongue"). The octopus then secretes a toxin that paralyzes the prey and begins to dissolve it. The shell is pulled apart and the soft tissues are consumed.

Reproduction and Development: Males appear to be drawn to the female by following a scent she releases into the currents. The third right arm of the male has a modified tip that is used during mating to transfer large spermatophores (up to 1 m long) to the female, which she accepts from one or more males, and stores for future use. It may take several weeks for the female to find a suitable den for her eggs. She lays the 20,000 to 100,000 eggs, fertilizing each as it is produced. She tends, cleans, and aerates them until they hatch 5–7 months later (rate of development depends

on temperature.) Females do not feed during this time, and die after the eggs hatch. (The male returns to the sea after mating and dies.) The young are about the size of a grain of rice, and spend 4–12 weeks drifting in the plankton, before settling to the bottom for further development. A giant octopus becomes sexually mature in about three years.

Mortality/Longevity: Predators include marine mammals (harbor seals, sea otters, and sperm whales). Also, occasionally are eaten by others of their own kind and are caught commercially. Life span in the wild is 3-5 years.

Conservation Status: Not endangered. However, the octopus is sensitive to water pollution and its populations in some areas may depend on limiting contaminants.

Remarks: The animals are surprisingly intelligent invertebrates. They are able to learn and to perform complex tasks, such as twisting the cap off a jar to reach enclosed food. Captive animals have been known to leave their tank at night to feed in other, nearby tanks, and then return to their home tank before morning.

They are notable for their complex eyes, similar in structure and acuity to the human eye.

The octopus can change color in less than a second. In the skin, specialized cells called chromatophores hold yellow, red, orange, blue or black pigments. When the tiny muscles around the pigment cells contract, the colors show as large spots; when they relax, the colors dissipate. The octopus uses color change as camouflage, but also changes color with shifts in interest and activity, such as during feeding.

When pursued or threatened, the octopus can squirt ink into the water before fleeing, an action that confuses and obscures the vision of predators, helping the animal to escape.

This species is the largest octopus known: the record forweight is 70 kg (153 lbs) and 7 m (23 ft) arm span.

Red Octopus

Octopus rubescens (Octopodidae)

Distribution: Alaska to Baja California.

Habitat: From the intertidal and shallow subtidal as juveniles to 180 m depth as adults.

Appearance: Often red, as its common name implies; however, able to change colors—in the blink of an eye.

Diet: Small crabs (a favorite), hermit crabs, and other crustaceans, mollusks, and an occasional fish. Nocturnal forager.

Reproduction and Development: Mate offshore at depth, then females spawn in the shallow subtidal. Larvae hatch after 6–8 weeks of protection and grooming by the female, who then dies. Juveniles usually live within the protection of kelp holdfasts before moving offshore onto the continental shelf, where they are quite common.

Mortality/Longevity: Life span: about 2 years.

Remarks: See description of giant Pacific octopus for added information about octopuses in general.

Female red octopuses in the Discovery Tide pool may on occasion spawn and be seen grooming and aerating their eggs.

These animals should not be touched! Not only do they have sharp beaks and the inclination to use them, they also secrete venom from salivary glands on the wound, which can take several weeks to heal.

PHYLUM ARTHROPODA

CLASS CHELICERATA

ORDER SCORPIONES

Death Stalker Scorpion

Leiurus quinquestriatus (Buthidae)

Distribution: North Africa and the Middle East.

Habitat: Dry habitats, especially desert areas except on sand dunes. Hides under stones or in small, natural burrows and crevices.

Appearance: About 8 cm long; tan body with slim, small pincers, used for capturing and manipulating prey, and segmented tail with stinger, used for delivering venom. Pincers and stinger tip often dark, even black. Females larger than males.

Diet: Spiders, insects including crickets, flies, moths. Occasionally captured by pincers alone, but usually by venom delivery.

Reproduction and Development: Ovoviviparous; female bears eggs internally for up to a year, about 30 young are born live.

Mortality and Longevity: Lifespan: up to 5 years in the wild.

Remarks: Adaptations of scorpions to arid habitat include waxy outer covering of exoskeleton that reduces desiccation; ability to estivate and/or hibernate; nocturnal habit.

The death stalker is the most toxic scorpion on the planet. Its venom can cause extreme pain, convulsions, paralysis, even death by heart or respiratory failure. Sting is rarely fatal to a healthy adult, but severity of symptoms is weight-dependent; small children are at extreme risk.

Components of venom are being studied for potential use in the treatment of brain tumors and diabetes.

Only the most experienced keepers should care for this aggressive arachnid. Fortunately, antivenom is available.

Scorpions that have small, narrow pincers generally possess more toxic venom than brawnier types, presumably to make up in chemical potency what they lack in physical strength.

Scorpions kill twice as many people as snakes do.

Note this scorpion is in the same family as the species in African Hall's Olive Baboon exhibit.

Desert Hairy Scorpion

Hadrurus arizonensis (Caraboctonidae)

Distribution: Found in Mexico, western Arizona, southern California and Nevada, southwestern Utah.

Habitat: Semi-arid and arid habitats. Dig and live in deep burrows in soil during summer.

Appearance: Black cephalothorax with pale yellow rimmed segments; pale yellow abdomen, pincer-like pedipalps, and legs; pale undersurface; and abundant erect dark brown sensory hairs. Largest of the nine scorpion species in North America. Max. size: 14 cm.

Diet: Other scorpions, insects, spiders, small lizards and snakes. Forages at night for prey and mates.

Reproduction and Development: Like all scorpions, the female gives birth to live young, which remain on the mother's back for 10–15 days. After shedding their first skin, the young scatter to live independently. Young grow slowly, shedding their skin several more times before maturity.

Mortality/Longevity: Predators include owls and bats.

Conservation Status: Important to the area ecology and food chain.

Remarks: Venom in the scorpion's stinger is used to subdue struggling prey and for self defense. The venom is not very potent or painful to humans.

Females are more active in food seeking; males are more active in mate seeking. In both sexes, older scorpions are more active than younger ones.

Like all scorpions, has poor eyesight, excellent hearing, and a fine sense of touch (body hairs detect air and ground vibrations).

Also like all scorpions, they fluoresce under ultraviolet light, a characteristic that allows scientists (and well-equipped backpackers) to detect them in the night and perhaps signals scorpions to avoid damaging UV light.

ORDER ARANEAE (TRUE SPIDERS)

Cobalt Blue Tarantula

Haplopelma lividum (Theraphosidae)

Distribution: Southeast Asia.

Habitat: Tropical forests. *H. lividum* lives in deep burrows. Reclusive; seldom seen outside its burrow during the day, becoming somewhat more active at night.

Appearance: Iridescent blue legs, light brown carapace. Abdomen dark brown, often with horizontal stripes.

Diet: Insects. Silk is laid down in and around the burrow, and the spider darts out to capture insects that disturb the silk.

Remarks: Notable for its aggressiveness. It is not recommended for hobbyists unless they are experienced and well informed. Like Asian tarantulas generally, *H. lividum* lacks the urticating hairs of North and South American species; instead it relies on biting for defense.

Brazilian Salmon Pink Bird Eater

Lasiodora parahybana (Theraphosidae)

Distribution: Throughout eastern Brazil.

Habitat: Terrestrial; floor of tropical rainforests.

Appearance: A large-bodied tarantula with abdomen and legs covered with sensitive, long,

and partially pink or salmon-colored hairs.. Max. size: body, 9-10 cm; leg span, 20-25 cm.

Diet: Eat large crawling insects and other invertebrates, small rodents, lizards, & frogs. Regardless of its name, the spider is rarely seen eating birds. However, it does occasionally attack the newly hatched chicks of ground-dwelling birds. Prey is subdued by venom injected by chelicerae. Digestive juices are injected that liquefy the kill, which is then sucked in by the mouthparts.

Reproduction and Development: This species, like most tarantulas, is solitary and comes in contact with others of its species only during mating. Once sexually mature, the male spins a small area of silk onto which he deposits his sperm. The sperm is then absorbed into the pedipalps, which during mating are inserted into the reproductive organ of the female, transferring sperm which can remain viable within the female. The female lays up to 2000 eggs in a thick, silken sac, approximately 3 months after breeding. She will guard this sac fiercely, and incubation lasts approximately 3 weeks, after which white spiderlings are born. Young are voracious feeders. As a result the babies grow very quickly, up to 15 cm in the first year.

Mortality/Longevity: Tarantulas have few enemies except the tarantula hawk wasps. Members of this wasp family use their sting to paralyze species specific tarantualas. The wasp lays an egg on the tarantula's abdomen and then seals the spider in its burrow. The wasp larva hatches and feeds on the immobile and doomed tarantula. Males usually die shortly after maturity and mating, usually Females can live up to 15 years in the wild, perhaps significantly longer. Typically thrive in captivity 4–8 years.

Conservation Status: Still quite common, though destruction of the rainforests reduces natural habitat.

Remarks: Like most tarantulas and some other spiders, if this spider loses one of its legs, it can regrow the lost appendage, which begins as a small stump & then grows more complete with each molting.

While not highly aggressive and bites are not fatal to humans, this big bruiser can inflict a serious wound which one researcher defined as "capable of medically significant mechanical damage"! Translation: handle with care!

Will become aggressive if threatened. Though body hairs are most often used to detect predators and prey by picking up air movements around the spider, they are also used as defensive weapons. If pursued by a potential foe, the spider rubs its legs against its abdomen, throwing tiny, barbed hairs that become imbedded in the attacker. The barbs can cause significant irritation, especially if lodged in the eyes or nasal passages.

Possible origin of the fanciful name "Bird-Eating Spider": In 1705, a Swiss naturalist and painter, Madame Maria Sibylla Merian, painted a Dutch Guianan bird-eating spider with a size ridiculed as a flight of female fancy until 1863 when an English naturalist observed a spider of similar features and size in the Amazon forest.

Black Widow Spider

Latrodectus mactans (Theridiidae)

Distribution: In the U.S. ranges north to New England, south to Florida, Texas, Oklahoma; west to California, and throughout the southwest deserts. Also found in Canada, Mexico, the West Indies, and South America.

Habitat: Favors retreats close to the ground, especially dark, sheltered spots, such as under stones, in woodpiles, crevices, barns, and outbuildings. Usually not found indoors.

Appearance: Female is glossy, coal-black color with long, slender legs and round abdomen; her underside usually carries a characteristic red hourglass mark. Larger than the browner male, the female may grow to about 3.8 cm, counting legspan.

Diet: Carnivorous, mostly on insects, but also on other small invertebrates. When prey becomes ensnared in the web, black widow wraps it in silken threads and injects venom. When movement ceases, the spider releases digestive enzymes that liquefy the flesh of prey.

Reproduction and Development: Female produces eggs sacs, which she guards until spiderlings hatch and are wind dispersed. A single mating provides her with a lifetime sperm supply. The widespread story that female's eat the male after mating is actually an infrequent occurrence.

Mortality/Longevity: Probably lives, like most spiders, about one year. Preyed upon by mud-dauber wasps.

Remarks: Bright markings serve as warning to predators. While eating a black widow may not kill a bird or other small predator, the digestive discomfort warns the attacker that this spider is to be avoided. Males are less venomous and also less brightly marked.

Black widow venom is highly potent (15 times that of rattlesnakes and reportedly more potent than that of cobras or coral snakes); however, because the spider is not large, the chelicerae cannot inject venom to depth or in quantity.

It is rare for bites to kill humans, though young children or the elderly are likely to have severe reactions. Most victims recover completely in 2–5 days.

Golden Orb Weaving Spider

Nephila sp. (Nephilidae)
Golden Orb Weavers

Distribution: Southeast U.S south through Argentina and Peru. *Nephilia* spp. are found worldwide in the tropics and subtropics.

Habitat: Areas of high humidity and relatively open space; forest areas along trails and clearing edges.

Appearance: Highly sexually dimorphic. Females, which grow up to 8 cm, are 5–6 times larger than males. Adults are mostly yellow with elongated abdomen and long, hairy legs.

Diet: Small flying insects: beetles, flies, moths, etc. After prey is entangled in the web, the spider incapacitates it by biting and then encases it in silk.

Reproduction: Mating is a tricky proposition for orb weaving males. For successful reproduction, males must successfully stimulate females in order to prevent being a meal for their would-be mate, though this unfortunate ending is relatively rare with this species.

Mortality/Longevity: Life span: a single season (1 year).

Remarks: Orb weavers construct webs for defense and capture of prey.

The silk of the web usually has a golden color which is visible to the naked eye and is the source of the common name.

The impressive web of most orb weavers is a semi-permanent structure, repaired and rebuilt daily as necessary.

This spider lives in hot places. The long cylindrical abdomen of the spider may be angled towards the sun to reduce the amount of exposed body surface and thus prevent overheating. The reflective silvery surface of much of the body serves the same purpose.

See *Nephila madagascariensis* for more information on *Nephilia* spp.

Madagascar Golden Orb Spider

*Nephila madagascariensis (*Nephilidae)
Golden Orb Weavers

Distribution: Various species of orb weaving spiders are widely distributed. They exist in the southern United States, Central and South America, Southeast Asia, and the South Pacific. *Nephila madagascariensis* is found on the island of Madagascar and certain parts of Southern Africa.

Appearance: Females are much larger than mature males, reaching 10–14 cm length when full grown. Males are about one-sixth this size. In females, the dorsal side of the abdomen has bright yellow markings surrounded by a light gray border. The rest of the body and legs are black with patches of brown.

Diet: Eat insects that get caught in their webs, primarily flying insects. They kill their prey with a venomous bite. While painful, a bite from this spider would not seriously hurt humans.

Reproduction and Development: Mating occurs at the center of the web where the female lives. The males stays in a corner of the web, and approaches the female when she is eating or is in the process of molting her exoskeleton, and mating occurs. In about 30 days the eggs hatch. The nymph spiderlings, each about as big as a pinhead remain in the egg case for 5– 6 days until their first molt. Then they emerge and stay in a tight cluster until their second molt, about 24–30 days later. After this molt, they begin to disperse.

Mortality/Longevity: Females usually live about a year, and males about 6 mos.

Remarks: Golden orb spiders weave large, strong webs out of golden colored silk. The webs can be as big as 2 m across. The silk strands are reputed to be five times stronger than steel and three times more elastic than Kevlar.

Spiders can produce up to seven types of silk, each optimized for a certain task. These can include silk for drag lines, structural silk,

cementing silk, tough outer silk for the egg case, soft inner silk in the egg case, and others.

They weave their threads from a liquid, stored as a gel in the spinning gland. The gel is a mixture of water-soluble proteins that turns into a solid fiber when pulled through structures in the spinning gland, called spinnerets. Scientist are trying to mimic the process, using genetically engineered bacteria to produce the protein gel. They have invented artificial "spinnerets" where the gel is mixed with salt water and forced through tiny channels. While they have succeeded in getting silk, it was not high quality.

Fishing Spider

Dolomedes okefinokensis (Pisauridae)

Distribution: Swamps in the southeast United States, particularly southern Georgia and Florida.

Habitat: *Dolomedes* spiders live in semi-aquatic areas.

Appearance: In general, members of the genus *Dolomedes* are large (2.5–7.5 cm) and hairy; most species are brown with a striking pale stripe on each side. *D. okefinokensis* exhibit female gigantism and male dwarfism, with the male being less than half the size of the female.

Diet: Fishing spiders usually eat aquatic insects, but they have also been known to eat small fish and even small frogs. They often hunt nocturnally, to avoid predators. Like most spiders they inject venom to kill and digest the prey.

Reproduction and Development: Females may eat the males after breeding. This may help the female have adequate nutrition to produce healthy young.

Mortality/Longevity: Main predators are birds and lizards. Dragonflies may also eat young spiders. Probably live for one season.

Remarks: *Dolomedes* spiders are covered in short hydrophobic hairs. This aquatic adaptation gives them many advantages. They can use surface tension to stand or run on water. The air trapped among the hairs forms a thin film over their bodies when they descend beneath the water. They breathe with book lungs that open into the air film, allowing them to breath under water. The trapped air also makes them buoyant, and when they release their hold on rocks or plant stems they pop up to the surface.

While hunting they hold on to the shore with their back legs and rest their bodies on the water surface. Fishing spiders have vibration-detecting organs on their front legs and feet that help them identify not only the source of the vibration, but also the distance and direction to the source. They feel vibrations carried in the water, just as other spiders feel vibrations transmitted through their webs.

SUBPHYLUM CRUSTACEA

CLASS MALACOSTRACA

ORDER STOMATOPODA (MANTIS SHRIMPS)

Peacock Mantis Shrimp

Odontodactylus scyllarus (Odontodactylidae)

Distribution: Indo-Pacific.

Habitat: Warm waters of bays, lagoons, and reefs in sand or rubble areas where they build U-shaped burrows.

Appearance: Beautifully colored in peacock colors of greens, blues, and reds. Has a green body, blue head, green antennal scales, red limbs. The body is elongated with a long, flattened, blue tail and ranges in size from 3–18 cm. Highly noticeable is the pair of clubbed-shaped, praying mantis-like claws.

Diet: Feeds on other shrimp, worms, snails, crabs, mollusks. Lies in wait for prey in front of burrow, then swims out and quickly crushes prey with a strong, powerful smash. The claw moves through the water so quickly it generates cavitation bubbles, which explode with a second powerful burst. The speed with which the claw moves through the water generates a force 100 times the shrimp's body weight, and is so fast it can only be caught and measured by expensive, high-speed cameras.

Reproduction and Development: The male deposits his sperm in a special pouch on the female's body and she releases her eggs and sticks them together in a mass which she carries by her front legs. The embryos hatch in about six weeks.

Remarks: Large peacock mantis shrimp generate forces powerful enough to crush the shell of a large conch, and have been known in captivity to break the glass of their tanks!

The amazingly complex eyes of mantis shrimp detect 12 base colors (compared to our 3). They also can discern ultraviolet, infrared frequencies, and the polarization of light!

Mantis shrimps are popular ingredients in Japanese and Cantonese dishes.

Divers note that they are very active and curious.

It should be no surprise that, in most aquaria, this fellow lives alone!

ORDER DECAPODA (CRABS, SHRIMPS, LOBSTERS, ETC.)

Pistol Shrimp

Alpheus sp. (Alpheidae)

Distribution: Maldive Islands to Great Barrier Reef, Australia.

Habitat: Sand, 5-40 m.

Appearance: Length to 3 cm. Like all pistol or snapping shrimp of the family Alpheidae, have asymmetrical claws, with the larger capable of producing a remarkably loud snapping sound.

Diet: Fairly omnivorous; algal and animal material.

Reproduction and Development: Like all shrimp, sexes are separate. After mating the female carries the eggs beneath the abdomen on modified swimmerets.

Remarks: Many pistol species in this genus live in association with a burrow-guarding goby species, as in this tank. The shrimp maintains contact with the goby with its antennae, the goby alerts the poor-sighted shrimp to danger, and both shelter in their shared burrow.

Shrimp use their snap to ward off trespassers and to stun prey, such as small crabs. Claws close with incredible speed, generating a powerful water stream that travels up to 100 km/hour creating a low-pressure bubble in its wake. As the pressures equilibrate, the bubble bursts with a sonic bang.

One source noted that when many pistol shrimp are "shooting" at the same time, the sound can be so loud that sonar used to seek submarines is useless.

If a snapping shrimp loses its over-sized claw, the small claw grows into the new snapping claw while the missing limb regenerates into a small claw.

Wood Shrimp

Atyopsis moluccensis (Atyidae)

Basket Shrimps

Distribution: Southeast Asia.

Habitat: Freshwater streams in areas with driftwood, caves and vegetation for hiding places.

Appearance: Max. size: 12 cm. Most individuals are brownish with a lighter strip down the back, though color is variable with surroundings and mood, Males have larger and thicker forelegs than females. The species lacks pincers; chelae have evolved instead into fan-like appendages tipped with tufts of long bristles used for gathering small food particles.

Diet: Suspension feeder; uses specialized appendages to filter food and then wipes appendages across mouth.

Reproduction: Difficult to breed in captivity.

Remarks: Because of it large size, the wood shrimp is rarely a prey item for small fish, and so an attractive and intriguing addition to our tank of Borneo freshwater fishes

Black and Red Bee Shrimp

Caridina cf. Cantonensis (Atyidae)

Distribution: Southern China, still found in the wild in South Eastern Asia. It is a popular choice for aquarium hobbyists.

Habitat: A fresh water fish, it prefers soft acidic water.

Appearance: The bee shrimp has bands of black and white; the red bee shrimp has red and white. Some have been selectively bred over time to increase the amount and intensity of the white. Adult size: 1 in to 1.2 in.

Diet: Omnivore. Algae eaters by nature, the bee shrimp will eat naturally occurring algae in the home aquarium and are happy with supplements.

Reproduction: When the female's ovaries are developed, she will shed her skin and pheromones to the water. The sexually mature males will overtake her, flipping around and furiously whamming her tail. The winner

will copulate the female by sliding along side, attaching a slip-covered sperm package (spermatophore) on to her genital opening located right between her striding legs. The female will find a safe place to hide and lay the eggs, a process that dissolves the slipcover and thus fertilizes the eggs. Gestation is usually 3-4 weeks, and the newly hatched shrimp then fend for themselves.

Mortality/Longevity: The bee shrimp take a little bit longer to mature and longer to hatch than many other dwarf shrimp. The shrimp may live up to 2 years.

Copper is toxic to the bee shrimp (and to all dwarf shrimp).

Conservation Status: Not at risk; bred successfully around the world for the aquarium trade.

Remarks: Bee shrimp are good overall cleaners for tanks, always crawling in search of food and algae. They are non-aggressive toward other fish.

California Bay Shrimp

Crangon franciscorum (Crangonidae)

Distribution: From southeastern Alaska to San Diego. A common species in San Francisco Bay and other Pacific Coast estuaries.

Habitat:. Sand or mud substrate. Euryhaline (able to tolerate varying levels of salinity).

Appearance: The largest of common SF Bay shrimp species: females to 4.8 cm, males to 3.7 cm.

Diet: Especially mysid shrimp; also amphipods, bivalves, foraminifera, isopods, copepods, plant material. Their turnover of bottom sediments as they search for food may improve nutrient recycling.

Reproduction and Development: Males and females separate; females oviparous, can store sperm; move to more saline habitat to spawn; young seek low salinity nursery areas.

Mortality/Longevity: Males live about a year, females to two years.

Remarks: Species abundance correlates to increased levels freshwater outflow; numbers are relatively low during drought years.

Once the basis of a commercial fishery in SF Bay. Today is fished primarily for bait, with some human consumption.

Anemone Shrimp

Periclimenes venustus (Palaemonidae)

Distribution: Indo-Pacific; including Australia.

Habitat: Commonly associate with anemones and certain corals.

Appearance: About 2.5 cm long. Light purple body with white spots; well camouflaged on frogspawn coral *(Euphyllia* spp.*)* a common host.

Diet: These cleaners sway and wave their antennae, using their motion and bright colors to attract fishes in order to feed on their dead tissue and parasites.

Mortality/Longevity: Life span: about 2 yrs.

Remarks: Like only a few other animals, able to live in association with anemones and corals without being stung**.**

Humpback Cleaner Shrimp

Lysmata amboinensis (Hippolytidae)

Distribution: Red Sea to Australia; Indonesia, Society Islands.

Habitat: Active day and night at cleaning stations on coral and rocky reefs, 8–25 m. Reside in pairs or groups (to 100 individuals) in caves and crevices.

Appearance: Length to 6 cm. Dorsal redline on tan body. Long white antennae.

Diet: Glean parasites and infected skin from large, stationary reef fishes such as morays, triggerfishes and groupers.

Reproduction and Development: (See *L. californica*)

Remarks: Cleaner shrimp advertise their services by their bright coloration and by waving their very long antennae, which contrast with the dark recess of their station.

Jacques, a character in *Finding Nemo*, is a humpback cleaner shrimp.

In aquaria, cleaner shrimp are valued because they clean not only the fish, but the tank as well.

Red Rock Shrimp

Lysmata californica (Alpheidae)

Distribution: Eastern Pacific, from Santa Barbara to Baja California.

Habitat: Found in shallow waters among rocky crevices

Appearance: Max length: 7.5 cm. Conspicuously colered with longitudinal broken stripes over a red transparent body.

Diet: Scavengers on scrapes of decaying tissue or, when available, the carcasses of dead fish and invertebrates. Opportunistic "cleaner" shrimp.

Reproduction and Development: Studied members of the genus L*ysmata*, including *L. californica*, have been recently shown to be protandric simultaneous hermaphrodites, a long name that describes a most unusual reproductive system. Juveniles first mature and reproduce as males (thus the "protandric"), but later attain the female sexual function as well (thus "hermaphoditic"). Put any two *Lysmata* shrimp in a tank and don't worry if you have a sexual pair: you do! Each is able to inseminate the other, and each is able to lay and brood eggs (thus "simultaneous"). No self-fertilization has been observed. Whatever works!

Remarks: Red rock shrimp often share crevices with and act as cleaners to moray eels. According to one source: "They are also known to perform cleaning activities on divers' hands when placed in their vicinity, paying particular attention to areas around fingernails or scratches on the skin."

A small commercial fishery exists for these shrimp as they are considered choice bait for recreational anglers of many fish species, such as opaleye, rubberlip surfperch, and pile perch.

The species may be moving northward, perhaps due to climate change, as they have been found seasonally for more than 20 years in the open ocean filter housing of the Monterey Bay Aquarium.

Fire Shrimp

Lysmata debelius (Hippolytidae)

Distribution: Indo-Pacific.

Habitat: Coral reefs, in or near overhangs or caves.

Appearance: Carapace bright red with white spots. Lower legs and antennae white. Max. size: 5 cm.

Diet: In the wild, the fire shrimp is primarily a cleaner, setting up cleaning stations on the reef. In an aquarium setting, they often feed on algae or scavenge and forego their cleaner role.

Reproduction and Development: Hermaphroditic. Any two shrimp make a pair! (See *L. californica*)

Mortality/Longevity: Life span: about 4 years in captivity.

Remarks: Usually live in pairs, aggressively defending their territory.

Commensal Shrimp aka Sexy Shrimp

Thor amboinensis (Hippolytidae)

Distribution: Common in tropical seas worldwide.

Habitat: Coral reefs; in association with giant anemones.

Appearance: Length to 2 cm. This distinctively colored brown-orange prawn with large white spots is a stout shrimp with short legs and claws. Eyes are white.

Diet: Feeds on scraps missed by its commensal anemone.

Remarks: Not observed to be a cleaner shrimp. Some *Thor* anemone shrimp species may gain protection by mimicking cleaner shrimps, which many fishes avoid eating.

The distinctive vertical position and movement of the abdomen earn this shrimp its common name of "sexy."

Harlequin Shrimp

Hymenocera picta (Gnathophyllidae)

Distribution: Along East Africa, the Red Sea, to Indonesia, south to northern Australia and as far east as the Galapagos.

Habitat: Hard rocky or coral substrates, with many hiding places.

Appearance: Pinkish white body color with splashes of purple-edged pink spots. Stalked eyes and antennae flattened and leaf-shaped. Max.size: c. 5 cm.

Diet: This shrimp feeds solely on the tube feet of sea stars. Nocturnal feeder; uses large claws to pry sea stars off coral reefs.

Reproduction and Development: Male and female pairs defend their territory. Females produce ~1,000 eggs at a time that hatch in about 18 days. Larvae planktonic.

Remarks: Have been bred successfully in captivity.

Advice to aquarists: given known feeding habits, don't keep these aggressive fellows close to prized sea stars.

On the up side, *H. picta* is known to feed on crown-of-thorns sea stars, so perhaps it should be considered a reef preservationist!

Banded Coral Shrimp

Stenopus hispidus (Stenopodidae)

Distribution: Worldwide tropical distribution.

Habitat: Coral reefs.

Appearance: Strikingly colorful with contrasting red and white bands on body and large pincers. Short spines cover the body and are used for defense. Males smaller, more slender than females.

Diet: A cleaner shrimp, it removes dead tissue, algae and parasites from fish. Olfactory sensors in the tentacles and pincers make it adept at finding food.

Mortality/Longevity: Life span in captivity: 2–2.5 years.

Remarks: Like most cleaner shrimp species on coral reefs, they congregate at cleaning stations, waving their extremely long antennae to advertise their services.

These "picky" eaters have been known to clean under the fingernails of hands!

Look for molts in their tanks; all cleaner shrimp molt every 3–8 weeks.

Candy Shrimp

Rhynchocinetes durbanensis (Rhynchocinetidae)

Distribution: Indo-Pacific.

Habitat: Lives deep in cracks and crevices of coral reefs, often in large numbers.

Appearance: Transparent, with bold red and white stripes. Long rostrum bears spines along both the upper and lower edges. Males tend to have larger claws than females. Max. size: c. 5 cm.

Diet: Omnivore/scavenger. Mostly nocturnal.

Mortality/Longevity: Life span: up to 4 years.

Remarks: This species is not a cleaner shrimp.

Also called the "hinge-beak shrimp" as the rostrum can be moved up and down independent of the head. With these long, flexible beaks, they can reach food not available to others.

Blue Crab

Callinectes sapidus (Portunidae)

Swimming Crabs

Distribution: North American coast, from Nova Scotia south to Uruguay. Introduced elsewhere.

Habitat: They live in brackish coastal lagoons and estuaries, muddy shores, bays with low salinities, and occasionally in freshwater near estuaries.

Appearance: The blue crab has sapphire-tinted claws and a mottled brownish shell; females have red highlights on their pincer tips. Appendages include a pair pincers of large/unequal size, three pairs pointed walking legs. and the fifth pair flattened for swimming. The carapace (shell) can be up to 10 cm long and 25 cm wide, and the crab may weigh up to 1 kg. Like crabs in general, males and females are differentiated by their abdomens—long and narrow (male), wide and rounded (female).

Diet: Primarily molluscs, crustaceans and fish, but will feed on almost anything, including plants, carrion and smaller blue crabs.

Reproduction and Development: The female mates only once after her final molt. She is grasped by a pair of male appendages and carried right side up under the crab, mating for many hours. Able to store sperm for up to a year, the female may spawn several times after this single mating. The larvae hatch after 14-17 days, remain in the plankton, undergoing complex molts for many weeks, and eventually settle as minute crabs.

Mortality/Longevity: Life span in the wild is 1–3 years. Causes of mortality are predation, disease and exploitation.

Conservation Status: Blue crabs are sensitive to environmental changes, and play a key role in managing their prey populations. Constant over-harvesting has negatively affected their ecosystems.

Remarks: Blue crabs are the Maryland State crustacean, and are very heavily harvested.

Blue crabs have recently been found in San Francisco Bay, where they may be a threat to the native crab population. They have a prickly disposition and are quick to use their sharp front pincers.

Dungeness Crab

Cancer magister (Cancridae)

Distribution: Alaska, south to Pismo Beach or perhaps Santa Barbara, California.

Habitat: Adults commonly on deep sandy substrates, subtidal to 230 m; not abundant below 90 m. Occasionally on soft bottoms; remain buried in mud with only eyes and antennae exposed. Juveniles in sandy bays.

Appearance: Carapace to 23 cm across in males, to 16.5 cm in females.

Diet: Adults are rather non-discriminating nocturnal carnivores. Diminutive crustaceans are favored prey items. Small bivalves are also consumed; shells are crushed or opened by chipping away the margins with their powerful claws. Also consume worms and fishes as well as fresh carrion.

Reproduction and Development: Mating occurs from April to September in British Columbia and perhaps earlier in California. Females able to retain viable sperm for up to several months; gravid mostly during November to February and spawn between September and December. Clutch from 700 thousand to 2.5 million eggs. Hatching begins during December, peaking during March. Molting of the adults follows reproduction.

Mortality/Longevity: Larval stages are eaten in enormous numbers by herring, pilchard and salmon. Crabs live to eight years or possibly longer.

Remarks: Largest edible crab on the North American west coast. Accounts for 99% of all crab species taken commercially in California.

Red Rock Crab

Cancer productus (Cancridae)

Distribution: Alaska to Baja California.

Habitat: Rocky areas of bays and estuaries; found on gravel, rock, and sand; often buries itself in sandy substrate.

Appearance: Carapace usually a reddish color in adults, juveniles highly variable, often with stripes. Large claws with black tips. A large crab, up to 18 cm across the carapace.

Diet: Voracious hunter of live and dead organic matter. Most active at night. Uses powerful claws to open clams, mussels, snails, barnacles, as well as to catch smaller crabs and hold dead fish.

Reproduction and Development: Mating occurs most often in summer after female has molted. Males will often guard a molting female until her exoskeleton hardens. Female may carry up to ½ million eggs on her pleopods (swimming appendages).

Mortality/Longevity: Preyed upon by fish and seabirds, such as gulls.

Remarks: Large and good eating, but not plentiful enough for commercial catch.

Nasty fighters; known to pinch painfully through neoprene gloves of curious SCUBA divers.

Green Shore Crab

Hemigrapsus oregonensis (Grapsidae)

Distribution: Alaska to Baja California. The common shore crab of San Francisco Bay.

Habitat: Open mud flats, algal mats, eelgrass beds in bays, estuaries, and on open beaches.

Appearance: Many color variations from grayish green to white, often mottled; carapace up to 5 cm.

Diet: Feeds mainly on diatoms and green algae, but will scavenge and take meat if available. Feeds primarily at night.

Reproduction and Development: Females brood up to 4,500 eggs per mating. Larvae spend about 5 weeks in the plankton before metamorphosis and settling. Females may mate twice a year.

Mortality/Longevity: Preyed upon by various shorebirds. These crabs are good diggers, and can bury themselves rapidly in sand to escape predators.

Conservation Status: While our native green shore crab is still plentiful, their population may be seriously compromised by the aggressive European green crab (*Carcinus maenas*), which feeds on the smaller *H. oregonensis* and may displace it from its favored habitats.

Remarks: This small crab tolerates varying salinities and temperatures well, and so is common in estuaries where salt and fresh waters mix.

Purple Shore Crab

Hemigrapsus nudus (Grapsidae)

Distribution: Alaska to Baja California.

Habitat: Rocky shore, upper to low intertidal under stones and among seaweeds. Less common along clay banks in sloughs and estuaries.

Appearance: Carapace to 5.5 cm wide in males, 3.5 cm in females; smooth and convex anteriorly, flat posteriorly. Usually colored purple, occasionally yellow-green or reddish brown.

Diet: Diatoms and other algae. Also scavenge animal material.

Reproduction and Development: In Central California breeding occurs from November

to April. Fertile females ready to molt emit a pheromone, which attracts males. Mating occurs after the female molts, while she is still soft-shelled. Size of brood correlates with the size of the female, from 441 eggs in a female with a 1.2 cm carapace width, to more than 36,400 in a female 3.4 cm wide. One brood per year is typical, two rarely. Hatched larvae enter the plankton and metamorphose through several stages before the first juvenile crab instar.

Mortality/Longevity: Preyed upon by shorebirds and fishes.

Striped Shore Crab aka **Lined Shore Crab**
Pachygrapsus crassipes (Graspidae)

Distribution: Oregon to Baja California, also the Gulf of California; introduced to Japan and Korean coast in the late 1800s.

Habitat: Intertidal zone in crevices, tide pools, mussel beds; or along muddy shores of bays and estuaries. Semi-terrestrial, living on land at least half the time, but returning regularly to water to moisten gills.

Appearance: Square dark body with green cross stripes.

Diet: Feeds on films of algae and diatoms, scraped off with claws. Also scavenges and takes live limpets, snails, crabs, and insects. Most active at night.

Reproduction and Development: Reach full size in about 3 years, molting some 20 times before maturity. Female broods about 50,000 eggs under her abdomen during each breeding cycle.

Mortality/Longevity: Eaten by sea gulls, rats, raccoons, and humans.

Remarks: These crabs can spend up to 3 days out of water, depending on the water stored in gill chambers.

Their eclectic and voracious feeding habits make them the clean-up crew of the high intertidal.

Masking Crab aka **Decorator Crab**
Loxorhynchus crispatus (Majidae)

Distribution:: Northern California south to Baja California.

Habitat: Common on pilings, kelp beds, and subtidal rocks to 183 m depth.

Appearance: A large crab with carapace to 9 cm in males, 7 cm in females. Often heavily decorated, and during the day, seldom noticed until it moves.

Diet: Algae, sponges, small crustaceans, bryozoans.

Mortality/Longevity: An important food source for several fishes, including croakers, some rockfishes, and cabezon.

Remarks: Crabs in this family are known as decorator crabs for their habit of attaching marine algae or invertebrates to their carapace, which has tiny hooks (setae) that hold their "riders" securely. Different species tend to choose different organisms as decorations.

Decorator crabs take good care of their living symbionts. When the crabs molt, especially when they are small and still vulnerable to predation, they remove the "decorations" from their old shell and apply them to the new!

The size of decorator crabs varies significantly. One study suggests this differential reduces competition in the wild for crevice refuges in rocky habitats.

Decorator crab species also seem to partition food resources, with some specializing on species of kelp and others being more general feeders on both plants and a variety of animals.

They are often very destructive in our displays. They pick and tear at anything they can. That's why you don't see very many in the exhibits.

Graceful Decorator Crab
Oregonia gracilis (Majidae)

Distribution: Bering Sea to Monterey, California; Japan.

Habitat: Intertidal to about 425 m. Often on wharf piles or in eelgrass beds. In intertidal areas, remains below water surface.

Appearance: Heart-shaped carapace with long rostrum. The only decorator (or masking) crab with a long, hooked spine behind the eye. Long, thin, spider-like legs and pincers. Like many of its family, is a camouflage artist, usually liberally decorated with algae, sponges, bryozoans and/or hydroids. Carapace up to 5 cm.

Diet: Brown algae; also, known to eat carrion.

Reproduction and Development: Usually spawn between May and August during spring and summer plankton blooms.

Mortality/Longevity: Pacific halibut is a known predator; probably other fishes, cephalopods, and sea otters as well. Lives up to several years.

Remarks: Masking or decorator crabs typically add camouflaging items to their bodies by attaching them to hook-like spines on the carapace and legs. This strategy may conceal the crabs from predators, prey, or both.

Northern Kelp Crab

Pugettia producta (Majidae)

Distribution: Alaska to Baja California.

Habitat: Rocky intertidal in kelp beds and tide pools with abundant surfgrass or algae. The crab uses the vegetation as protection from sun and predators. Subtidal to 70 m.

Appearance: Mostly dark brown to green. Color varies with diet depending on the type of algae consumed, providing a natural camouflage. Like other members of its family, noted for its unique, elongated carapace with extended rostrum and four pairs of relatively long, slender walking legs. Because of these features, the family common name is "spider crabs."

Diet: Mainly a nocturnal vegetarian feeding on bull kelp, sea lettuce, rockweed and other kelp. Occasionally will take barnacles, mussels, hydroids, and bryozoans in winter when vegetation is scarce.

Reproduction and Development: Females usually mate June to July, though can mate year round. Fertilized eggs develop for several months underneath the female's abdomen.

Mortality/Longevity: Preyed upon by sculpins, gulls, cabezon, and sea otters among others.

Remarks: Most crabs in this family are called masking crabs; they attach fragments of shells and algae to their carapace for camouflage. *P. producta*, a large active crab, maintains a clean surface, perhaps for ease of movement.

P. producta is a feisty animal; long legs are dextrous, and claws can pinch hard.

Orange Fiddler Crab

Uca vocans (Ocypodidae)

Distribution: Indo-Western Pacific: Madagascar, South Africa to Thailand, Indonesia, Malaysia, Philippines.

Habitat: Adults are semi-terrestrial, like all fiddler crabs. Usually in or near mangrove sandbanks. Prefer slightly sandier substrates to mudbanks, burrows located in the intertidal zone of both substrates.

Appearance: Carapace width to 2.5 cm. Strong sexual dimorphism; males have one of their chelae very greatly enlarged (the "fiddle"), females dull colored with chelae equal and small.

Diet: Organic matter in the sand.

Reproduction and Development: Males gain the attention of potential mates by waving their enormous chela in a semaphore manner; each species of *Uca* has a distinctive huge claw movement pattern. The male also attracts a female with acoustic signals by rapping the propodus (elbow) of his claw against the substrate or by rapid flexion of the walking legs. The number of pulses (raps) in a series, as well as the interval between every series, is characteristic to each *Uca* species. Females detect these acoustical signals in special organs in their legs.

Remarks: When disturbed, quickly retreat into a burrow, which may not be their own, or dig a new one.

Males use their huge claw to defend their burrow turf against other males. Male-to-male combat is highly ritualized. The huge chela is held like a shield. Combat involves variations of pushing and extension.

Common Hermit Crab

Dardanus pedunculatus (Diogenidae)

Distribution: Indo-Pacific.

Habitat: Coral, rock or sand; depth to 40 m. Likely the most common species of hermit crab in the locations in which it occurs.

Appearance: To 10 cm. Spiny chelipeds, light-colored bristles. Candy-cane white and red-striped eyestalks, green eyes. Abdomen protected by a recycled mollusk shell.

Diet: Algae, scavenger.

Remarks: Adults locate a prospective empty home with their eyes and inspect it by inserting one of their chelae into its interior. No real estate agents are employed. If the shell seems like a good fit on their "test drive," they walk away with their find. On the other hand, if the fit, weight, or movability doesn't suit, the crab returns to its old, crowded shell with no qualms about searching for other choices.

The mollusk shells selected as homes for this otherwise naked crustacean are typically coated with diminutive sea anemones (*Calliactis* spp.). This symbiotic pairing provides protection and camouflage for the hermit, and gives the hitchhiking anemones food shared with the crab. When disturbed, the anemones aboard for the free ride expel acontia (lengthy stinging cells).

Hermit crabs have been observed transferring their hitchhikers to a new shell when they outgrow their home!

Naked or Pacific Mole Crab

Emerita analoga (Hippidae)

Distribution: Pacific coast from Alaska to Baja California and from Ecuador to Argentina.

Habitat: The swash zone of the sandy intertidal beach, which ranges from the lowest to highest reaches of the waves at any given time. The swash zone changes with the tides, and so does the location of the mole crabs

Appearance: Gray or sand-colored crab that lacks claws or spines. Females are larger than males. Swims, crawls, and burrows, always moving backwards, using its five pairs of legs. Hairs on appendages aid in rapid movement through the sand. First pair of antennae reach above the sand for respiration, and eyes with long stalks often extend above the sand as well.

Diet: Small organisms, mostly diatoms. When the sand is covered by a wave, the second pair of antennae are extended above the sand to collect these tiny organisms, which are brought toward the mouth and scraped off. The movement is quick; a mole crab can make several passes for food in one receding wave.

Reproduction and Development: Females produce about one clutch of eggs per month, which she carries, like many crab species, attached on her abdomen beneath the telson until they hatch. Planktonic larvae metamorphose through multiple stage, often traveling far offshore until some successfully settle onto beaches.

Mortality/Longevity: A major food source for shorebirds and some fish species of the surf zone, such as barred surfperch. Also eaten by sea otters.

Remarks: Mole crabs are found on the beach in large numbers from spring to fall. In winter, storms carry them to offshore sandbars.

Used as bait by shore fishermen.

Mole crabs are collected to indicate levels of DDT and neurotoxins produced seasonally by diatoms, substances that are toxic to birds, otters, and fish that eat them.

Hermit Crab

Pagurus spp. (Paguridae)

Distribution: Some species in this genus occur in northern Japan, the Bering Strait, and south to Baja California.

Habitat: Tide pools in upper to middle intertidal zones. Some species reported to more than 110 m depth.

Appearance: These clever crabs appropriate gastropod mollusk shells into defensive homes. On our seacoast there are typically 4 species of hermits in the intertidal. Their appearance is most obviously recognized by their appropriated shell (*Tegula* is a popular choice).

Diet: Scavenge dead algae and animal matter.

Reproduction and Development: : Sexes separate, fertilization is internal. The male often grasps the edge of the female's shell and drags it around with him, waiting for the female to molt, after which he deposits sperm on her abdomen. Females carry eggs and then release planktonic larvae. Once they have outgrown their home due to weight gain they select a larger, empty shell.

Mortality/Longevity: Preyed upon by fishes, crabs, and sea anemones.

Remarks: Hermit crabs (Anomura) have 3 pairs of walking legs. True crabs (Brachyura) have a pair of claws and 4 pairs of walking legs.

Their abdomens are long, slender, soft and usually flexed to the right which allows them to fit into old snail shells, which are practically all right handed.

Black-eyed Hermit Crab

Pagurus armatus (Paguridae)

Distribution: Coastal areas of the Pacific Northwest from Alaska, British Columbia, the Puget Sound area of Washington south to California.

Habitat: Found on a variety of substrates, from muddy areas to protected sandy bottoms from the intertidal zone to depths of 120 m.

Appearance: One of the largest species of hermit crabs. Easily identified by its large, oval,

black compound eyes set on short eyestalks. Legs and claws have red and orange bands with white spots; the dark brown claws have short spines on the dorsal surface. Max carapace length: 4 cm.

Diet: Hermit crabs generally feed on detritus but may scavenge on dead animal and plant material.

Reproduction and Development: In October, the females carry their brood of eggs under the abdominal telson flap. The first brood hatches in February and March. Adult females can carry up to three broods with the last brood hatching in September. The larval and advanced developmental stages of these hermit crabs lasts a total of 73 days depending on temperature.

Remarks: When hermit crabs outgrow their shells they are vulnerable to predation until they locate and move into a larger shell.

A point of interest: the holotype of *Pagurus armatus* was lost in the Great Chicago Fire of 1871.

Hairy Hermit Crab

Pagurus hirsutiusculus (Paguridae)

Distribution: Alaska to southern California; Siberia, Japan; common in San Francisco Bay.

Habitat: Intertidal tidepools, gravelly beaches, and under rocks and algae; more abundant in protected water. Tolerant of brackish water.

Appearance: Length to 3 cm, but generally smaller. Antennae grayish brown with white bands and spots. Walking legs white, often with blue bands. Body remarkably hairy.

Diet: Generally a scavenger feeing on detritus and dead animal matter, though also feeds on seed weed and occasionally takes live prey.

Reproduction and Development: LIke other crabs, female attaches eggs to her pleopods (swimming legs), carrying up to 5 broods through spring and summer. Larvae are planktonic, metamorphosing through various stages before settling to the bottom.

Mortality/Longevity: Preyed upon by fish, primarily sculpins.

Remarks: Unlike most hermit crabs, this species usually chooses a shell so small that the snail cannot withdraw its body completely for protection. When a predator is encountered, the hairy hermit crab may abandon its shell completely, depending instead on speed for defense.

Vampire Crab

Geosesarma sp.'vampire" (Sesarmidae)

Distribution: Southeast Asia.

Habitat: Inhabits forests or near running fresh water. On land, usually make burrows for hiding and resting.

Appearance: Carapace length: c. 2.5 cm. Small pincers, similar in size. Pincers and other appendages tend to be purplish, carapace variable in color from reddish to blue. Eyes may be a bright neon orange or red.

Diet: Active during the day; feeds mostly on insects, alive or dead. May also take other small invertebrates.

Reproduction and Development: This crab genus is quite unusual, the only group known to reproduce in a freshwater environment. Other crabs, even the few terrestrial species, must return to salt or at least brackish water to reproduce; the eggs ultimately hatch into planktonic larvae that "go to sea" to metamorphose through a variety of stages before developing into the adult form. The mostly terrestrial vampire crab, on the other hand, has large eggs. The young go through their larval stages within the egg, and hatch out as fully developed small crabs. Are being bred successfully in captivity. Like all crabs, the female has a wide abdomen where eggs are cemented and protected until they hatch.

Mortality/Longevity: Life span: 2–3 years.

Remarks: Genus *Geosesarma* consists of about 40 members, all small terrestrial crabs. The "vampire crab" was described fairly recently.

The common name seems a reference to the glowing eyes, reminiscent of the vampires in old movies.

Another species of *Geosesarma* from Malaysia seems to live symbiotically with several species of pitcher plants. The crab uses the plant as a safe harbor from predators, and in return drops its own insect prey and feces that nourish the plant.

CLASS CIRRIPEDI.A (BARNACLES AND THEIR KIN)

Acorn Barnacle

Balanus glandula (Balanidae)

Distribution: Aleutian Islands, Alaska to Baja California.

Habitat: On rocks, pier pilings and hard-shelled invertebrates in the high and middle intertidal zones in bays, estuaries and especially along the open coast.

Appearance: Diameter to 2.2 cm. Colored white to grayish.

Diet: Like all barnacles, is a filter feeder.

Reproduction and Development: Hermaphroditic. Produce 2–6 broods during the winter and spring, 1,000–30,000 larvae per brood; number correlated with size of the parent. Larvae settle in the spring and summer. Typically reach a diameter of 1.5 cm after 3 years; crowding by conspecifics reduces the rate of growth. Larvae that settle in the spring are reproductive their first winter.

Mortality/Longevity: Predatory gastropods and sea stars take their toll, as do limpets feeding upon or bulldozing off juvenile barnacles on their turf. May live to 10 years.

Remarks: Various barnacle species create serious and expensive fouling problems on ship hulls and pilings. In two years, 10 tons of barnacles may attach to a large tanker, causing huge losses in fuel efficiency.

Giant Acorn Barnacle

Balanus nubilus (Balanidae)

Distribution: Alaska to Baja California.

Habitat: Found on pier pilings, rocks and hard-shelled animals, upper subtidal to depth 300 feet. Prefers areas of current or waves that deliver food.

Appearance: Sessile; volcano-like shell attached to hard substrate. A large barnacle, often 5–8 cm in diameter.

Diet: Plankton and detritus; feathery legs protrude and filter water to trap particulate matter.

Reproduction and Development: Each animal contains both sexes (hermaphroditic). They cross-fertilize, passing sperm to one another via internal fertilization. A barnacle can fertilize itself if there's no other barnacle within reach.

Not a bad strategy when you're glued to one spot. And if you're not going anywhere fast, some part of you should be able to make the reproductive journey: barnacles have the longest penises in relation to adult size than any such equipped organism known!

Mortality/Longevity: Life span: Thought to be 60 yrs. or more. Prey to some sea stars and snails.

Remarks: Edible; found in the middens of coastal Native Americans.

Empty shells provide refuge to small rock crabs and juvenile red octopuses (*Octopus rubescens*).

Gooseneck Barnacle

Pollicipes polymerus (Scalpellidae)

Distribution: British Columbia, Canada to Baja California.

Habitat: High to middle intertidal on wave-swept rocky shores in clusters, and also among California barnacles (*Mytilus californianus)*.

Appearance: To 8 cm in height. Tough stalk (peduncle). Top (capitulum) covered with more than 5 plates.

Diet: Filter feed upon detritus, large zooplankton and crustaceans to 1 cm long.

Reproduction and Development: Hermaphroditic. Reproduction occurs during summer in northern California. Fertilized eggs are brooded in the mantle cavity of the shell. Time from fertilization until release of larvae is about one month. A female may produce 3–7 broods per year; 100,000–240,000 larvae are produced per brood. Growth is slow in attached juveniles over 1 cm in length. Sexually mature at 5 years.

Mortality/Longevity: Preyed upon by *Pisaster ochraceus*. Fully grown individuals may be 20 years old.

Remarks: Exported to Spain and Portugal as a food delicacy.

SUBPHYLUM HEXAPODA

CLASS INSECTA

ORDER BLATTODEA

Giant Cockroach

Blaberus giganteus (Blaberidae)

Distribution: Central and South America.

Habitat: Also called giant cave cockroaches, they live in caves, under stones and in dead tree branches.

Appearance: A giant cockroach has a flattened,

oval body, about 9 cm long and 4 cm wide. Females are slightly larger than males. They commonly run along the ground, although the adults have wings that are rarely if ever used for flight. They have long, very slender antennae and two sensory organs, called cerci, at the tip of the abdomen.

Diet: Cockroaches are omnivores and detritivores. They help recycle decaying matter on the ground into useful nutrients for plants.

Reproduction and Development: All species of cockroaches are ovoviviparous. After mating, the female forms a protective pouch to hold the eggs until they hatch. She keeps the pouch inside her abdomen, taking it out only once to turn it and retracting it until gestation is complete. Incubation is about 60 days. The female expels the pouch when the eggs start to hatch.

Mortality/Longevity: They can live about 20 months as adults.

Remarks: Females emit a pheromone that induces males to mate. Male courtship rituals include raising wings at right angles to abdomen and making trembling movements with abdomen.

Happily these huge insects provide services to the forest, and are not found in the average kitchen!

Madagascar Hissing Cockroach

Gromphadorhina portentosa (Blaberidae)

Distribution: Madagascar.

Habitat: Tropical lowland forest floor, hiding in leaf litter and rotting logs.

Appearance: Dark brown exoskeleton, no wings, foot pads and hooks to climb smooth surfaces. Females have larger, heavier bodies. Males sport horns. They are one of the largest cockroach species in the world (5–7.5 cm long and weighing up to 25 gm).

Diet: Nocturnal scavengers of decaying plant material, small insects and animal carcasses.

Reproduction and Development: Mating occurs year around. The male hisses during courtship by constricting its abdomen to expel air through breathing holes (spiracles), producing both calling and courtship sounds. Females carry 15–40 eggs internally, then bear live young. Nymphs molt their exoskeleton as they grow, reaching sexual maturity in 7 months. Parents and offspring stay close for extended periods. Males defend mating territories, and use their horns in fights with rivals, ramming each other and hissing loudly.

Mortality/Longevity: Likely predators include large spiders, tenrecs, and birds. When disturbed, both sexes sound an alarm hiss to startle predators. Can live up to 5 years.
Conservation Status: These cockroaches live in forest pockets that are dying (degradation and fragmentation) so Madagascar is a top conservation priority.

Remarks: Territory sizes are small: a male may sit on a rock and defend it for months. Dominant males stand on their "toes" to "show off."

Indigenous people call this species *Kofokofoka*, approximating the hisser's call.

Madagascar hissing cockroaches are not pests, do not inhabit houses, cannot fly, are not aggressive, and do not bite.

ORDER MANTODEA (PRAYING MANTIDS)

Ghost Praying Mantis

Phyllocrania paradoxa (Hymenopodidae)

Distribution: Tropical Africa including Madagascar, Mozambique, Namibia, Somalia.

Habitat: Warm, highly humid tropical forests.

Appearance: Miniature species of leaf mantis, growing to under 5 cm. Sexual dimorphism is usual, with females slightly longer, and having a wider abdomen than males. Colors can vary from grey/green to dark brown or almost black. Colors are dependent on humidity and light levels. *Phyllocrania* has leaf-like head and shoulder shields, and leaf-like protrusions hanging from its limbs. This "dead-leaf" appearance makes it very difficult to see.

Diet: In captivity ghost mantids eat *Drosophila*, houseflies, crickets, flour worms.

Reproduction and Development: No specific information found. In general mantids reproductive organs are found at the tip of their abdomen. Females usually attract males with pheromones, there is a brief courtship dance, and the male alights on the female's back. After fertilization the female deposits batches of eggs, using an ovipositor at the tip of her abdomen. The eggs stick to stems and

leaves, and each batch is housed in an egg case made from an abdominal secretion. The case hardens to protect the eggs from birds, and other predators. After about a month the nymphs hatch and then molt several times, each time becoming more like the adult form.

Mortality/Longevity: Generally a long-lived species. Molt every 3–5 weeks, until the 4th and final molting. Life span: up to 14 months in captivity.

Remarks: The scientific name is probably derived from Greek for "leaf "(*phyllo*) and Latin for "head" (*crania*), thus "leafy head mantis."

ORDER COELEOPTERA (BEETLES)

Sunburst Diving Beetle

Thermonectus marmoratus (Dytiscidae)
Predaceous Diving Beetles

Distribution: Arizona, Southern California, New Mexico, Western Texas and Mexico.

Habitat: Freshwater rivers, lakes, intermittent streams, and pools. Because they are winged, they travel to other areas when their water source dries up.

Appearance: Bodies are oval and flattened with smooth contours. Gold markings on the black carapace and yellow spots on the abdomen give the species its common name. Females slightly larger than males. Length: 10–15 mm.

Diet: Small aquatic animals such as mosquito larvae, water mites, and worms. The beetles may also eat dead organisms found on the surface film or the bottom, engulfing small items and chewing large ones. They have sometimes been seen swarming a prey item and feeding en masse.

Reproduction and Development: Diving beetles undergo complete metamorphosis. Their eggs are attached to underwater plants and hatch into the larval stage. Larvae later pupate in mud near water; and the adult emerges ready to breed a few weeks late.

Mortality/Longevity: Both adults and larvae are predators and, with strong sickle-shaped jaws, can attack prey larger than themselves. They survive dry periods by burrowing into the mud.

Remarks: With their streamlined body, the beetle swims effortlessly by flexing its hind legs together simultaneously, and can remain underwater for a long time breathing air trapped in a chamber under its wing covers.

Large swarms of these beetles sometimes fly to artificial lights at night.

When disturbed, they eject a milky fluid which contains a mixture of steroid compounds, presumably as a deterrent to fish predators.

They benefit humans because they eat other invertebrates including mosquito larvae and pupae.

ORDER LEPIDOPTERA (BUTTERFLIES AND MOTHS)

Banded Orange

Dryadula phaetusa (Nymphalidae)
Brush-footed Butterflies

Distribution: Native throughout the continental Neotropics, from central Mexico to Brazil; summer migrant in U.S. north to Kansas.

Habitat: Disturbed lowland areas.

Appearance: Males: bright brown and orange-striped pattern above; striking and quite different brown, orange, and white pattern below. Females somewhat duller.

Diet: Caterpillars feed on various host passion flower vine species; adults feed primarily on nectar and bird droppings.

Reproduction and Development: Eggs are laid singly on stems and leaves of host plants.

Mortality/Longevity: Long lived for butterflies (*See* Postman).

Remarks: The Banded Orange is the sole member of its genus. The genus is distinguished by having shorter, broader wings and shorter antennae than others in the heliconiine subfamily.

Giant Owl Butterfly

Caligo memnon (Nymphalidae)
Brush-footed Butterflies

Distribution: Mexico south to Amazonia.

Habitat: Rainforests and secondary forests.

Appearance: A very large butterfly: wingspan up to 12.5 cm.

Diet: Adults feed on rotting fruit, sipping liquids through their proboscis.

Remarks: Giant owls not always applauded by human cohabitants. Larvae are large and

voracious, and one individual can consume an entire banana leaf more than 3 feet long!

Common name derived from the large "eyespots" on the underside of wings, thought to be deterrents to bird predators.

Julia Longwing

Dryas julia (Nymphalidae)
Brush-footed Butterflies

Distribution: Resident in Brazil north through Central America, Mexico, West Indies, peninsular Florida, and South Texas. Strays as far north as eastern Nebraska.

Habitat: Subtropical forest openings and edges, and nearby fields.

Appearance: Elongate forewings, thus the common name Males bright orange above and below; upperside of hindwing has narrow black border on outer margin. Female duller, with more black markings above.

Diet: Caterpillars feed on passion vines; adults on nectar from flowers.

Reproduction: Like all species in the subfamily Heliconiinae, also known as heliconians or longwings, adults lay eggs only on select host plants of the genus *Passiflora,* commonly called passion vines or passion flowers. *D. julia* eggs are laid singly on new growth; caterpillars feed on leaves. Larvae of heliconians

Remarks: The Julia, like many other butterflies in the rainforest exhibit, belongs to the Longwing or Heliconian subfamily (Heliconiinae).

Isabella's Longwing

Eueides isabella (Nymphalidae)
Brush-footed Butterflies

Distribution: Widely distributed in Central America and throughout northern South America south through Brazil. Occasional migrant to southern U.S., especially Texas.

Habitat: Occur from sea level to 1,500 m in tropical forests.

Appearance: Upper wing: outer half of forewing black with yellow areas, area close to body orange with a black stripe. Hindwing orange with 2 black stripes. Underwing similar.

Diet: Caterpillars: host passion vine leaves; adults: nectar and pollen.

Reproduction and Development: Males mate with receptive females, which may breed more than once. Not a pupal mater. (*See* Zebra Longwing). Eggs laid singly on underside of host plant.

Mortality/Longevity: Like all Heliconians, they are long-lived

Remarks: Adults roost alone on underside of leaves.

Zebra Longwing

Heliconius charithonia (Nymphalidae)
Brush-footed Butterflies

Distribution: Tropics and subtropics of Central and South America. Also West Indies, Mexico, southern Texas, Florida, and occasionally as far west as New Mexico and north to the Carolinas.

Habitat: Moist forests, edges, and fields.

Appearance: Long, narrow wings patterned with black and yellow stripes.

Diet: Adults feed on flower nectar and pollen. Larvae feed almost exclusively on the leaves of a few host species of passion flowers (genus *Passiflora*).

Reproduction and Development: Almost half of the Heliconian species, including the Zebra Longwing, practice a unique mating behavior known as pupal mating. The male seeks out larval host plants to find female pupae of its species, and may fend off other males from one or more pupae for up to a week before the female butterfly emerges. Mating takes place before the female is fully hardened. With the exception of one other species, Heliconians are the only butterflies known to practice this behavior.

Mortality/Longevity: From 3–6 months (sources vary). Taken by birds and larger insects.

Remarks: Declared the Florida State Butterfly in 1996.

Species name refers to the Charities, or Graces, of Greek mythology, known as the epitome of charm and natural beauty.

The Zebra Longwing, because of its striking pattern and long life, is a favorite species for butterfly exhibits.

This species also practices communal roosting

Doris Longwing

Heliconius doris (Nymphalidae)
Brush-footed Butterflies

Distribution: Central America to northwestern Amazonia.

Habitat: From sea level to 1,800 m in forest clearings. Fly and feed mostly in the mid-story.

Appearance: Appears in several color morphs; hindwing markings may be red-orange, blue, or green. Two white markings on forewing.

Diet: Nectar and pollen.

Mortality/Longevity: Eaten by birds.

Remarks: Heliconians are unique. Unlike other butterflies, they not only sip nectar, but also use their proboscises to collect and absorb the protein from pollen. This amino acid-rich diet allows them to function and live longer than most other butterflies.

Postman

Heliconius melpomene (Nymphalidae)
Brush-footed Butterflies

Distribution: Widespread in the Neotropics of Central and South America to southern Brazil.

Habitat: Open areas, also locally common along river edges and streams.

Appearance: The Postman is famous for the geographic diversity of its color pattern, and has around 30 named subspecies. These factors, in combination with its co-mimicry with *Heliconius erato*, make an individual sometimes difficult to identify.

Diet: A plant specialist on passion vine flowers (*Passiflora* spp.). In Central America, focuses on only two species; in other areas, is more of a generalist, feeding on several *Passiflora* species.

Mortality/Longevity: *Heliconius* spp. are among the Methuselahs of the butterfly world. Most butterflies live only days; some Heliconians in the adult (butterfly) stage, including the Postman, live for as long as 8 months.

Remarks: The Postman is reportedly named after its habit of flying a route that allows visitation of all the nectar plants in a given area like a postman delivering the mail.

In Greek mythology, Mt. Helicon was sacred home to the Muses; Melpomene is the Muse of Tragedy.

Sapho Longwing

Heliconius sapho (Nymphalidae)
Brush-footed Butterflies

Distribution: Central and northwestern South America to the west of the Andes.

Habitat: Occurs from sea level to 2,000 m in dense forest.

Appearance: Iridescent black wings that exhibit blue metallic sheen under right light conditions; a variety of white bands on fore- and hindwings. *H. sapho* is often confused with its co-mimic *H. cydno,* but can be distinguished by the small red teardrop patterns close to the body.

Diet: Larvae feed on host passion flower vines (*Passiflora* spp.). In Costa Rica and Belize, *H. sapho* seems to have a complex coevolved relationship with only one host plant, *Passiflora pitteri*.

Reproduction and Development: Also a pupal-mater (*see* Zebra Longwing).

Mortality/Longevity: Relatively long lived.

Remarks: Several distinct geographical races are known; remarkably, *H. cydno* exhibits parallel geographic variations. The two species are Mullerian mimics. Like most Heliconians, both sequester toxins distasteful to predators; their similar patterns give would-be predators more chances to learn the error of their ways and leave both species alone.

Researchers suggest that Heliconians, perhaps due to their long lives, are able to learn to recognize specific host plants where the female lays her eggs. This specificity allows a variety of Heliconian species to live in close proximity, efficiently partitioning habitat resources.

Sara Longwing

Heliconius sara (Nymphalidae)
Brush-footed Butterflies

Distribution: Widespread throughout Central America and the tropics of South America, including the Amazon Basin.

Habitat: Occurs from sea level to 1,300 m along the edges of rainforests.

Appearance: Upper wing surface is black with large patch of metallic blue framed by two white bands. Underside is brown-black with faded white bars above and small red spots near the body.

Diet: Larvae (caterpillars) feed on select host passion flower leaves; adults feed on pollen and nectar.

Reproduction and Development: Pupal maters: males sit on female pupae a day before emergence, and mating occurs the next day before the female has completely hardened (*see* Zebra Longwing for more information). Females lay eggs in clusters on new growth of

host passion flower species.

Mortality/Longevity: Adult life span: 2–3 months.

Remarks: Passion flowers contain toxic compounds to which caterpillars are immune; like monarchs, the caterpillars concentrate the toxin in their tissues and pass it along to the adult during metamorphosis.

Research suggests that adult Heliconian butterflies may be able to synthesize their own toxins with the amino acids they absorb through the protein-rich pollen they feed on.

Blue Morpho

Morpho peleides (Nymphalidae)
Brush-footed Butterflies

Distribution: Tropics of Latin America from Mexico to Colombia.

Habitat: Feed and sleep on or near the forest floor, but when mating, they fly throughout forest layers.

Appearance: A large butterfly: 12–20 cm. Wing tops are an iridescent blue, caused not by a true color, such as the dye of blue jeans, but by the tiny, overlapping scales that cover their wings. Because of the precise angle of the ridges they form, the scales reflect blue light back to our eyes. The contrasting underside of the wing is brown with a confusion of eyespots that blend with surroundings and hide the *morpho* from predators. Females less brilliantly colored.

Diet: Adult drinks juices of rotting plants and animals, tree sap, and wet mud, sipping all with its straw-like proboscis.

Reproduction and Development: Like most butterflies, males release pheromones to attract females. Fertilized eggs hatch in about 9 days.

Mortality/Longevity: Total lifespan: egg to adult, about 4.5 months; adults (butterflies): about 1 month. Predators include birds and large insects.

Conservations Status: Not listed, but under some pressure as trophies for collectors.

Remarks: Blue morphos brilliant reflection is so intense that pilots report seeing their flash of color as the butterflies warm themselves above the treetops.

Different angles of view (and so different angles of reflecting ridges) produce variations in the shades of blue perceived.

Orange Barred Sulfur

Phoebis philea (Pieridae)
Whites and Sulfurs

Distribution: Resident from Brazil, north through Central America to peninsular Florida.

Habitat: Open lowland sites along forest edges. Also frequents gardens, parks, and road edges.

Appearance: Upperside of male bright yellow-orange; forewing has red-orange bar, hindwing with red-orange outer margin. Female much larger than male.

Diet: Caterpillar: *Cassia* species in the pea family; adult: nectar from various flowers.

Reproduction and Development: Females lay single eggs on leaves and flowers of host plants during the wet season. Caterpillars feed preferentially on the flowers.

Remarks: These swift, high flyers have been reported as rare migrants as far north as Canada.

Malachite

Siproeta stelenes (Nymphalidae)
Brush-footed Butterflies

Distribution: Common resident throughout Central and northern South America. In U.S., found in southern Texas and south Florida.

Habitat: Subtropical evergreen and semideciduous forests. Frequent fruit orchards in Florida.

Appearance: Upperside dark black-brown with translucent yellow- to lime–green patches. Underside duller.

Diet: Caterpillars: host plants of the family Acanthaceae. Adults: rotting fruit; occasionally bird droppings and nectar.

Reproduction and Development: Eggs laid singly on host plant leaves. In warmest climates, up to four broods per year.

Remarks: Named for the mineral malachite, reminiscent of the bright green of the wings.

Adults roost together under the leaves of low shrubs. Green and black coloration provides excellent camouflage.

ORDER HYMENOPTERA (ANTS)

Leafcutter Ant

Atta cephalotes (Formicidae)

Distribution: Fungus growing ants, or

gardening ants, number about 200 species, all in the tribe Attini, and are found only in the New World, in every mainland country except Canada and Chile. Most leafcutter ant species are native to tropical Central and South America, though a few species occur in the southwestern United States.

Atta cephalotes ranges from southern Mexico to Costa Rica and south to northern Argentina.

Habitat: Colonies are found throughout the tropical rain forest, tropical deciduous forest, and tropical scrub forest. Nests are underground to a depth of 6 m. Some have up to 3000 chambers, hundreds of "gardens," and can cover an area up to an acre. Crescent-shaped mounds at the entrance of the nests contain as much as 350 m^3 of soil.

Appearance: Rust colored with lighter colored legs, members of the genus *Atta* are among the largest, most socially complex leafcutters. The huge queen is up to 1.5 cm in length, an egg-laying machine capable of building a colony of several million individuals. *Atta cephalotes* is noted for its especially large head (hence the name). Workers take many forms and sizes, from large soldiers and major workers with their impressive mandibles to the smallest workers, sized to move easily through the narrow galleries of fungal gardens. A soldier may be 10 times longer and weigh several hundred times more than the smallest worker. The abdomen has a stinger, but it is not used.

Diet: Leafcutter ants are true gardeners. They grow their own food by cutting leaves, mostly during the evening and nighttime, and carrying them back to the nest, where smaller workers then process them further and take them to underground "garden" chambers. All along the way, the leaves are fertilized by their handlers with anal secretions. Fungi then grow on the decaying vegetation, and the ants feed exclusively on the fungus, not the leaves. Each ant species grows a specific fungus.

Reproduction & Development: *Atta cephalotes* swarm in mating flights at the onset of the rainy season. The queen mates with multiple males. The founding female has a pocket in her mouth cavity for storage of fungus spores to start her new nest. After she digs the first chamber for the garden, she deposits the spores, gathers appropriate leaves, and begins laying about 1000 eggs each day. The first group of workers to develop takes over for the queen in caring for eggs, larvae, and pupae. The queen has only one job then—to lay the eggs that will build the colony.

Mortality/Longevity: Queen lives up to 10 years on average, but some have lived up to 14 years.

Remarks: Fungus and ants are mutually dependent for survival. Obviously, the fungus provides the ants with food, but equally important, the fungus receives a warm, moist home and is supplied with fresh, fertilized nutrients. The ant colony also remorselessly rids the colony of any competing fungal strains.

Many ants make noises while they work, generating the sound by rasping a file-like widget on one segment of the gaster (the enlarged part of the abdomen) against a specialized rough spot on a neighboring segment. The ants pick up the vibrations, called stridulations, with sensors on their knees.

Leafcutter ants are able to set up vibrations in their mandibles that helps the ants cut smoothly through leaves. These workers also seem to communicate via stridulations with a smaller worker caste that accompanies them on harvesting missions. The vibrations signal the small ants to climb onto the leaf for the ride home. These hitchhiking minor workers protect the leaf carriers from phorid flies that try to inject an egg in the braincase or gaster. If the fly is successful, its larvae parasitize the ant, ultimately killing its victim by digesting its body tissues, finishing with the brain and leaving a headless corpse!

Leafcutter ants are responsible for destroying more vegetation than any other group of animals: they inflict more than a billion dollars in crop damage yearly. A large colony harvests the same amount of plant material that a cow consumes in a single day. Some leafcutter species, though not *Atta cephalotes*, compete with cattle for grass and harvested foodstuffs stored by humans, such as cereal grains, flour, dried beans, and cattle meal. Large colonies of leafcutter ants also undermine the foundations of buildings, causing structural damage.

Leafcutters have their benevolent side as well. *Atta* species, like most insects, are a good source of protein; they are eaten by people in parts of

Mexico and in many places in South America. They also circulate nutrients and aerate huge quantities of soil in forests and grasslands as they construct their subterranean cities.

SUBPHYLUM MYRIAPODA

CLASS CHILOPODA (CENTIPEDES)

Scolopendra Centipede

Scolopendra subspinipes (Scolopendridae)

Distribution: Widely distributed in Southeast Asia.

Habitat: Live in humid environments. Usually found in soil, leaf litter, or rotten wood.

Appearance: The name *centipede* literally means "hundred legs," though some centipede species have more and some have as few as 30. *Scolopendra subspinipes* has 21 segments, with 2 legs on each segment, except for the last. These legs attach laterally and are used for locomotion. The last pair of legs extends backwards from the ultimate segment and is used as a sensory organ. The *Scolopendra* grows to 20 cm. Quite variable in color with many identified subspecies, but most specimens are brown to reddish brown with yellow to yellow-orange legs.

Diet: Like all centipedes, exclusively carnivores. Large species feed on bats, mice and other small mammals, snakes, frogs and toads, and birds, as well as other arthropods.

Reproduction and Development: A male centipede has no copulatory organ: he spins a small silk pad and then deposits his sperm on it. Guided by the male, the female picks up the sperm, fertilizes and lays her eggs.

Mortality/Longevity: Adult lifespan: 10 years.

Remarks: All centipedes possess "poison claws." The venom delivery apparatus consists of a modified pair of front legs, near the mandibles. The venom is formed in glands at the base of these legs and injected through ducts. Large scolopendromorphs can inflict painful bites that may necessitate a visit to a doctor. The bite causes intense pain, swelling, discoloration, numbness, and necrosis. However, unlike scorpions and spiders, there are no deadly centipedes and no confirmed human fatalities.

During World War II, *Scolopendra subspinipes* roamed freely around military installations in the Pacific theater. Centipedes crawled into foxholes, latrines, and shelters, where they hid in the bedding. Many soldiers suffered from centipede bites. The bites caused instant, fiery pain. At least one resourceful medic injected a localized dental anesthetic around the bite, which numbed the pain.

PHYLUM ECHINODERMATA

CLASS ASTEROIDEA (SEA STARS)

Sand-eating Sea Star

Archaster typicus (Archasteridae)

Distribution: Indo-Pacific.

Habitat: Shallow sandy or silty areas near seagrasses.

Appearance: Arms tapered to a sharp tip and edged with short flat, blunt spines. Diameter with arms: c. 12–15 cm. Underside pale with large, suckered tube feet. Color of upper side may vary from grayish blue, to brown or beige.

Diet: Detritus, decaying plants, burrowing through the substrate in search of food items. Like many seas tars, extrudes its '"stomach" from its mouth on the ventral side, engulfing its meal with digestive enzymes.

Reproduction: The genus *Archaster*, which consists of only three species, engages in a peculiar mating behavior known as pseudocopulation. The male, usually considerably smaller than the female, positions himself on top of the female, his arms alternating with hers, and releases his sperm as she releases her eggs. This practice presumably increases the chance of fertilization. This behavior has been observed at the Steinhart.

Remarks: The size differential, with the female being significantly larger than the male, is very unusual in echinoderms.

The sand-eater in the Steinhart is provides a cleaning service to the upside-down jellies with which it lives, eating algae and detritus.

Vermillion Sea Star
Mediaster aequalis (Goniasteridae)

Distribution: Alaska south to southern California.

Habitat: Common in subtidal waters; rarely exposed to the air. Found especially in rocky areas; occasionally on sand and gravel.

Appearance: Orange to vermillion red. Aboral surface covered with oval or hexagonal plates (ossicles). Oral side lighter.

Diet: Opportunistic: sponges, bryozoans, tunicates, algae, and detritus. Also known to feed on sea pens.

Remarks: Moves more rapidly than most sea stars.

Elegant Sea Star
Fromia monilis (Ophidiasteridae)

Distribution: Andaman Sea to western Pacific Ocean.

Habitat: Various coral reefs substrates at 1–30 m depth.

Appearance: Diameter to 12 cm. Body with tapering arms. Central disc and ray tips red, remainder of body and rays dark creamy yellow.

Diet: Detritus and small invertebrates.

Remarks: Distinctive pattern and bright color may indicate foul taste.

Blue Linckia Sea Star
Linckia laevigata (Ophidiasteridae)

Distribution: Indo-Pacific.

Habitat: Coral rubble or among seagrasses in shallow lagoons and to 60 m depth.

Appearance: Overall arm radius to 40 cm. Color bright blue overall, but olive-brown, pink and yellow variants exist. Long, cylindrical, smooth arms.

Diet: Scavenger. Also consumes algae and microbes.

Reproduction and Development: Unlike most sea stars that can regenerate missing parts if at least part of the central disk remains, linckias are able to regenerate into a complete sea star from a single cast off ray. Initially four minute arms bud from the end of the lone ray; this form is called a comet, as it resembles a shooting star.

Mortality/Longevity: Pufferfishes are known to feed on blue linckias, and harlequin shrimp nibble on the ends of their rays.

Red Linckia Sea Star
Linckia multiflora (Ophidiasteridae)

Distribution: Red Sea, Indo-Pacific.

Habitat: Shallow reefs to 40 m.

Appearance: Mottled red, blue or yellow colors. Typically has five rays.

Diet: May be a suspension feeder. It may feed on microscopic algae and microbes.

Reproduction and Development: Sexual reproduction. Also asexual: casts off an arm at base of the disc; the "comet" regenerates a new disc and rays. Thus the new individual is a clone of the parent.

Mortality/Longevity: Remarks: Regeneration of an adult from a single arm is very unusual for sea stars.

Remarks: Parasitic snail, *Thyca chrystallina,* often found on the oral side of this sea star.

Panamic Cushion Sea Star
Pentaceraster cumingi (Oreasteridae)

Distribution: Mid- to eastern Pacific: Hawaii, Sea of Cortez to Peru and Galapagos.

Habitat: On rubble and sand from shallows to 45 m.

Appearance: Body colors vary from red, orange to greenish blue, with large red spines. Max. size across: 45 cm.

Diet: Micro-fauna in the substrate, benthic algae, and other echinoderms.

Conservation Status: Anecdotally, this species seems to be found less frequently at shallow depths because, given its large size, handsome coloration, and slow movement, it is regularly taken by humans.

Chocolate Chip Sea Star
Protoreaster nodosus (Oreasteridae)

Distribution: Red Sea, Indian and western Pacific oceans.

Habitat: Shallow sand and seagrass beds, typically in sheltered locations 1-30 m.

Appearance: Diameter to 30 cm. Ground body color is highly variable; may be beige, brown, orange, red or other hues, such as green or blue. Horn-shaped nodules colored blue, dark green, dark chocolate or black, sometimes surrounded by milk chocolate-colored margins, are distinctive and are responsible for this sea stars common name.

Diet: Sponges, clams and snails, other

invertebrates; also opportunistic carrion feeders.

Reproduction and Development: As in other sea stars, fertilization is external. Eggs and sperm are stored in the rays and released simultaneously. Larvae look nothing like the adults. The form that first hatches from the eggs is bilaterally symmetrical and planktonic. Larvae eventually settle and transform into tiny sea stars.

Conservation Status: Reportedly common, but threatened in some areas of their distribution, such as Singapore. Over-harvested for the "shell trade" in some localities as a consequence of their spectacular appearance (however, coloration fades upon death).

Crown of Thorns Sea Star

Acanthaster planci (Acanthasteridae)

Distribution: The Red Sea and throughout the Indian and Pacific Oceans, east to Panama.

Habitat: Tropical reefs.

Appearance: Up to 50 cm in diameter, 12–19 arms. Red, with thorn-like spines, which are toxic.

Diet: Feeds on living coral polyps. Feeds by extruding its stomach over a coral colony, releasing digestive enzymes, and absorbing the liquefied tissue. Each individual feeds alone (at night), and maintains a constant distance from other crown-of-thorns starfish. One sea star can consume up to 6^2 m of reef per year. Can live without food for over 6 months.

Reproduction & Development: Sexes separate. Eggs and sperm released simultaneously. Up to 65 million eggs per spawn. Fertilized eggs may drift long distances and result in sudden population booms. This is especially likely in regions of algae blooms, which may satiate predators and reduce feeding on sea star eggs. New sea stars can grow from dismembered arms, if part of the central body remains.

Mortality/Longevity: Predators include the Giant Triton (*Charonia tritonis*), a large sea snail. Larval or small adults are prey to a species of shrimp, a species of worm, and various reef fish, especially the humphead wrasse (*Cheilinus undulatus*).

Remarks: Notorious for its destructive effect on coral reefs. Although it may once have been a natural force in ecological succession, populations of the crown-of-thorns starfish have increased since the 1970s, and it is now at least partly responsible for much loss of coral reefs, particularly on the Great Barrier Reef in Australia.

Bat Star

Patiria miniata (Asterinidae)

Distribution: Sitka, Alaska to Baja California.

Habitat: Low intertidal on rocks overgrown with surfgrass, large algae and sponges. Subtidal to 290 m depth on rocky or sandy substrates.

Appearance: This bat-webbed five-rayed star may be colored red, orange, purple or mottled. Arm radius to 10 cm.

Diet: Typically an omnivore or scavenger: surfgrass, algae, colonial tunicates, organic films on hard surfaces, as well as other sea stars. Like most sea stars, feeds by everting its stomach over prey.

Reproduction and Development: Usually spawns May to June. Embryos and larvae are transparent.

Conservation Status: Collecting by tide pool visitors has diminished some populations, for example around the Monterey Peninsula.

Remarks: Behavioral biologists (ethologists) have documented "arm wrestling" between competing bat stars.

Blood Sea Star

Henricia leviuscula (Echinasteridae)

Distribution: Aleutian Islands to Baja California.

Habitat: On rocky substrates, especially in areas encrusted with bryozoans and sponges. From the intertidal to 400 m.

Appearance: Brilliant red above and bright yellow below, though may be tan, yellow, or purplish. Long slender rays. Diameter to 9 cm. Disc small, arms long and tapering, typically 5 in number, but may be 4–6.

Diet: Uses cilia to feed on suspended particles of bacteria and microscopic bacteria; may also feed on bryozoans and sponges.

Reproduction and Development: Smaller females brood young and release tiny juvenile sea stars. Larger females broadcast eggs into the water.

Mortality/Longevity: Predators include birds and humans.

Remarks: Like all sea stars, has spots at the tip of each arm, sense organs that are able to "see"

only differences in light and dark.

Blood stars lack pedicellariae (tiny pincers for removing ectoparasites and debris, common to most sea stars).

Leather Sea Star
Dermasterias imbricata (Poraniidae)

Distribution: Eastern North Pacific: Alaska to Northern California.

Habitat: On rocks and rocky reefs in subtidal areas.

Appearance: Medium size sea star up to 12 cm in diameter with disproportionately short arms. Mottled coloring—bluish-grey with brown to orange blotches all over.

Diet: Mainly sea anemones, but also takes sea cucumbers, sea urchins, and other invertebrates.

Reproduction and Development: Releases eggs and sperm; fertilized eggs float in plankton and develop into juveniles, which eventually settle out.

Remarks: Is smooth and slimy to the touch; smells like garlic. Leather stars, unlike many other sea stars, such as the ochre, bat, and pink sea stars, swallow their prey whole and digest internally.

Pink Sea Star aka Pink Pisaster
Pisaster brevispinus (Asteriidae)

Distribution: Sitka, Alaska to San Diego County, California.

Habitat: Occasional in low intertidal zone, more common 0.5–100 m on sand and mud substrates, sometimes on rocks and pier pilings in calm waters.

Appearance: Maximum diameter nearly 1 m, individuals usually smaller. Pink color diagnostic. Robust appearance. Aboral spines much shorter than those of other *Pisaster* species.

Diet: Preys on live clams, snails, sand dollars, barnacles, mussels, tube-dwelling annelid worms, and scavenges dead fish and squid.

Reproduction and Development: Spawns in the spring.

Mortality/Longevity: Likely preyed upon by the sunflower sea star *Pycnopodia helianthoides.*

Remarks: Can chemosense clams through sand. May dig down to the clam for 2 –3 days or extend tube feet to the clam a distance equal to the arm radius (to 20 cm!) Once contacted, the clam is lifted from the substrate or the stomach may be everted to 8 cm to digest the prey in place.

Some sand-bottom invertebrates including the sand dollar *Dendraster excentricus* and the snail *Olivella biplicata* chemosense the presence of a pink star and attempt to avoid contact by burrowing.

Giant Sea Star
Pisaster giganteus (Asteriidae)

Distribution: Eastern Pacific coast from British Columbia to Baja California.

Habitat: Rocky but also sandy substrates from middle to lower intertidal zone down to 90 m.

Appearance: Five arms. Can be colored red, orange, brown, or green. Evenly spaced blunt spines. Maximum arm span about 60 cm.

Diet: Typical prey are hard-shelled organisms such as mussels, snails, and barnacles. May occasionally eat anything slow-moving enough to be caught, such as dying fish or shellfish, anenomes, or other sea stars.

Reproduction & Development: Individual sea stars are male or female. Both sexes release gametes into the water for external fertilization. Larvae are planktonic and have bilateral symmetry.

Mortality/Longevity: Sea gulls and sea otters are sea star predators. Giant sea stars live about 20 years.

Ochre Sea Star aka Pacific Sea Star
Pisaster ochraceus (Asteriidae)

Distribution: Prince William Sound, Alaska to Santa Barbara County, California.

Habitat: Low-middle intertidal zones on rocky shores, especially on mussel beds. Subtidal to 88 m depth. Juveniles in crevices and under rocks.

Appearance: Arm radius to 28 cm (usually half that figure). Rays 5–7, typically 5. Colored orange, violet, green and mottled; very rarely ochre.

Diet: California mussels (*Mytilus californianus*) are the favored and locally abundant prey. Also consume acorn barnacles, emarginate dogwinkles, gooseneck barnacles, owl limpets, etc. Can insert stomach into slits as narrow as 0.1 mm between the valves of bivalves and begin digestion.

Reproduction and Development: Sexual reproduction occurs during the spring. Mature

gonads may be 40% by weight in mature *Pisaster*. Fertilization external. Free-swimming plankton-feeding larvae.

Mortality/Longevity: Adults are eaten by sea otters and seagulls.

"Lucky" individuals of this hardy sea star species probably live to over 20 years.

Conservation Status: Locally over-collected as a souvenir of a tide pool visit.

Remarks: Proposed as a "keystone" species (*i.e.*, structures its ecological community) by Roger Paine in 1966. Many researchers have since suggested that *Pisaster* is "just another brick in the wall."

One study showed that less than 2% of the individuals in three local Northern California populations were "ochre" in color. When dead and dry become ochre in color.

Sunflower Sea Star

Pycnopodia helianthoides (Asteriidae)

Distribution: Aleutian Islands, Alaska to San Diego, California.

Habitat: Common in subtidal regions rich in seaweeds, but rare in the upper intertidal zones of rock, sand and mud.

Appearance: Imposing! Up to 24 arms. 40-65 cm diameter. Typically purple, some are yellow-orange. The limbs are soft and flimsy; rough handling by humans causes arms to be shed.

Diet: Carnivorous. Preferences include purple sea urchins, mussels, chitons, clams, snails, crabs, sea cucumbers, polychaetes as well as other sea stars. Tube feet chemosensorilly "taste" objects they encounter for edibility.

Reproduction and Development: Fertilized eggs result in pelagic, plankton feeding larvae.

Mortality/Longevity: The sea star *Solaster dawsoni* and the Alaskan king crab eat this sea star.

Remarks: Fastest moving of the stars in our area, clocking over 50 cm/min.

Largest and heaviest sea star on the eastern Pacific coast.

CLASS ECHINOIDEA (URCHINS AND SAND DOLLARS)

Pencil Sea Urchin

Eucidaris tribuloides (Cidaridae)

Distribution: Caribbean, Bahamas, Florida.

Habitat: Coral reef in small crevices, in turtle grass beds, or under rocks and rubble in back reef lagoon areas, usually found at less than 50 m.

Appearance: Brown body with thick spines in all directions.

Diet: Omnivore: algae and small invertebrates such as sea squirts and sponges. Feeds nocturnally.

Reproduction and Development: Sexual reproduction; eggs and sperm are synchronously shed into the water column where fertilized eggs develop into free-living larvae that, after several stages, settle out of the plankton.

Mortality/Longevity: Life span: up to 5 years.

Remarks: Pencil sea urchins belong to a primitive sea urchin order, the Cidaroids, the only kind of sea urchin to survive the Permian extinction some 245 million years ago. All modern sea urchins descend from this group.

The spines of pencil urchins, unlike other urchin groups, are not covered with epidermis. They are, however, often covered with algae and epizoans that provide excellent camouflage. Spines are also covered with barbs that can inflict serious pain to a predator.

Seek shelter in rocky crevices by day, using the thick spines to maintain a protected position.

Fire Urchin

Astropyga radiata (Diadematidae)

Distribution: Tropical Indo-Pacific from east coast of Africa to Hawaiian Islands.

Habitat: Rubble and sand in bays and lagoons.

Appearance: Radially symmetrical with long, mobile spines usually banded in orange and white. Five areas free of spines carry striking red V-shapes with blue spots.

Diet: Herbivore, mostly algae. Active diurnally.

Reproduction and Development: Indirect reproduction through the release and fusion of eggs and sperm in the water.

Remarks: This urchin delivers a potent sting with its spines. Bright colors warn predators to give it wide berth.

It has a symbiotic relationship with the large decorator crab *Dorippe frascone*, which is known to carry this urchin species on its back. Commensal shrimp and juvenile cardinalfishes

may seek protection in the urchin's spines.

Long-spined Sea Urchin

Diadema setosum (Diadematidae)

Distribution: Red Sea, east Africa to western Pacific (Philippines).

Habitat: Low tide to 20 m. On rubble and seagrasses. Often abundant in shallow water areas that have been recently disturbed. Also in lagoons and on coral and rocky reefs.

Appearance: Adult test to 9 cm diameter. Very long, black spines to 30 cm. Orange-red ring around anal cone at the center of its dorsal surface is distinctive.

Diet: Herbivore. Hides during the day, and emerges at night to feed on algae, plankton, and waste material. Its feeding habits help keep the reef free from coral-smothering algae; however, too many of these algal-eating machines can actually threaten a reef, scraping away living coral as they devour algae and leaving little food for other herbivores.

Reproduction and Development: During spawning, many males and females release eggs and sperm synchronously.

Remarks: Spines contain toxins. Tiny barbs, requiring surgical removal, secure spines painfully in the skin of the careless or unsuspecting diver.

Commensal with a number of species, including various shrimps and fishes. The dark, elongated body of the urchin shrimp S*tegopontonia commensalis* camouflages it among the spines of its host. Cardinalfishes, shrimpfishes such as *Aeoliscus strigatus*, and others are also found in association with this urchin.

Pincushion Tuxedo Urchin

Mespilia globulus (Temnopleuridae)

Distribution: Coastal waters of Asia from India to Southern Japan.

Habitat: Coral reefs. During daylight hides among rocks, in crevices, or under plants in a sandy substrate.

Appearance: Diameter to 8 cm. Red to brown short, sharp spines are separated by ten blue-velvet regions where spines are absent.

Diet: Primarily a nocturnal feeder on coralline algae, also green filamentous algae. Grazes by scraping with its Aristotle's lantern apparatus, as do all sea urchins.

Reproduction and Development: Like all echinoids, this species has a planktonic larval form which swims and feeds. In later larval life the exterior skeleton begins to form and the maturing larvae sink to the substrate but do not attach as in sea stars. Metamorphosis is remarkably speedy; larvae to adult in ~an hour! Young urchins are no larger than 1 mm.

Remarks: Usually hidden diurnally.

Camouflages itself with various items such as rubble and detritus

Urchins have structures called "pedicellariae." Pedicellariae are constructed of several small spines which have become modified to articulate with one another and function as snapping jaws. Each pedicalliria is typically found on an elongate and extensible stalk, and they reach out to pinch any small animals or body parts, such as the adhesive tube feet of a predatory sea star, that threaten the sea urchin.

Green-spined Salmacis

Salmacis sphaeooides (Temnopleuridae)

Distribution: Western Pacific Ocean.

Habitat: Rock and rubble areas covered in algae and in seagrass beds.

Appearance: Test diameter: 5–8 cm. Bears short, sharp spines, either maroon or green, or with bands of one of these colors.

Diet: A mostly nocturnal feeder on seagrass fronds, seaweed and other algae, detritus.

Reproduction and Development: Sexes separate; sperm and eggs released synchronously.

Remarks: A tank cleaner, this engaging urchin helps control algal growth.

This urchin uses the spade-shaped tube feet on its underside to move over the substrate seeking food. The much longer tube feet on its aboral side are often used to pick up scraps of wood, shells, and other debris and hold them firmly on its surface, probably a camouflage strategy.

Red Sea Urchin

Strongylocentrotus franciscanus (Strongylocentrotidae)

Distribution: N. Japan and Alaska to Isla Cedros, Baja California.

Habitat: Very low intertidal on open, coastal rocky substrates; more abundant subtidally to

90 m deep. Juveniles often shelter among the rigid outer spines of adults.

Appearance: Large red, red-brown or purple test to 10 cm or more diameter; primary spines 5 cm or more in length.

Diet: Herbivorous upon red and brown algae; preference is for the giant brown kelp *Macrocystis*.

Reproduction and Development: Breed in the spring. Free-swimming larval period lasts 62–131 days.

Mortality/Longevity: A favored treat of sea otters. Red sea urchins can live at least 20 years.

Conservation status: Gonad trade may be affecting some populations.

Remarks: Raw gonads (*uni*) are considered gastronomic delicacies by some people.

Removal of sea urchins promotes growth of kelp and thus improves habitat for many other species, including rockfish juveniles.

Purple Sea Urchin

Strongylocentrotus purpuratus (Strongylocentrotidae)

Distribution: Vancouver Island, Canada south to Isla Cedros, Baja California.

Habitat: Rounded burrows in rock that have been scoured out by the present or previous urchin using its teeth (Aristotle's lantern) and spines, a strategy that protects from predators and surge.

Appearance: Test commonly 5 cm in diameter, rarely to 10 cm. Test and spines green to purple.

Diet: Brown and red algae. These urchins prefer the giant brown kelp *Macrocystis*.

Reproduction and Development: Sexually mature during their second year. Sexes are separate, although hermaphrodites occur. Most spawning occurs from January to March. Pluteus larvae hatch, drift and settle. Growth after metamorphosis is slow.

Mortality/Longevity: Preyed upon by sea stars such as the sunflower star and cancer crab species as well as fish such as the California sheephead and shorebirds. Can live to more than 30 years.

Remarks: Purple pigments from this urchin lodge in the bones and teeth of sea otters, turning the otter's skeleton and teeth purple.

Eccentric Sand Dollar aka Western Sand Dollar

Dendraster excentricus (Dendrasteridae)

Distribution: Southeastern Alaska to Baja California.

Habitat: Subtidal to low intertidal zone on sandy or sandy/muddy substrates, subtidal to 40 m (rarely to 90 m).

Appearance: Both scientific and common names come from the fact that the star design is off center and somewhat lopsided, a pattern most notable on an exposed test. The body of the living sand dollar is covered with tiny, closely packed purple spines. May grow to 7.5 cm in diameter.

Diet: Feeds on detritus, diatoms, and plankton such as crab larvae and amphipods, captured by mucous-covered spines and pincers (pedicellariae). Particles and mucus are then moved along groves to the mouth in the center of the lower surface by cilia that cover the spines. Specialized tube feet also aid in feeding and gas exchange.

Reproduction and Development: Sexes separate; females may produce over 350,000 eggs per year; spawning spring to summer. Planktonic larvae that travel considerable distances with currents settle within or near an existing sand dollar bed, usually not near the parent group.

Mortality/Longevity: The pink sea star (*Pisaster brevispinus*), starry flounders, and California sheephead feed on this species. Sand dollars often bury themselves in the sand to escape predators. Can live 6–10 years.

Remarks: This species and other sand dollars may live in concentrated fields with up to 625 animals per m^2.

In calm water, eccentric sand dollars burrow into the sand at an angle to catch nutrients. In rougher water, they lie flat at the surface of the sand or partly buried.

Tests of individuals living in colder waters and more turbulent environments tend to have thicker shells and internal buttressing.

Unlike sea stars that use tube feet for locomotion, sand dollars use their spines.

Young sand dollars ingest large sand grains that act like a diver's weight belt to help them maintain position.

CLASS HOLOTHUROIDEA (SEA CUCUMBERS)

Yellow Sea Cucumber

Colochirus robustus (Cucumariidae)

Distribution: Indo-Pacific area, including Indonesia and Philippines.

Habitat: It lives with its ventral surface in contact with or buried in the sandy or rocky substrate.

Appearance: A soft-bodied, bright yellow, 7 cm elongated echinoderm with tube feet that cling to the substrate. Like all echinoderms, it has pentameral (five-rayed) symmetry. Five rows of tube feet run from the mouth along the body.

Diet: A suspension feeder; on phytoplankton and zooplankton; specialized mucous-covered tube feet surround the mouth and capture phytoplankton and zooplankton. The animal then brings each foot to its mouth systematically, essentially "licking its fingers." While other sea cucumbers are considered a "sea floor janitors" because they "sweep" the sand of food, the yellow is, by contrast, a filter feeder.

Reproduction and Development: It spawns annually in spring or summer. Its development is either direct (lacks a larval stage) or indirect (with a larval stage that undergoes a metamorphic transition into a juvenile).

Mortality/Longevity: 5 to 10 years.

Remarks: An ability to release toxins keeps away some predators.

The yellow sea cucumber is used in Chinese and other Asian cuisines, most often as an ingredient in soups or stews.

Several countries have imposed fishing restrictions and have developed management programs in the harvesting of these sea creatures.

Philippine Sea Apple

Pseudocolochirus violaceus (Cucumariidae)

Distribution: Indian and west Pacific oceans; India, Philippines and northern Australia.

Habitat: Relatively shallow reef flats.

Appearance: To 18 cm. Body and tentacles can be various colors (violet, blue, red, yellow, white) yet it always has yellow-red tube feet. The most common body color is dark inky blue; the tentacles are usually white.

Diet: Filter feeds on plankton by extending its oral tentacles into the current; as food is trapped, it draws the tentacle into its mouth.

Reproduction and Development: Sexes separate, fertilization external.

Mortality/Longevity: To 35 years.

Remarks: Venomous and considered to be among the most toxic sea cucumbers in the world: about 1 g of tissue from any of these particularly toxic species could poison the fish in a 95-liter tank. Toxins are released when the animal is stressed or dies.

Creeping Pedal Sea Cucumber

Psolus chitinoides (Psolidae)

Distribution: North American Pacific coast from the Aleutian Islands south to central Baja California.

Habitat: Abundant in deeper water up to 245 m on hard surfaces swept by currents. Somewhat common in shallow subtidal areas preferring clean, vertical rocks that are free of sediment.

Appearance: Beautifully colored bright orange, oval in shape with 8–10 vividly colored red branched tentacles extending out of the domed dorsal surface. Upper body is covered with large overlapping calcareous plates. Ventrally the sole is flat and flexible with tube feet extending around the perimeter and under the length of the body, which are used to attach firmly to the substrate. The mouth and anus are located at opposite ends of the dorsal surface. Typical size: 12 cm long / 7.5 cm wide.

Diet: A suspension feeder, trapping particles of food from currents with its tentacles. Feeding occurs by extending the tentacles, bending them inward to form a cage-like structure; the mouth and lips extend toward the food as the nearest tentacle pushes the food into the mouth.

Reproduction and Development: Sexes separate with spawning occurring annually from mid-March to late May. Males disperse sperm into the water column and fertilize the eggs by waving a tentacle across the gonopore of the females. Females release long strands of red eggs. The fertilized eggs develop into larvae nourished by stored lipids until the juvenile stage when they settle on the substrate.

Mortality/Longevity: Preyed upon by several species of sea stars, especially the leather sea

star (*Demasterias imbricata*), some fish, and red rock crabs.

Remarks: Looking more like a cross between a chiton and a nudibranch, the creeping pedal sea cucumber looks nothing like the typical cigar-shaped sea cucumber.

Uses toxic chemicals to discourage predators from preying on its tentacles.

California Sea Cucumber

Parastichopus californicus (Stichopodidae)

Distribution: British Columbia, Canada to Isla Cedro, Baja California.

Habitat: Low intertidal in areas protected from strong wave action; also on pilings in open bays, and subtidally to 90 m deep.

Appearance: California's largest sea cucumber is 25–40 cm long; dark red, brown or yellow.

Diet: Deposit feeder; organic detritus and small organisms ingested in bottom sediments.

Reproduction and Development: Breeding occurs during the summer. Development is indirect; fertilized eggs develop into several different larval forms before settling.

Mortality/Longevity: Eaten by sea stars including the sunflower star. Sea otters and humans are also predators.

Warty Sea Cucumber

Parastichopus parvimensis (Stichopodidae)

Distribution: Monterey Bay to Baja California.

Habitat: Sandy or muddy-sandy soft bottoms between rocks or in eelgrass beds, subtidal to 27 m depth.

Appearance: Length to 25 cm. Colored brown above, lighter below. Conical black-tipped papillae on the dorsal side provide the common name.

Diet: Digests organic detritus and small organisms in soft sediments.

Remarks: Sea cucumbers breathe through special "respiratory trees" that branch internally from the anus. Rhythmic muscle contraction and relaxation forces water out, then brings oxygenated water in

Certain species of pea crabs and scale worms live as commensals within the respiratory tree of our local cukes, taking advantage of a protected space and small particles of food also delivered by water exchange.

PHYLUM CHORDATA.

SUBPHYLUM VERTEBRATA (VERTEBRATES)

CLASS ELASMOBRANCHII (CARTILAGINOUS FISHES: SKATES, RAYS AND SHARKS)

ORDER HETERODONTIFORMES (BULLHEAD SHARKS)

California Horn Shark

Heterodontus francisci (Heterodontidae)
Bullhead and Horn Sharks

Distribution: Monterey Bay, California to the Gulf of California.

Habitat: Solitary bottom dweller from intertidal to 150 m deep. Inhabits rocky bottoms, kelp forests, sandy draws between rocks, sand flats, deep crevices and small caves as well as large underwater caverns. Active nocturnally. Sluggish during the day, often rests among rocks with its head in a crevice. Adults tend to return to the same resting place every day.

Appearance: Horn sharks have a short blunt head with high ridges above the eyes and two dorsal fins, each with a strong spine at the origin. Color is light to dark brown above, with small, scattered dark spots on the body and fins. Spots may be faded or absent on adults. Length to 1.2 m.

Diet: Nocturnal predator of benthic invertebrates, especially sea urchins, crabs and probably abalone, also fishes. Horned sharks have 2 different types of teeth (*heterodontus* = "different teeth"); front teeth have sharp cusps for seizing prey, rear teeth are molariform for crushing crab shells. Juveniles may eat worms, and have been observed eating club-tipped anemones (*Corynactis californica*). One author noted that the horn shark's predilection for red sea urchins may result in the shark's teeth being stained a reddish brown.

Reproduction and Development: Like all sharks, fertilization is internal. The male horn shark holds the female by grasping one of her pectoral fins with his mouth and then maneuvers his tail around her so he can insert one of his pair of claspers. Horned sharks mate

during December and January; egg cases are laid from February to April. The large (length 12 cm) brown egg case is screw-shaped with a broad flange spirally twisted around it. Egg cases are scattered among rocks and in crevices. The pup emerges 7–9 months later as a miniature (16 cm) shark.

Mortality/Longevity: Long-lived, up to 25 years.

Conservation Status: Not on IUCN Red List. Commercial catch is used to produce fish meal; fin spines used in production of jewelry.

Remarks: Can clamber on substrate with flexible pectoral and pelvic fins.

Horn sharks typically spend daylight hours in one spot, usually a cave or crevice. True to their nocturnal habit, our specimens are often out of view during Aquarium hours.

ORDER CARCHARINIFORMES (GROUND SHARKS)

Swell Shark

Cephaloscyllium ventriosum (Scyliorhinidae)
Catsharks

Distribution: Central California to southern Mexico; also reported near central Chile.

Habitat: Rocky reefs and kelp forests, from surface to 460 m, in temperate and subtropical waters.

Appearance: Stout body with flat, broad head; snout short; mouth huge, proportionally larger that the great white shark (*Carcharodon carcharias*).

Diet: Active at night; feeds on crustaceans and fishes, often blacksmith. Lie-in-wait predator that sits on the bottom with wide-open mouth, ready to ambush unsuspecting prey.

Reproduction and Development: Female lays amber-colored egg cases that hatch in 8–10 months. Young have enlarged toothlike denticles on the back that help them break through egg cases.

Mortality/Longevity: Embryos may be eaten by snails that bore through egg cases.

Conservation Status: Numbers declining along the California coast, perhaps due to changes in sea temperature.

Remarks: Hides in caves and crevices during the day, and so is often not to be seen during normal aquarium hours.

Common and specific (ventriosum = "large belly") names come from its ability to take in water that makes it appear up to twice as large as its normal size, a difficult meal for predators to bite or to remove from a crevice. If caught and brought to the surface, it can swell its body with air.

Leopard Shark

Triakis semifasciata (Triakidae)
Houndsharks

Distribution: Oregon state to Baja California and northern Gulf of California.

Habitat: Prefers sandy and rock-strewn substrate near rocky reefs. Most commonly in enclosed muddy bays, including estuaries and lagoons, typically at less than 3.7 m depth, but ranges to 91 m.

Appearance: Grayish with bronze tinge above, white below. Broad black bars, saddles and spots on dorsal surface; saddles solid in young, with light centers in adults. Adults have more spots. Males to 2 m; females slightly larger.

Diet: Fishes (especially northern midshipman, sanddab, shiner perch, bat rays and smooth-hounds), siphons of clams, crustaceans such as crabs and shrimp. Feeds heavily on fish eggs (herring, jacksmelt and topsmelt) attached to rocks and plants.

Reproduction and Development: Ovoviviparous. Litters 4–29. Young average 21 cm at birth.

Mortality/Longevity: Can live to at least 30 years. Part of the commercial shark fishery and very popular as a sport "fish." Preyed upon by other sharks.

Conservation Status: This mid-sized coastal shark is fairly common in bays and estuaries of the eastern North Pacific from California to the northern Gulf of California, Mexico.

Remarks: Often in schools with other hound-sharks Nomadic; schools may visit an area briefly, then depart.

Most research on this species has been conducted in the SF Bay; thus there is a tie-in with the Academy's Bay2K project.

In SF Bay, leopard sharks tend to remain in the Bay throughout the year, with some emigration during fall and winter.

Fossils of leopard sharks have been discovered in deposits dated to more than 1,000,000 years old in southern California.

Blacktip Reef Shark

Carcharhinus melanopterus (Carcharhinidae)
Requiem Sharks

Distribution: Subtropical from Red Sea and East Africa to the Hawaiian Islands and the Tuamoto Archipelago. Also enters the Mediterranean from the Red Sea (via the Suez Canal).

Habitat: Prefers inshore coral reefs and the intertidal zone. Has been observed in mangrove areas and fresh water, traveling in and out with the tide.

Appearance: Up to 2 m long and weight up to 13.6 kg. All fins tipped with black, the large dorsal fin with a white band beneath the black tip, conspicuous white bands along flanks, sometimes edged with black. Otherwise, yellowish-tan above, white below.

Diet: Mostly bony fish and cephalopods, also other mollusks, shrimp.

Reproduction and Development: Viviparous, incubate young for up to 16 months, 3– 4 pups per litter. In a fashion not uncommon in sharks, the male takes the female's pectoral fin in his teeth and the two mate belly to belly.

Mortality/Longevity: Preyed upon by other sharks as well as large groupers. Average lifespan c. 12 years.

Conservation Status: Listed as Near Threatened by the IUCN, due to small litter size and long gestation period.

Remarks: Often hunt in packs, driving prey into a tight ball and then attacking the ball in a feeding frenzy, even leaping out of the water. Its distinctive appearance and active swimming habit make it a favorite specimen for aquariums. It has been known to bite people wading in shallow water and is aggressive towards spear fishers.

When foraging, may enter water so shallow that both back and fins are exposed, a potentially shocking sight to a wader.

Fortunately, there are very few reports of black tips biting humans. Rare occurrences are most likely a case of mistaken identity on the part of a normally shy but easily frightened shark species.

Nearly all shark species are under heavy pressure from an ever-more efficient fishing industry. Blacktip populations are declining: the flesh is eaten, the liver is prized for yielding a valuable oil, and the fins are used for shark-fin soup, especially in the Far East.

ORDER RAJIFORMES (SKATES AND RAYS)

Bowmouth Guitarfish

Rhina ancylostoma (Rhinobatidae)
Guitarfishes

Distribution: Indo-West Pacific: Red Sea and East Africa to Papua, New Guinea, north to Japan, south to New South Wales, Australia.

Habitat: Sand and mud bottoms in coastal areas, coral reefs close inshore. Sometimes found in the water column. Found at depths from 3–90 m.

Appearance: Length to 2.7 m, weight to 135 kg. Broad, rounded snout, clearly demarcated from the pectoral fin. Long tail. Gray or brownish above, white below, white spots dorsally on fins, body and tail, black spots on head and shoulders. No venomous sting. Heavily ridged crushing teeth. A large row of spines along the head, nape and shoulders is a distinctive characteristic.

Reproduction and development: Ovoviviparous.

Diet: Primarily bottom-dwelling crustaceans and mollusks.

Conservation Status: Vulnerable; not common, population declining due to overfishing and heavy pressure on habitat. A low reproductive rate exacerbates its vulnerability.

Remarks: Although classified as a ray, guitarfish do not have their pectoral fins fused to their head as do other rays. In appearance they look like a cross between a ray and a shark and are often known as shovelnose sharks. In most rays the caudal fins are separate from the tail, but in guitarfish, again like sharks, the tail is the caudal fin, though lacks a lower lobe.

They are caught for the Asian food market and their pectoral fins are highly valued. When caught in a net they are very difficult to handle and can cause severe damage to other fish caught at the same time.

The use for the spines is unknown; they may be used for butting.

Big Skate

Raja binoculata (Rajidae)
Skates

Distribution: Bering Sea and southeastern Alaska to central Baja California.

Habitat: Bottom dwellers on soft substrates, usually from shallow water to 300 m. Found

along the coast in estuaries, bays, and over the continental shelf.

Appearance: Flat, diamond-shaped body with long, pointed snout; lacks the prominent notch on the rear edge of their pectoral fins common to all other Pacific Coast skates. Color: ranges from brown, gray, olive, and muddy black. Large eyespots, one on each upper pectoral fin, as well as bright dots and mottlings. Average length: 1.3 m; largest known: 2.4 m.

Diet: Benthic shrimps, worms, clams, some fishes.

Reproduction and Development: Oviparous. Lays distinctively large (up to 30 cm) egg capsules in pairs on substrate; sometimes on display in the sand dollar exhibit. Capsules contain up to 8 embryos. Eggs hatch in about 9 months and produce a small, but perfectly formed skate.

Mortality/Longevity: Life span: c. 15 years.

Conservation Status: Because they attain sexual maturity late and produce fewer offspring that most fishes, sharks, skates, and rays are especially vulnerable to overfishing.

Remarks: Usually seen hiding motionless, buried in sediments, with only the eyes protruding.

Like all skates, swimming occurs by the undulations of the pectoral fins.

A small fishery for this species exists in California; its smaller "cousin" species are even more popular as the source of the skate "wings" (the pectoral fins) served in fine restaurants.

Bluespotted Stingray

Dasyatis kuhlii (Dasyatidae)
Whiptail Stingrays

Distribution: Throughout the tropical Indo-West Pacific from the Red Sea east to the Philippines, Japan, and south to Australia.

Habitat: Sandy bottoms near coral and rocky reefs, from intertidal zone to 50 m. Moves onto reef flats and into shallow lagoon waters at high tide.

Appearance: Angular disc. Dorsal color reddish-brown to olive drab with blue spots and smaller black spots, ventral side white. Tail with black and white bands is about as long as the body and usually has one stinging spine. Maximum disc width: 50 cm.

Diet: Crabs and shrimp, also small fishes.

Reproduction and Development: Ovoviviparous; eggs retained in the female's body; embryos receive nourishment from a yolk sac.

Mortality/Longevity: Killer whales are known predators; probably also taken by other marine mammals and sharks.

Remarks: Venomous tail can deliver a painful wound. Like many other rays that wound humans, it most often stings only when inadvertently stepped on: it is difficult to see in turbid waters, especially when covered by sand with only the eyes visible.

Caught commercially, but its meat is of limited value due to its small size.

Javanese Cownose Ray

Rhinoptera javanica (Myliobatidae)
Eagle, Cownose and Manta Rays

Distribution: Tropical, Indo-West Pacific from South Africa north to India and possibly Thailand, Indonesia and southern China. Also in Okinawa, Ryukyu Islands and possibly Australia.

Habitat: Tropical bays, estuaries, among mangroves, and near coral reefs over sand and mud bottoms. Can tolerate brackish water.

Description: Bat-like, swept back pectoral fins. Double-lobed snout and indented forehead. Long, slender tail. Brown above, white below. Width up to 1.5 m, weight up to 45 kg.

Diet: Feeds on clams, oysters and crustaceans. The ray sucks in sand and expels it out of its gills, blowing off sand covering its prey.

Reproduction and Development: Ovoviviparous, 1–2 pups per litter. Females have been known to leap out of the water and slam into the surface; this action seems to be an aid in birthing.

Conservation Status: IUCN listed: Vulnerable. A declining population is inferred from the unregulated nature of inshore fisheries as well as small litter size.

Remarks: The stinger is located at base of the tail rather than half way or more down the tail as in the whiptail rays. Does well in captivity and has been known to survive for 2 years. Like its pelagic relatives the manta and devil rays, it swims by flapping its pectoral fins like wings, enabling it to swim at greater speeds than most bottom-dwelling stingrays. Sometimes these "wings" protrude above the water, bearing a frightening resemblance to a shark.

Ocellated Freshwater Stingray
Potamotrygon motoro (Potamotrygonidae)
River stingrays

Distribution: South America: Uruguay, Paraná-Paraguay, Orinoco, and Amazon Basins.

Habitat: Freshwater, able to tolerate only a narrow range of salinities.

Appearance: Length to 1 m, weight to 15 kg. Body greatly flattened and circular, composed principally of expanded pectoral fins. Tail is slender and longer than body with venomous spine. Ventral color muddy brown inset with darker brown circular markings.

Diet: Mostly benthic hard-shelled invertebrates, such as clams, mussels, and crustaceans. Also worms, insect larvae, and small fishes. Like most rays, flat teeth are used to grip and crush prey that is sucked into the ventral mouth. Like all river stingrays, it has exceptionally good eyesight and its jelly-filled sensory pores (Ampullae of Lorenzini) detect prey buried in the substrate or hidden in murky water.

Reproduction and Development: Sexes separate. Fertilization internal. Livebearers.

Conservation Status: IUCN Data deficient. This brackish water ray is poorly known and life history and population data are lacking. Further studies and a new assessment in the near future have been highly recommended, due to the limited geographic range and the major impacts affecting river habitat of this species.

Remarks: River Stingrays (Family Potamotrygonidae) spend much of the time buried in sand or mud with only their relatively large eyes protruding.

This family is the only group of rays adapted exclusively to freshwater and is found only in Neotropical river basins.

Potent venomous spine, used defensively, makes this a dangerous species. Like all stingrays, sheds spine periodically as the individual grows.

White-blotched River Stingray
River Stingrays
Potamotrygon leopoldi (Potamotrygonidae)

Distribution: South America: Tocantins River basin.

Habitat: Freshwater, able to tolerate only a narrow range of salinities.

Appearance: Width to 45 cm. Body greatly flattened and circular, composed principally of expanded pectoral fins. Tail is slender and longer than body, has venomous spine. Color black, white polka dots.

Diet: *See* Ocellated Freshwater Ray above.

Reproduction and Development: Ovoviviparous. Like all in the family, fetuses developing in the mother's uterus first feed on their yolk sacs, after which filaments develop from the uterine wall and carry nutrients and remove wastes from the fetuses until they are fully developed.

Conservation Status: A rare, poorly known river ray, possibly endemic to river drainages in Brazil where freshwater habitat degradation is occurring. Although this attractive freshwater ray enters the ornamental fish trade, life history and population data are lacking. Further study and a new assessment in the near future is highly recommended for this species.

Smooth Back River Stingray
*Potamotrygon orbignyi (*Potamotrygonidae)
River Stingrays

Distribution: Amazon and Orinoco basins; rivers of Guyana.

Habitat: Riverine sandy substrate into which they burrow.

Appearance: Mottled, grayish-brown, smooth skinned; rough, flat teeth; At maturity, this species can reach one meter in overall length.

Diet: Crustaceans, isopods, insects and their larvae.

Reproduction and Development: Ovoviviparous; as in all elasmobranchs, sperm transferred by clasper to female for egg fertilization. Copulate in rainy season; young are born in next rainy season.

Remarks: Shed and regenerate stings regularly.

CLASS ACTINOPTERYGII (RAY-FINNED OR BONY FISHES)

ORDER ACIPENSERIFORMES (STURGEONS)

Pallid Sturgeon
Scaphirhynchus albus (Acipenseridae)
Sturgeons

Distribution: Missouri and Mississippi

Rivers and their large tributaries, especially the Kansas River, from Montana to the Gulf of Mexico.

Habitat: Bottom dwellers in turbid, deep, fast flowing rivers over sand and gravel bars.

Appearance: Shark-like with heterocercal tale and scutes instead of scales; gray above, white below. Flat, upturned head. Four long barbels. One of the rarest and largest freshwater fishes in North America; length to over 2 m, weight over 75 lbs.

Diet: Mollusks, insects, and small fishes. The pallid sturgeon is a bottom feeder. In addition to taste buds on the tips of the barbels it has sensory organs on the ventral surface of the snout that pick up electrical fields emanating from prey. The sturgeon stirs up the muck with its snout, then the mouth, which is folded in like a telescope, shoots out to suck up prey.

Reproduction and Development: In the wild, fertilization is external; eggs scattered and not guarded. However, natural reproduction is almost non-existent. Since 1990 over 150,000 pallid sturgeon have been raised in hatcheries and released.

Mortality/Longevity: Life span: up to 50 years or more.

Conservation Status: ESA, federally listed 1990: Endangered. Not enough is known about the biology of this fish to determine exactly why it has almost disappeared, but destruction of habitat, alterations in its forage base, pollution and overfishing for both meat and eggs (caviar) are contributing factors. Additionally, the high water of spring seems to trigger mating but now river flows are so controlled by dams, especially along the Missouri, that this stimulus has mostly disappeared. Federal and state hatcheries are working to improve spawning techniques and habitat.

Our juvenile pallids came from Gavin's Point National Fish Hatchery in Montana. The Steinhart is permitted to display these endangered species as long as an educational message is presented about their distribution, endangered status, and threats facing them.

Remarks: Pallid and shovelnose sturgeon are known to hybridize, another potential threat to the pallid's survival in the southern portion of its range where shovelnose sturgeon dominate.

Often referred to as the "Dinosaur of the Missouri," the pallid sturgeon is known from 70 million years ago and at one time was the top freshwater carnivore.

Like all sturgeon, has a cartilaginous skeleton.

Shovelnose Sturgeon

Scaphirhynchus platorynchus (Acipenseridae) Sturgeons

Distribution: Ohio, Mississippi, Missouri rivers; Mobile Bay drainage, Alabama; Rio Grande in Texas and New Mexico.

Habitat: Bottom of channels of large, turbid rivers with moderate current over firm sand or gravel mixed with mud. Also in embayments.

Appearance: Length to 1 m, weight to 4.8 kg. Snout shovel-shaped. Elongate, bony plates sharply keeled. Olive to yellowish-brown above, sides lighter, white below. Tail heterocercal; skeleton cartilaginous.

Diet: A bottom feeder. Primarily eats aquatic insect larvae; also feeds on crustaceans, worms, and small fish.

Reproduction and Development: Sturgeon typically migrate from feeding grounds to particular breeding grounds in large rivers during spawning season. Fertilization external. Spawn over gravel in fairly swift water. Non-guarders. Eggs hatch and larvae drift down stream to suitable areas.

Mortality/Longevity: Likely very long-lived; data lacking.

Conservation Status: IUCN listing: Vulnerable. Species of concern (USFWS).

Today this sturgeon's roe has become commercially important as imported sources far less available Also, poaching is a problem as the species is not sexually mature until about 8–10 years old, and females reproduce only once every 3 years or so.

Remarks: As with many riverine fish species, the shovelnose sturgeon does not have a restricted home range and may travel long distances.

Was once an important game and commercial fish. Sturgeon flesh, especially smoked, is considered a delicacy by many.

Mississippi Paddlefish

Polyodon spathula (Polyodontidae) Paddlefishes

Distribution: Rivers of central United States,

especially Mississippi River and its tributaries.

Habitat: Prefers deep pools in large rivers where the current is slow; is highly mobile and has been known to travel more than 2,000 miles.

Appearance: Grey above, white below. Extended upper jaw (rostrum) flattened into paddle-shape, accounts for 1/3 of total body length. Fins stiffer than those of teleost fishes. Heterocercal tail. Skeleton cartilaginous, skin tough, scales lacking. Max length 221 cm; max weight 90.7 kg, average weight considerably less.

Reproduction and Development: Female swims upriver to spawn, lays 2 eggs at a time. Egg cases rounded. Eggs hatch in 7 days; young are swept downstream to permanent home.

Diet: Zooplankton, the majority being water fleas; also tiny crustaceans and larvae.

Predators: Only man.

Conservation Status: IUCN: Vulnerable. Threatened by overfishing throughout much of its range, particularly for its eggs since the ban on imported caviar. Dams prevent fish from reaching spawning grounds, sedimentation and river modifications destroy habitat.

Remarks: To feed, the fish swims with its huge mouth wide open. As the water passes over its gills food is filtered out by special filaments called gill rakers.

What is the paddle used for? Its broad, flat shape acts as a rudder keeping the fish stabilized and provides lift as the animal moves slowly through the water filtering out its planktonic diet.

Also, the paddle is covered with pores that extend over the head and along the gill covers. These pores are electroreceptors capable of detecting as little as 1/100 of 1-millionth volt per cm, enough to sense the presence of plankton, a valuable tool especially as vision, hearing and smell are poor.

ORDER LEPISOSTEIFORMES (GARS)

Alligator Gar

Atractosteus spatula (Lepisosteidae)
Gars

Distribution: Rivers draining to the Gulf of Mexico.

Habitat: Freshwater streams and rivers. Also found in brackish water.

Appearance: Alligator-like. Large size and broad, short, wide, blunt snout. Light dorsal stripe. Dark olivaceous brown above and white to yellowish beneath. Dark brown blotches on all fins. Body is covered with armor-like ganoid scales, diamond-shaped, interlocking, and extremely hard. Head protected by bony plates. Conspicuous teeth. Length to more than 3 m, weight to 137 kg.

Diet: Depending on which source you consult, alligator gars are either passive, superb lie-in-wait predators or aggressive voracious carnivores of fish, notorious for destroying fishnets and gulping their contents. They are all of the above! Adult gars feed primarily on fish, but have been found also to consume blue crabs, birds, reptiles, amphibians, and small mammals. Also known to scavenge.

Reproduction: Eggs laid on aquatic vegetation, to which they adhere. Young cling to the stems with an adhesive disc on their head until yolk sac is absorbed, and then swim actively. Juveniles feed on plankton, invertebrates, amphibians, and fish before transitioning to fish almost exclusively.

Mortality/Longevity: Females generally larger and longer lived than males. Some may live to 50 years or more in the wild, 80 years in captivity. Our oldest gars are 60.

Conservation Status: Not on IUCN Red List. Pollution and degradation of habitat threaten this species.

Remarks: One of the largest freshwater fish in North America.

Alligator gars have two rows of teeth, a longer one on the palate, and an outer row in the jaw, enabling them to pierce and hold prey. Take a look when one of these big fish "yawn."

Gars also have a highly vascularized swim bladder that enables them to breathe in air, an adaptation to life in water with low oxygen levels.

Fished intensively by professional and sports fisherman and marketed as a food fish.

Fish eggs are poisonous to humans.

Native Americans used armor-like ganoid scales as arrowheads and jewelry. Early American farmers used the scales on the blades of their plows.

Spotted Gar
Lepisosteus oculatus (Lepisosteidae)
Gars

Distribution: Lake Erie and south Lake Michigan drainages; Mississippi River drainage from Illinois south to East Oklahoma, East Tennessee; Gulf Coast streams from West Florida to Central Texas.

Habitat: Clear pools with aquatic plants in streams, swamps and lakes; may enter brackish water on the Gulf Coast.

Appearance: Length to 1.1 m, weight to 4.4 kg. Body cylindrical, colored dark olive to brown above. All fins with dark spots; belly whitish; snout short.

Diet: Voracious predator on fishes and benthic crustaceans.

Reproduction and Development: Spawn during the spring in shallow water over vegetation. Like all gars, the larvae have an adhesive pad on their heads, by which they affix themselves to plants.

Mortality/Longevity: Live to at least 18 years.

Remarks: Minor commercial fishery. Also taken as a gamefish.

Longnose Gar
Lepisosteus osseus (Lepisosteidae)
Gars

Distribution: Saint Lawrence River drainage; freshwater systems along Atlantic coast from south of New Jersey to Orlando, Florida; Southern Great Lakes and Mississippi River system, south to Rio Grande in Texas.

Habitat: Backwaters, large creeks, lakes; may enter brackish water; live near aquatic vegetation when young.

Appearance: Length to 2 m. Weight to 22 kg. Snout more than twice as long as head. Body cylindrical; dark olive-green to brown above, lighter on sides with dark spots, usually on posterior; belly whitish.

Diet: Voracious predators. Piscivorous; also feeds on crabs and other crustaceans. Catches prey by swinging jaws back and forth, impaling fish on its sharp teeth.

Reproduction and Development: Non-guarding egg scatterers. Eggs demersal and adhesive. Eggs are protected from potential predators by being poisonous.

Mortality/Longevity: Live to at least 36 years. Parasitized by the sea lamprey *Petromyzon marinus*.

Remarks: Considered a nuisance by fishermen because it damages gill nets and feeds on game fishes. The longnose gar is caught but rarely eaten.

ORDER OSTEOGLOSSIFORMES (BONY TONGUES AND ARAPAIMAS)

Pirarucu aka **Arapaima**
Arapaima gigas (Osteoglossidae)
Bonytongues

Distribution: Amazon River and its tributaries.

Habitat: Freshwater, enters flooded areas dense with aquatic vegetation and shore plants, avoids the acidic waters of the "black water" zones.

Appearance: Length to 2.3 m, weight to 133 kg. In the 1800s specimens 4.5 m long and 200 kg were reported. Heavy, elongate body has very large scales.

Diet: Specialized for surface feeding with their upturned mouths. Adults prey on fish at the surface; suck smaller fish into the mouth, then crush prey against the roof of its mouth with its tooth-covered bony tongue. Juveniles consume smaller organisms, especially shrimp.

Like its close relative the arawana, it can leap from the water to snatch a bird or even a monkey from an overhanging branch.

Reproduction: Spawning occurs in April and May in shallow lakes of flooded regions. Builds a nest of about 15 cm depth and 50 cm width in sandy bottoms. Male guards the eggs and the young. Once hatched, young fish follow their father.

Mortality/Longevity: Preyed upon by humans.

Conservation status: CITES Appendix II. Heavily exploited as a commercial fish throughout the Amazon. Populations have been greatly reduced during the past 200 years.

Remarks: Obligate air breather, well adapted to oxygen-deficient waters. Gulps air into its gas bladder every 10–15 minutes when oxygen levels are low.

Indigenous people utilize the scales and bones. The tongue was once used as a seed grater to make drink powders. Scales were used as scrappers.

Often referred to as the largest freshwater fish;

some freshwater catfishes and sturgeon may challenge this "record."

One of the arapaimas is the largest fish in the Steinhart by length.

Silver Arawana

Osteoglossum bicirrhosum (Osteoglossidae)
Bonytongues

Distribution: Northern South America: Amazon River system.

Habitat: Benthopelagic, freshwater tropical, 24–30 °C. Especially prevalent in flooded areas or swamps.

Appearance: Length to 1.2 m. Weight to 4.6 kg. Body covered with very big scales; dorsal and anal fins almost fused with the caudal fin. 2 barbels at the extremity of the lower jaw; adult silvery. Juvenile with blue glints and a yellow-orange bar.

Diet: Feeds mainly on crustaceans, insects, smaller fishes, and other animals that float on the water, its upturned mouth an adaptation for surface feeding. Arawana are also excellent jumpers, and have been known to leap some 2 m out of the water to pluck a surprised and often doomed insect or bird from overhanging branches. Bats and snakes have also been occasionally found as stomach contents.

Reproduction and Development: External fertilization. Male carries eggs, larvae, and young juveniles in mouth for about 2 months.

Elephant Nose

Gnathonemus petersi (Mormyridae)
Elephantfishes

Distribution: African Niger and Congo River basins, mainly in the countries of Cameroon, Nigeria and Congo.

Habitat: Turbid, muddy, bottom areas of fresh tropical waters; prefers areas with submerged wood for hiding places.

Appearance: Blackish/brown in color with a pair of yellow-white vertical bands that extend from the back of the dorsal fin to the anal fin. Elongated, laterally compressed body with a round mouth located at eye level and an extensible lower jaw, hence the nickname, "Elephant Nose."

This snout is its most unique feature. It is not actually a nose, but an extension of the mouth that is covered in electroreceptors that capture information from the weak electric field the fish generates. Receptors, which cover much of the body as well, are used to navigate, avoid predators, and find food and mates in the turbid waters of its habitat. The caudal fin is forked. Length to c. 30 cm.

Diet: This fish is a scavenger and uses its long snout to dig and find worms and insects. The elephantnose has poor eyesight, and depends on the nose's sensory receptors to find food.

Reproduction and Development: No external differences between males and females. Electroreceptors are also used to find a mate. These fish are territorial and aggressive.

Remarks: Elephantnose fish have the largest brain of any fish their size with a brain size to body weight ratio higher than a human's.

They have been used by water departments in the U.S. and Germany to test the quality of drinking water. When the quality of the water declines, the amount of electrical pulses released increases.

These fish are depicted in ancient Egyptian tombs dating from 2500 BC.

ORDER ELOPIFORMES (TARPONS)

Atlantic Tarpon

Megalops atlanticus (Megalopidae)
Tarpons

Distribution: Nova Scotia south to Brazil, Gulf of Mexico, Caribbean. West coast of Africa.

Habitat: Inhabits coastal waters, bays, estuaries, mangrove-lined lagoons, and rivers. Often found in river mouths and bays.

Appearance: Length to 2.5 m. Weight to 160 kg. Large, elongate, moderately deep and compressed body. Sides and belly silvery, back blue-gray. Caudal fin deeply forked.

Diet: Sardines, anchovies, and other fishes; shrimp, crabs, and other crustaceans.

Reproduction and Development: Spawn offshore. High fecundity, a 2.3 m female estimated to produce over 12 million eggs. Spawn in waters which can be temporarily isolated from the open sea. Larvae develop inshore and are leptocephalic in shape (flattened, tansparent, and eel-like).

Mortality/Longevity: Individuals caught and released by gamefishers are subject to injury. Natural predators are sharks. Juveniles taken

by other fishes. Live to at least 55 years.

Remarks: Have a habit of "rolling" at the surface. This behavior helps them take air into their lunglike swimbladder. This swim bladder, attached to the esophagus, can be filled directly with air and permits the fish to live in oxygen-poor waters.

Tarpon are among the most "primitive" extant bony fish.

A popular gamefish of sportfishers, due to its dynamic reaction once hooked. Since the flesh is of poor quality, they are usually released. Another source states "The flesh is highly appreciated despite its being bony." Marketed fresh or salted.

Their large (5–8 cm diameter), silvery scales are fashioned into jewelry.

Pacific Tarpon

Megalops cyprinoids (Megalopidae)
Tarpons

Distribution: Red Sea to Society Islands, north to Korea, south to SE Australia.

Habitat: Young inhabit river mouths, lakes, lagoons and swampy blackwaters.

Adults are found in inner coastal bays, mouths of rivers, and mangroves in marine and fresh waters, but generally at sea.

Appearance: Very large, silver-sided with blue-green dorsal fin and deeply forked tail. Large mouth with prominent lower jaw. Large scales. Length to 150 cm. Weight to at least 18 kg.

Diet: Primarily a diurnal predator of fishes and crustaceans.

Reproduction and Development: Breed offshore, perhaps all year long. Like true eels, undergo a leptocephalus larval stage. Unlike eels, the larvae have forked tails.

Mortality/Longevity: Life span: at least 44 yrs.

Conservation: Though the species is not rated, 2005 article in the journal Biological Conservation indicated that tarpon are at present highly vulnerable.

Remarks: A popular sport fish, edible but not prized (too bony); a minor commercial fishery target.

Tolerate oxygen-poor water by inhaling air into a lung-like air bladder.

Systematically, this oddball species is considered a "primitive" teleost.

ORDER ANGUILLIFORMES (EELS)

Snowflake Moray

Echidna nebulosa (Muraenidae)
Moray Eels

Distribution: Red Sea and E. Africa to southwest Japan and Australia, east to Hawaii and Panama.

Habitat: Shallow lagoons, reef flats and rocky shorelines in 1–18 m depth, often in open water.

Appearance: Body whitish with pattern of large black blotches containing yellow spots and numerous small blackish spots and scribbly markings between. Length to 75 cm.

Diet: Primarily crustaceans.

Reproduction and Development: Distinctive leptocephalus larvae.

Mortality/Longevity: There is a minor commercial fishery.

Conservation Status: IUCN: Not Evaluated. A 2005 article in the journal Biological Conservation indicated this fish is presently highly vulnerable to extinction.

Remarks: Solitary.

Zebra Moray

Gymnomuraena zebra (Muraenidae)
Moray Eels

Distribution: Indo-Pacific.

Habitat: Sandy and rocky substrates. In reef crevices and beneath ledges of exposed seaward reef flats and seaward slopes from 2–40 m.

Appearance: Length to 1.5 m. Easily recognized by its zebra striping; usually dark brown to black with numerous narrow white bars encircling head, body and fins. Snout very blunt.

Diet: Primarily crabs. Also preys on other crustaceans, mollusks, and sea urchins. This species' close-set, pebble-like teeth are used to crush its hard-shelled prey.

Reproduction and Development: External fertilization. Eggs not guarded. Like most eels, morays undergo a lengthy pelagic leptocephalus larval stage. Are protogynous hermaphrodites.

Mortality/Longevity: There is a minor commercial fishery, but large individuals may be ciguatoxic.

Remarks: One source remarks that this moray,

like other species in its family, has a great sense of smell coupled with poor vision. Bottom line: watch your fingers and do not hand feed!

Honeycomb Moray

Gymnothorax favagineus (Muraenidae)
Moray Eels

Distribution: S. Red Sea, East. Africa to Papua New Guinea, and Great Barrier Reef.

Habitat: Reef flats and outer reef slopes of continental reefs, 1–45 m.

Appearance: Length reported to 3 m, thus one of the two largest of Indo-Pacific moray eels. Covered with dark spots the size of their eye that form a honeycomb pattern. Some individuals colored almost totally black.

Diet: Predator upon cephalopods, crustaceans and small fishes.

Reproduction and Development: Distinctive leptocephalus larvae.

Remarks: Spots variable between individuals and size, often in relation to habitat: those in clear coral reefs usually have proportionally less black than those found in turbid waters.

Often rest in crevasses with cleaner wrasses or cleaner shrimps.

Whitemouth Moray

Gymnothorax meleagris (Muraenidae)
Morays

Distribution: Red Sea and East Africa to the Marquesas and Mangaréva, north to the Ryukyu and Hawaiian islands, south to Lord Howe Island, west to Galapagos.

Habitat: Coral-rich lagoon and outer reefs among rocky, boulder strewn areas and walls. Depth to 1–51 m. Juveniles often in the intertidal zone.

Appearance: Dark brown to reddish brown with numerous close-set white spots. Length to 1.2 m. The inside of the mouth is white, thus the common name.

Diet: Primarily fish, also crustaceans.

Reproduction and Development: Like many true eels, has a lengthy leptocephalus larval stage.

Remarks: Constantly open and close mouth, an action required for respiration; not a threatening behavior.

When not feeding, rests in a hole or crack with head and forebody exposed.

The extended larval phase has resulted in this species' broad distribution.

Hunts diurnally during low tide, and likely also seeks prey nocturnally.

The comet (*Calloplesiops altivelis*) has a color pattern that mimics the whitemouth moray. This small fish is known to take cover in coral crevices when alarmed, displaying only its tail, which looks very much like the head of the moray, even including an eyespot!

California Moray Eel

Gymnothorax mordax (Muraenidae)
Morays

Distribution: Point Conception to south Baja California.

Habitat: Rocky subtidal. Diurnally rests in crevices or holes, head usually protruding. Depth 6–40 m, typically 0.6–20 m.

Appearance: Length to 1.5 m. No pectoral fins (all eels lack pelvic fins). Dark brown to green, mottled.

Diet: Feeds nocturnally upon crustaceans, octopuses and fishes. Prey detected by smell.

Reproduction and Development: Oviparous. Waters off southern California probably too cold for reproduction of this species, thus recruitment (there) is by larvae that drift north from Baja. 30 cm individuals about 2 years old.

Mortality/Longevity: Live to more than 30 years.

Remarks: Constantly open and close mouth. Moray eels do this to aid respiration. The behavior is not a threat display.

Octopuses have a chemical in their ink that temporarily disables the moray's sense of smell.

Ribbon Eel

Rhinomuraena quaesita (Muraenidae)
Morays

Distribution: Indo-Pacific from East Africa to the Tuamota Archipelago (French Polynesia).

Habitat: Lagoons and associated reefs at depths up to 57 m.

Appearance: Long thin body and high dorsal fins. Juveniles are black with a yellow dorsal fin, males are mostly blue, and females are mostly yellow. Length up to 130 cm.

Diet: Mostly small fishes, some invertebrates.

Reproduction and Development: Protandrous

hermaphrodite. As the ribbon eel grows and matures, it changes sex from male to female and its color changes from blue to yellow. This is the only moray known to undergo such abrupt changes in sex and color.

Mortality/Longevity: May have lifespan up to 20 years in the wild.

Remarks: The ribbon eel buries itself in sand or hides in rocks or reefs, sometimes with head protruding, lying in wait or emerging to hunt for small fish. Like all morays, it rests with mouth open, displaying sharp teeth that appear ready for use. Actually, ribbon eels are among the least aggressive of morays, the gaping mouth simply aiding breathing by allowing oxygenated water to enter and pass over the gills.

Spotted Garden Eel

Heteroconger hassi (Congridae)

Conger and Garden Eels

Distribution: Indo-Pacific: Red Sea and East Africa to the Society Islands; tropical, between 30 degrees N to 23 degrees S.

Habitat: Usually found on sandy bottoms near a reef at depths of 7–45 m with some current.

Appearance: Up to 40 cm in length with a body diameter of about 14 mm. Color is variable with tiny spots covering the body including three large black spots, two of which are usually visible. The third spot is on the anus, which is usually in the burrow. Like all members of the family, they lack scales. Lack pelvic fins and pectoral fins reduced. Males larger than females.

Diet: Microscopic animals in the water column.

Reproduction and Development: During mating season, males and females move their burrows closer together. With tails remaining in their burrows, they meet and entwine bodies. Males defend the females they have chosen. After mating the fertilized eggs are released into the current and float near the surface in the open ocean. The eggs hatch and the larvae float until the eels are large enough to swim down and make a burrow.

Remarks: Garden eels are usually found in colonies containing up to several hundred, even thousands of individuals.

The garden eel drives its pointy tail into the sand to create a burrow. The skeletal features of the tail have been reduced and fortified to create a firm, pointed burrowing tool. Movement of the dorsal fin ejects sand and secretions from the skin harden and stabilize burrow sides.

Part of the eel's body remains in the burrow as it faces the current to feed., using its large eyes to find tiny animals floating by. When approached, the animal withdraws quickly into its burrow for protection. Anyone popping up in our "pop-up" should experience this reaction.

Garden eels, because they do not take bait from hooks and were not netted because they rarely leave their burrows, were discovered only with the advent of SCUBA.

ORDER CLUPEIFORMES

Pacific Herring

Clupea pallasii (Clupeidae)

Herrings, Shads, Sardines, Menhadens

Distribution: Found along the Pacific coast of North America and northeast Asia. Most common along the California coast from Baja California north to Alaska and the Bering Sea.

Habitat: Typically a coastal, schooling species, found at depths from the surface to 250 m at various times of the year.

Appearance: Dark blue to olive above, silvery below. Pacific herring look similar to Pacific sardines, but lack the dark spots usually seen on the sides of sardines.

Diet: Juveniles: mainly crustaceans, but also decapod and mollusk larvae; adults: larger crustaceans and small fishes.

Reproduction and Development: Move nearshore into bays and estuaries to spawn in large aggregations. San Francisco, Richardson, and Tomales Bays are among important local spawning areas, most often between January and February. Sticky eggs are attached to marine plants, rocks, or pilings, usually in rows 1–2 eggs deep. However, spawning can be so intense that egg masses may be as thick as 5 cm. Young stay in shallow waters until the next fall, when they head to sea.

Mortality/Longevity: Important prey for many other fish species, seabirds, and marine mammals, especially during spring spawning aggregations. Eggs are consumed by benthic

animals and seabirds. Larvae and juveniles also an important key to the marine food web. Maximum reported age: 19 years, Alaska. California populations typically to 11 years.

Conservation Status: Though the herring fishery has collapsed in various areas during the past 75 years, the species is not listed by the ESA or IUCN.

Remarks: An extremely important commercial fish. Pacific herring is smoked, dried, and canned, as well as used to produce oil and meal. The most profitable market is for herring roe (eggs), a popular food item in Asia, especially in Japan, where the eggs, slightly salted and still attached to edible algae, are considered a delicacy.

Pacific Sardine

Sardinops sagax (Clupeidae)
Herrings, Shads, Sardines, Menhadens

Distribution: Southeast Alaska to California; Peru to Chile.

Habitat: Pelagic: 0 to 200 m.

Appearance: Length to 38 cm. Blue green on back, white on flanks.

Diet: Zooplankton.

Reproduction and Development: Traveling in large schools insures plenty of mates. Eggs and larvae are pelagic.

Mortality/Longevity: To 25 years. Eaten by many fishes, birds, and marine mammals as well as humans.

Conservation Status: The most important California fishery from the 1920s thru the 1940s and made famous in the writings of John Steinbeck. Overfishing and a natural cycle of oceanic conditions led to a population collapse in the 1950s and for a time doomed Monterey's Cannery Row. The fishery showed signs of recovery in the 1980s and fully recovered by the late 1990s.

Northern Anchovy

Engraulis mordax (Engrauladidae)
Anchovies

Distribution: Northern British Columbia to Cabo San Lucas, Baja California.

Habitat: Mainly California coastal waters, usually near shore but may be found to 200 m. Pelagic; travels in large schools.

Appearance: Body is metallic blue to greenish above, silver below; round in cross-section. Max. length: 23 cm.

Diet: Filter feeder on plankton, fish larvae and eggs.

Reproduction and Development: Spawns in winter; eggs hatch in 2–4 days, and larvae enter plankton.

Mortality/Longevity: Life span: up to 4 years.

Remarks: Provides food for other fish, birds and sea mammals. Also used as bait and processed for oil and fish meal.

Schools move up and down the coast over fairly long distances.

ORDER CYPRINIFORMES

Tricolor Sharkminnow

Balantiocheilos melanopterus (Cyprinidae)
Minnows or Carps

Distribution: Southeast Asia.

Habitat: Midwater depth in large and medium-sized rivers and lakes.

Appearance: Elongated silver body up to 35 cm in length; black margins on dorsal, caudal, anal and pelvic fins; large, prominent eyes.

Diet: Phytoplankton, small crustaceans, rotifers, insects and their larvae.

Reproduction and Development: External fertilization.

Conservation Status: IUCN listed: Endangered: becoming rare or extinct in many river basins.

Java Barb

Barbonymus gonionotus (Cyprinidae)
Minnows or Carp

Distribution: Southeast Asia: Mekong and Chao Phraya basins, Malay Peninsula, Sumatra and Java.

Habitat: Found midwater to bottom of rivers, streams, and floodplains, especially in quiet water. Moves into flooded forest during high water.

Appearance: Compressed body with small head and pointed snout.

Diet: Plant matter, invertebrates.

Reproduction and Development: Females scatter eggs on the substrate. No parental care.

Remarks: A market fish; aquacultured in some areas.

Tinfoil Barb
Barbonymus schwanenfeldii (Cyprinidae)
Minnows or Carps

Distribution: Mekong and Chao Phraya basins, Malay Peninsula, Sumatra and Borneo.

Habitat: Rivers, streams, canals and ditches. Also enters flooded fields.

Appearance: Large individuals silvery or golden yellow, dorsal fin red with a black blotch at the tip; red pectoral, pelvic and anal fins; red or orange caudal fin with white margin and a black submarginal stripe along each lobe. Length to 35 cm.

Diet: Largely herbivorous, consumes aquatic plants and submerged land plants as well as filamentous algae. Occasionally feeds on insects, worms, crustaceans and small fishes.

Reproduction and Development: Spawns seasonally in winter. Fertilization external. Do not guard eggs.

Remarks: Caught by subsistence and commercial fishers; raised in aquaculture. Usually marketed fresh. Also marketed live for the aquarium trade.

Celestial Pearl Danio
Celestichthys margaritatus (Cyprinidae)
Minnows or Carps

Distribution: Asia: Myanmar. Also reported from Thailand.

Habitat: Inhabits small, shallow seepage and spring-fed ponds with luxuriant vegetation.

Appearance: Body is covered with small, pearly dots. Gill covers are transparent and reveal the blood-red gills. Fins are patterned with black and red lines. Males more brightly colored than females. Max. length: 2.1 cm

Diet: Omnivorous.

Reproduction and Development: After a courtship ritual, spawning takes place with eggs laid in vegetation.

Mortality/Longevity: Life span: 3 years.

Conservation Status: Because travel in Myanmar is restricted by the government, IUCN has not evaluated this fish's status. In 2007, Myanmar's Department of Fisheries identified a number of new locations where populations have been found, and some involved with the export trade reported that people in rural areas were making significant income from the sale of *C. margaritatus*. Hopefully, captive breeding by aquaria and hobbyists, which has been successful, will take pressure off of wild population.

Remarks: This handsome small species was first discovered in 2006, and has since become quite popular in the aquarium trade.

Siamese Algae-eater
Crossocheilus siamensis (Cyprinidae)
Minnows or Carps

Distribution: Mekong, Chao Phraya and Xe Bangfai basins; Malay Peninsula.

Habitat: Found at bottom depths in streams and rivers. Moves into flooded forests during periods of high water.

Appearance: Dorsal side brown, ventral white; black, wide longitudinal stripe on the side. Length to 16 cm.

Diet: Algae, phytoplankton and periphyton (layer of small plants and animals attached to surfaces projecting above the substrate).

Reproduction and Development: Likely spawns in flooded forests.

Koi aka **Common Carp**
Cyprinus carpio (Cyprinidae)
Minnows or Carps

Distribution: Probably native to the Danube River; has been introduced world wide.

Habitat: Favor large freshwater bodies with slow-flowing or standing water and soft bottom sediments. Koi thrive in large turbid rivers.

Appearance: Length to 1.2 m. Weight to 37.3 kg. Coloration ranges from grey to bronze; the back is dark, the sides lighter, ventral side even lighter. Paired fins are slightly red during the spawning period. That said, individuals are highly variable in form, proportions, development of fins, and color. Coloration is reportedly brighter in koi from rivers and darker in those that inhabit muddy pools. Wild carp usually have a less stocky build than aquafarmed individuals.

Diet: Omnivorous. Feed primarily on aquatic insects, crustaceans, annelids, mollusks, seeds of weeds and trees, wild rice, aquatic plants and algae. Gather food mostly by grubbing in sediments.

Reproduction and Development: Spawn during spring and summer in temperate

regions, throughout the year in the tropics. Polygamous: a spawning female is typically followed by several males. Fertilization is external. Female deposits sticky eggs in shallow vegetation. An average-sized female can produce about 300,000 eggs in a season. A larger female can deposit more than one million eggs per season. Eggs are not guarded, and hatch after four days.

Mortality/Longevity: Live to 20 years.

Remarks: A highly popular fish in the commercial trade, also a gamefish.

Romans introduced carp into various locations in northern and western Europe as a food fish. Monks in medieval times continued this "Johnny Appleseed" manner. Thus the native and introduced habitats of the koi are presently impossible to tease out.

Koi are a plastic species with a marked tendency to produce differing varieties and races in response to selective breeding and environmental factors. They have been selectively bred in many areas, especially Japan, for over 200 years.

Zebra Danio
Danio rerio (Cyprinidae)
Minnows or Carps

Distribution: Indo-Pacific.

Habitat: Streams, canals, ditches, and ponds as well as rice fields.

Appearance: Named for its five horizontal blue stripes extending along on the sides of the body as well as the anal and caudal fins. Grows to 6 cm. Males have gold stripes between the blue and females have silver.

Diet: Omnivorous. Small aquatic insects, crustaceans, worms, and plankton.

Reproduction and Development: Egg-scatterers; produce about 100 eggs in a single spawning. Breed readily in captivity.

Remarks: Typically a schooling fish. This species is useful for studies of vertebrate development and gene function as they reproduce easily and quickly, developing from egg to larva in less than 3 days. Zebra danios have the distinction of being one of the few fishes to have flown in space. In June, 1976, Salut 5 carried tortoises and a zebra danio (not to mention cosmonauts)!

Redtail Black Shark
Epalzeorhynchos bicolor (Cyprinidae)
Minnows or Carps

Distribution: Originally from the Mae Klong River in Thailand.

Habitat: Middle and bottom levels of freshwater streams and rivers, especially areas with rocks and/or plants for resting and hiding.

Appearance: A striking fish with deep velvet-black body and bright red caudal fin. Max. length: 15 cm.

Diet: Omnivorous, primarily a bottom-feeding scavenger. (Note the downward facing mouth with barbels for locating food items and feeding on soft substrate.)

Reproduction and Development: Spawner, egg layer.

Mortality/Longevity: Life span: 6–8 years.

Conservation Status: Currently extinct in the wild, probably due to construction of dams and draining of swamps rather than overcollecting, as some suggest. All red-tails available in fish stores today are commercially raised by the aquarium trade industry.

Remarks: This fish is aggressive and territorial. In spite of its common name, most likely a reference to its streamlined, torpedo shape, it is not a shark.

Cherry Barb
Puntius titteya (Cyprinidae)
Minnows or Carps

Distribution: Native to Sri Lanka with introduced populations established in Mexico and Colombia.

Habitat: Heavily shaded streams and rivulets, preferring shallow, slow-moving water with silt substrate and leaf cover.

Appearance: An elongated fish with a compressed body, fawn-colored on top with a slight greenish sheen. Sides and belly have silver highlights with a horizontal stripe extending from the tip of the snout through the eye to the base of the caudal fin, with an iridescent, metallic line above it. Males are redder than females and attain a deeper red color at breeding time; females lighter with yellowish fins. Max. length: 5 cm.

Diet: Omnivorous.

Reproduction and Development: Open water,

substrate egg-scattering fish. Males swim just behind females and chase away rival males. Adults spawn 200–300 eggs and scatter them on plants and on the substrate and eat as many eggs as possible when finished. The successful ones hatch in 1 or 2 days and become free swimming within 48 hours.

Conservation Status: Commercially important in the aquarium trade, and the more colorful varieties are in danger of being over-fished. IUCN listed: lower rjsk/conservation dependent.

Remarks: Cherry refers to the fish's red color.

Redstripe Rasbora

Rasbora pauciperforata (Cyprinidae)
Minnows or Carps

Distribution: Southeast Asia: Thailand, Cambodia, Malaysia, Sumatra.

Habitat: Sluggish forest streams, marshes, and swamps with overhanging and overgrown vegetation.

Appearance: Max. size: 7 cm. Back olive brown, body brownish gray, belly white. A bright stripe runs from the tip of the snout to the caudal fin. Stripe may be red, deep orange, or golden depending on diet, condition, or mood.

Diet: Micropredator on small worms, crustaceans, insects and zooplankton.

Reproduction: Eggs are scattered among plants, and hatch in about one day. Fry are free-swimming in 3–5 days. No parental care.

Mortality/Longevity: Life span: 3–5 years.

Conservation Status: Not evaluated, but its habitat is under threat from rubber/palm oil plantations, building developments, and other human activities.

White Cloud Minnow

Tanichthys albonubes (Cyprinidae)
Minnows or Carps
Carps and Minnows

Distribution: Asia: Southern China and Vietnam.

Habitat: Clear freshwater streams with vegetation.

Appearance:. Length: c. 2 cm. Elongated body with upturned mouth; slender, gold stripe extending from eye to the caudal fin, with blue/black parallel stripe below. Spot on caudal peduncle. Males slimmer and more intensely colored.

Diet: Zooplankton, detritus.

Reproduction and Development: Spawning takes place when male curls the rear of his body around the female. Eggs are attached to plants, and not guarded by parents. Easily bred in captivity.

Mortality/Longevity: Life span: 3– years.

Remarks: The species was supposedly first known from the White Cloud Mountains near Canton, China. *Albonubes* means "white cloud".

Today the white cloud minnow is nearly extinct in its native habitat, but because they are easily are captive bred, they are readily available in the aquarium trade

Harlequin Rasbora

Trigonostigma heteromorpha (Cyprinidae)
Minnows or Carps

Distribution: Thailand to Sumatra, Indonesia.

Habitat: Forest streams.

Appearance: Length to 5 cm. Color pattern reddish, pinkish or orange body with a conspicuous black stripe from below dorsal-fin origin to middle of caudal fin base and usually broadened anteriorly so as to have a triangular or hatchet shape. No barbels.

Diet: Feeds on worms, crustaceans and insects.

Reproduction and Development: Eggs spawned at the underside of broad leaves or similar structures. Parents do not guard eggs.

Hampala Barb

Hampala macrolepidota (Cyprinidae)
Minnows or Carps

Distribution: Asia: Mekong and Chao Phraya basins, Malay Peninsula and Indonesia.

Habitat: Occurs mainly in clear rivers or streams with running water and sandy to muddy bottoms. Found in most water bodies, except small creeks, torrents, and shallow swamps. A migratory species which enters flooded forests. Abundant in the Mekong.

Appearance: Length to more than 70 cm. Black bar between the dorsal and pelvic fins in adults; orange to red caudal fin with a black longitudinal, marginal stripe along each lobe. Scales silvery-pink with dark trailing scale margins in adults. Juveniles usually with an additional

vertical bar on the caudal peduncle. Juveniles with black teardrop-shaped marking on cheek; barbel always longer than eye width. Eyes located on upper-side of head.

Diet: Predatory. Adults mainly piscivorous, but in Saguling Reservoir, West Java, 74% of the diet consists of aquatic insects.

Reproduction and Development: Breeds throughout the winter rainy season.

Remarks: Good food fish, although bony. Marketed fresh.

Golden Shiner

Notemigonus crysoleucas (Cyprinidae)
Minnows or Carps

Distribution: East Coast of U.S. from Nova Scotia south to Florida, inland to Mississippi River drainage, and throughout most of the Midwest. Introduced to parts of Arizona and California.

Habitat: Clear, weedy, shallows of lakes, ponds, and rivers. Most often found in clear, vegetated areas, especially in quiet waters.

Appearance: Adults c. 15 cm long; females larger than males. Dark green above, olive sides, golden belly; large, loosely attached gold scales.

Diet: Young feed primarily on plankton; adults are also filter feeders on plankton, but also take aquatic insects, mollusks, and plant material, which makes up about half of the diet.

Reproduction and Development: Spawns May to July; female deposits adhesive eggs over filamentous algae and other submerged plants. Non-guarders.

Mortality/Longevity: Mature at 2–3 years; lifespan up to 9 years. Fed upon by larger fishes, including game fishes such as pike, trout and bass.

Remarks: A popular baitfish because of its bright, flashing coloration. Because baitfish are often dumped after a day of fishing, they may be introduced to new habitats, sometimes outcompeting native species. Today, some areas have banned the use of live baitfish.

Common name comes from the adult's characteristic golden sheen.

T-Barb

Puntius lateristriga (Cyprinidae)
Minnows or Carps

Distribution: Southeast Asia: Malaysia, Thailand, Singapore, Indonesia.

Habitat: Clear forest streams and rivers.

Appearance: Size to 18 cm. Noted for the black bars on the body, usually two vertical and one horizontal. Their pattern gives the fish its common name, "T-barb."

Diet: Feeds on insects, worms, and plant matter.

Reproduction and Development: Open water/substratum egg scatterers; non-guarders.

Black Ruby Barb

Puntius nigrofasciatus (Cyprinidae)
Minnows or Carps

Distribution: Southeast Asia.

Habitat: Clear, cool, shady streams in forested areas to 300 m elevation, over gravel or sand substrate. Sometimes found in pools of quiet water in the margins of clear streams and rivers.

Appearance: Length to 6.7 cm. Head red, flanks marked with 3–4 black bars. Breeding colors more dramatic.

Diet: Primarily filamentous algae and detritus.

Reproduction and Development: Spawns in shallow water among marginal weeds. Parents do not guard eggs. Eggs (>100) hatch in one to two days; fry are free-swimming after 24 hours.

Mortality/Longevity: Life span: 5 years.

Clown Loach

Botia macracanthus (Cobitidae)
Loaches

Distribution: Indonesia (Sumatra and Borneo).

Habitat: Demersal, tropical freshwater streams and rivers.

Appearance: Length to 30 cm. Body orange with 3 very broad black bars.

Diet: Feeds on annelid worms, benthic crustaceans and plant matter.

Reproduction and Development: External fertilization. Mate at the beginning of the rainy season in fast flowing rivers. Batch spawners. Nonguarders. Brood hiders.

Remarks: Minor commercial fishery; also taken for the aquarium trade.

Dwarf Loach

Botia sidthimunki (Cobitidae)
Loaches

Distribution: Cambodia, Laos, Thailand.

Habitat: Various tropical stream habitats, including flowing and standing water. Prefer areas of with bogwood, caves, and aquatic plants.

Appearance: Max. size: 6 cm. The smallest loach species. Males and females similar. The back is light brownish to light yellow with longitudinal bands that are connected by smaller bands across the back. Underside is white with a silvery sheen. Adapted to a bottom-dwelling lifestyle typical of most loaches, this species has a downward facing mouth and fleshy barbels for searching bottom gravels and mud for food.

Diet: Small aquatic invertebrates and insect larvae; algae.

Reproduction: Breeding habits in the wild unknown.

Mortality/Longevity: Life span: ~10 years.

Conservation Status: IUCN: Critically Endangered. Once thought to be extinct in the wild in Thailand, but recently rediscovered. Success in captive breeding in fish farms and aquaria has taken some pressure off wild stocks.

Remarks: The dwarf loach is a schooling fish, often found in large shoals.

Redtail Loach

Yasuhikotakia modesta (Cobitidae)
Loaches

Distribution: Southeast Asia: Mekong and Chao Phraya basins.

Habitat: Most often found in large rives over muddy substrate. Also flooded fields.

Appearance: Body bluish to grayish, occasionally with hint of green. Fins are a bright orange to red color. Mature males smaller and more slender than mature females. Max length: 30 cm.

Diet: Avid burrower for its preferred diet of worms, crustaceans, and insects. Nocturnal feeder.

Reproduction and Development: Migratory; moves to tributaries and small streams to spawn during the flood season.

Remarks: This species has a unique intestine that can act as a respiratory organ, allowing the fish to absorb oxygen at the surface directly from the atmosphere.

Tend to be territorial, with an established hierarchy with a group.

These Academy café residents are known as jumpers – hopefully they will stay in the tank and off plates!

Smallmouth Buffalofish

Ictiobus bubalus (Catostomidae)
Suckers

Distribution: Lake Michigan drainage and Mississippi River basin from Pennsylvania and Michigan to Montana, and south to the Gulf of Mexico. Also in Mexico.

Habitat: Inhabits pools, backwaters and main channels of small to large rivers. Also in lakes and reservoirs.

Appearance: Deep, moderately compressed body. Back arched. Back colored gray to dark olive, sides bronze to gray. Pelvic fins charcoal, other fins dusky. Length to 112 cm; weight to 37.3 kg.

Diet: Feeds on benthic crustaceans, mollusks; also algae. Grinds prey with the bony plates in its throat.

Reproduction and Development: Fertilization external. Scatter eggs and do not guard. One seasonal spawning peak per year.

Mortality/Longevity: Lives to at least 15 years.

Remarks: Common name refers to its large size and humped back.

Not a popular sportfish. There is a commercial fishery in the Mississippi River and some large lakes.

ORDER CHARACIFORMES

Flagtail Prochilodus

Semaprochilodus insignis (Prochilodontidae)
Flannel-mouthed Characins

Distribution: Central and western portions of the Amazon and Orinoco River Basins, Ecuador, Peru, Colombia, Guyana and Brazil.

Habitat: Tropical rivers, especially areas with aquatic plants.

Appearance: Sexes similar. Oval shaped and compressed laterally. Silver body, with orange and black striped tail and anal fin; orange/red dorsal fin and area above the head. Length: 27–40 cm.

Diet: Sifts through mud preferentially in floodplains for organic material and occasionally feeds on algae.

Reproduction and Development: Like other members of their family, they undertake dramatic mass migrations associated with both feeding and reproduction.

Mortality/Longevity: Eaten by some predatory fishes, such as the peacock bass (*Cichla temensis*), often found in the Flooded Amazon exhibit. Life span: c. 4 years.

Banded Leporinus

Leporinus fasciatus (Anostomidae)
Headstanders

Distribution: South America: Amazon and Tocantins River basins. Also Guyana.

Habitat: Rivers with sandy bottoms.

Appearance: Light tan with two distinct black spots (one before the tail and another on the flank). Length about 12 cm.

Diet: Small invertebrates, other fish, and plants. Will eat scales of larger fish.

Reproduction and Development: Spawns in open water above substrate. Doesn't guard eggs.

Remarks: *Leporinus* (L ="rabbit") relates to this fish's large protruding teeth The species is also known to leap out of the water, so perhaps its name has more than one reference point!

Like all members of its family, it very often position itself head down in rocky crevices.

Golden Pencilfish

Nannostomus beckfordi (Lebiasinidae)
Pencilfishes

Distribution: Amazon River basin in Guyana, Suriname, French Guiana and northern Brazil.

Habitat: Sluggish small rivers and swampy areas.

Appearance: Max. size: 6.5 cm. Elongate cylindrical body gives them their common name. Dark horizontal band extends through the midline from head to tail. The male is more colorful than female. The anal fin of the male has a curved posterior edge; the female's fin edge is straight

Diet: Small worms, crustaceans, insects.

Reproduction: Fertilized eggs hatch in 2–3 days; fry are free swimming 3–4 days later. Readily reproduce in captivity.

Mortality/Longevity: Life span: 5 or more years.

Remarks: A schooling fish.

Like many species of pencilfishes, has a duller nocturnal pattern and coloration that helps camouflage it from would-be predators while it sleeps.

Blind Cave Fish

Astyanax mexicanus (Characidae)
Characins

Distribution: Texas, New Mexico, and eastern and central Mexico.

Habitat: Freshwater pools within dark caves.

Appearance: Head is notable for the absence of eyes. Young born with functioning eyes which become completely enclosed in tissue as fish grows. Lack of sight is compensated by a highly developed lateral line that detects vibrations and changes in the water. The fish is without pigmentation and is plain pink with a silver sheen. They live in schools and grow to about 12 cm in length.

Diet: A keen sense of smell and electrolocation aid in finding food. Blind cave fish are omnivores and feed on animal and plant remains that wash into the caves and on bat droppings from cave ceilings. Much of their time is spent searching for food; they are able to store four times more energy as fat than their surface-dwelling relatives, allowing them to deal with irregular food supplies.

Reproduction and Development: Egg layers. Life span is approximately ten years.

Remarks: Both sighted, non-cave dwelling and blind cave forms of *A. mexicanus* exist. These fish are popular subjects for scientists studying evolution—did the cave fish lose their eyes because the lack of light and predators in dark caves selected against vision?

When lenses from sighted fish were transplanted to blind cave fish, eyes began to develop. This research may eventually prove useful in treating blindness in humans.

Blind cave fish have chemoreceptors all over the head.

Sweepline Brycon

Brycon melanopterus (Characidae)
Characins

Distribution: Amazon basin.

Habitat: Freshwater streams and Florida ivers.

Appearance: Length to over 30 cm, weight to 4.3 kg.

Diet: Consume terrestrial and aquatic plants and terrestrial and aquatic invertebrates.

Reproduction and Development: Migrate during the rainy season to formerly dry grassland to spawn. The eggs are broadcast among the submerged grasses.

Remarks: Highly esteemed as a a food fish; called the South American "trout."

Tambaqui aka **Black Pacu**
Colossoma macropomum (Characidae)
Characins

Distribution: South America: Amazon and Orinoco basins as wild form; aquacultured form is widely distributed in South America.

Habitat: Adults: open water of large rivers and seasonally flooded forests. Young stay in black waters of flood plains until maturity.

Appearance: Body laterally compressed with large eyes and an arched back. Color is basically gray to olive above, dark below often with spots and blemishes in the middle. All fins black, pectoral fins small. Size: to 100 cm long and up to 30 kg.

Diet: Adults: consume fruits and grain during seasonal flooding. Also feeds on zooplankton, insects, snails and decaying plants.

Reproduction and Development: Usually spawn once per year. Open water, substratum egg scatterers. Non-guarders.

Mortality/Longevity: Life span: 20 yrs. or more.

Remarks: Used in aquaculture because it can live in mineral poor waters and is very resistant to diseases. Marketed fresh and frozen.

Fossils of the living species have been found in the Miocene.

Silver Tetra
Ctenobrycon spilurus (Characidae)
Characins

Distribution: South America: Orinoco River basin.

Habitat: Areas of calm water.

Appearance: Deep bodied, laterally compressed, silvery color with black spot on caudal peduncle.

Diet: Zooplankton, plants, worms, insects, crustaceans.

Bucktooth Tetra
Exodon paradoxus (Characidae)
Characins

Distribution: South America: Amazon and Tocantins River basins. Also Guyana.

Habitat: Rivers with sandy bottoms.

Appearance: Light tan with two distinct black spots (one before the tail and another on the flank.) Common name comes from the large protruding teeth. Length about 12 cm.

Diet: Small invertebrates, other fish, and plants. Will eat scales of larger fish.

Reproduction & Development: Spawns in open water above substrate. Doesn't guard eggs

Remarks: Eating scales of other fishes is a behavior common to a variety of species. Scales are nutritional, offering a source of calcium carbonate and other minerals, as well as a layer of protein-rich mucus. A reliable resource, scales are plentiful, available year round, and readily regrown.

Rummy-nose Tetra
*Hemigrammus bleheri (*Characidae)
Characins

Distribution: South America, forest streams of the Rio Negro floodplain.

Habitat: Areas with dense plants and roots.

Appearance: Common name derives from the distinctive red area around its "nose" and over the eyes. The body is a silver/gold color with bold black and white stripes on the caudal fin. Males and females similar, though males tend to be slimmer.

Diet: Omnivorous.

Reproduction and Development: Egg scatterers in open water or on substrate..

Mortality/Longevity: Life span: 3–5 years.

Remarks: A popular fish in the aquarium trade as it is peaceful and moves in colorful shoals. One source reported that this species is an important part of an ornamental fishery that provides some 60% of the income of the riverine people from middle Rio Negro. The rummynose is difficult, though not impossible to breed and raise in aquaria.
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Rummy-nose Tetra
Hemigrammus rhodostomus ***(Characidae)***
Characins

Distribution: Lower Amazon River basin and Orinoco River basin.

Habitat: Tropical freshwater.

Appearance: Reddish-orange body, black margins on tail. Length to 5 cm.

Diet: Primarily insects and insect larvae, also consume plant matter.

Remarks: A popular aquarium fish. Shares its common name with *H. bleheri*.

Silver Dollar
Metynnis hypsauchen (Characidae)
Characins

Distribution: Tropical South America primarily Amazon and Orinoco basins.

Habitat: Calm river reaches overhung by foliage.

Appearance: Almost circular in profile; juveniles may be spotted or striped; adults solidly silver with anal and caudal fins edged in red or orange; grows to length of 30 cm in wild.

Diet: Generally herbivorous, eating leaves of river plants; occasionally eats worms and small insects.

Reproduction and Development: Females release up to 2000 eggs; juveniles hatch in a few days.

Remarks: A schooling species related to piranhas.

Redhook Silver Dollar
Myleus rubripinnis (Characidae)
Characins

Distribution: South America: Amazon and Orinoco River basins; north and eastern Guiana Shield rivers.

Habitat: Prefers calm zones of main rivers where vegetation hangs over the river banks. Gregarious and non-aggressive.

Appearance: Laterally compressed, "silver dollar" disc shape with brightly reflective small scales. The common name "red hook" refers to the mostly red large anal fin, bilobed in males and single in females. Mature adults often sport orange spots on the body. Max. length: 39 cm.

Diet: Feeds on the leaves of river plants. Has powerful jaws well adapted for the seeds and nuts it prefers.

Reproduction and Development: Female broadcasts eggs in water column that are then fertilized by the male. No parental care.

Mortality/Longevity: Preyed upon by larger fish, caimans, river otters, river dolphins, birds and humans.

Remarks: Can inflict serious bites.

Cardinal Tetra aka **Neon Tetra**
Paracheirodon axelrodi (Characidae)
Characins

Distribution: South America: Upper Rio Orinoco and Rio Negro.

Habitat: Mainly in schools of 12–30 over shoals in the middle water column; nonmigratory.

Appearance: Length to 3 cm. Dark above, red below with silvery blue horizontal stripe on sides.

Diet: Small crustaceans and worms.

Reproduction and Development: Move to floodplain during spring floods to spawn. External fertilization. Open water egg scatterers, broadcast 300–500 large eggs. Eggs hatch in 24–30 hours and fry are free-swimming after 3–4 days.

Mortality/Longevity: Adults often perish due to starvation after spring floods when foraging habitats retract during the low water season. Preyed upon by other fishes including piranha.

Remarks: Popular fish in the aquarium trade. Breeding in captivity is possible but difficult, thus most specimens in the aquarium trade are caught in the tributaries of the Rio Negro and Orinoco.

Pirapitinga aka **Red-bellied Pacu**
Piaractus brachypomus (Characidae)
Characins

Distribution: South America: Amazon and Orinoco River basins.

Habitat: Open water of large rivers and seasonally flooded forests.

Appearance: When young, pirapitinga look like red-bellied piranha, distinguished from its more aggressive look-a-like by the lack of the piranha's bulldog-like underbite on the lower jaw. As it grows older, its size protects it from predation, and mimicry is replaced by a black coloration, similar to the tambaqui, but less dark below.

Diet: Insects and decaying fruits and vegetation that fall into the water. (Do these fish celebrate the inevitable last flight of a bola butterfly?)

Reproduction and Development: Fertilization external, one seasonal spawning peak per year. Open water/substratum egg scatterers. Nonguarders.

Mortality/Longevity: Known to live to 28 years.

Remarks: Because pacu are closely related to piranha, sharing their coloration and shape, Hollywood producers have been known to use the pacu as a stand-in for piranha. Actors are appreciative of the pacu's preference for vegetable matter.

Like the tambaqui, an important aquacultured food fish in South America.

Red-bellied Piranha

Pygocentrus nattereri (Characidae)
Characins

Distribution: Amazon, Paraguay-Paraná and Essequibo basins.

Habitat: Freshwater creeks and interconnected pools.

Appearance: Length to 33 cm. Weight to 3.8 kg. Laterally compressed. Primarily dark scales with silvery glitter highlights. Chin and belly reddish.

Diet: Prey primarily on wounded and diseased fish. Feed communally in groups of 20–30 individuals who wait in vegetation for the opportunity to ambush prey. Once prey is attacked a feeding frenzy ensues. Adults forage at dusk and dawn, medium-sized fish most active at dawn, late afternoon and at night; small fish feed by day. Also scavenge on waste dumped into rivers from slaughterhouses. Former CAS Steinhart Aquarium director Earl Herald used to feed piranhas the hearts of horses!

Reproduction: Spawn after an elaborate courtship ritual where the mating pair swims in circles. Female deposits layers of eggs on aquatic plants; male fertilizes. Male defends and turns eggs. Masses hatch in 9–10 days.

Mortality/Longevity: Preyed upon by other fishes including large catfishes, crocodilians, birds and larger mammals including jaguar.

Remarks: The piranha's reputation as a voraciously attacking humans is highly exaggerated. The red-bellied piranha is primarily a scavenger. Stories of cows and humans striped clean of flesh may be true, but the "meal" in question was not alive when the attack took place.

Even so, piranha's can inflict a serious wound. Jaw muscles are incredibly strong, and the razor-sharp teeth on top and bottom fit in an interlocking pattern. These two features make the red-bellied piranha an efficient and formidable feeder.

Of the 20 or so species of piranha, 12 do not attack in schools. Rather they take a quick bites of the fins or scales of passing fish, causing little damage as these parts grow back.

Amazonian Indians use the sharp teeth as knives. They also coat the teeth with curare and attach them to the end of blow darts.

ORDER SILURIFORMES (CATFISHES)

Channel Catfish

Ictalurus punctatus (Ictaluridae)
North American Freshwater Catfishes

Distribution: North America: Central drainages of the United States to southern Canada and northern Mexico.

Habitat: Rivers and streams, ponds and reservoirs, especially on sand or gravel bottom near rocks or logs where they hide during the day.

Appearance: Color varies from blue, black, olive; speckled above, lighter below, with males generally darker than females. Like all catfish, are scaleless. Two barbels in upper jaw, and four below. Max. length: 130 cm; common length: 60 cm.

Diet: Opportunistic omnivores. Active at night, in search of fishes such as yellow perch and sunfish. Also snails, algae, snakes, frogs, insects, aquatic plants, and an occasional bird or small mammal.

Reproduction and Development: The channel catfish is monogamous at least for a single mating season and displays a complex courtship behavior. Mating takes place in the summer. The male and female wrap their tails around each other's head; when the male shivers, the female is stimulated and eggs and milt are released. Eggs are laid in a nest prepared by the male or both parents, often under overhangs or in deep holes. The male

guards and aerates the eggs. Both parents are known to provide food for the juveniles, the male by thrashing in the mud to stir up food particles and the female by releasing eggs over the nest for juveniles to eat.

Mortality/Longevity: Life span: usually about 15 years, some as long as 25 years. Not many predators take on a mature channel catfish. Dorsal and pectoral spines make them a nasty mouthful. Juveniles are prey to birds and carnivorous fishes.

Remarks: Farming of catfish for food is a multi-million dollar business. Introduced for aquaculture and recreational fishing in many areas worldwide.

Glass Catfish

Kryptopterus minor (Siluridae)
Sheat Catfishes

Distribution: South East Asia: Indonesia, Borneo, Malaysia.

Habitat: Among the vegetation of slow moving rivers with murky, often acidic water.

Appearance: Has two thin lateral stripes from head to tail and a body that is virtually transparent, which gives it the common name of "glass catfish." The swim bladder and other internal organs are visible. It can disappear from predators when the number of black-colored cells are reduced and platelets of guanine act as a mirror that reflect the habitat and camouflage the fish. Average length: 8 cm.

Diet: Omnivore: feeds on other fishes and small invertebrates. Using barbels, senses presence of food in river currents. Active in the daytime; feeds from middle to bottom of water column.

Reproduction and Development: An egg layer or scatterer; sexes are indistinguishable.

Remarks: Because of its transparency, is also known as "ghost " or "phantom" catfish.

Fish turns white at death.

African Glass Catfish

*Eutropiellus debauw*i aka *Pareutropius debauwi* (Schilbeidae)
Schilbeid Catfishes

Distribution: Africa: Ogowe River in Gabon, Congo system and Chiloango River.

Habitat: Freshwater schooling fish.

Appearance: Length to 11 cm. Translucent with a silvery throat and belly and three distinct stripes on each side that become more prominent with age. Female with paler stripes and more robust body.

Diet: Carnivore.

Reproduction and Development: Female deposits adhesive eggs on aquatic plants. Do not guard eggs.

Remarks: In captivity single and paired individuals are sluggish, hide, refuse food and quickly die. Apparently they have a biological need to be in a small group.

Gluttonous, will feed to bursting if overfed in captivity.

Walking Catfish

Clarias batrachus (Clariidae)
Airbreathing Catfishes

Distribution: Southeast Asia: Mekong and Chao Phraya basins, Malay Peninsula, Sumatra, Java, Borneo. Reported from Sri Lanka.

Habitat: Inhabits swamps, ponds, ditches, rice paddies, and pools left in low spots after rivers have been in flood. Usually confined to stagnant, muddy water, 1 m or less. Found in medium- to large-sized rivers, flooded fields and stagnant bodies of water including sluggish flowing canals. Undertakes lateral migrations from the Mekong mainstream, or other permanent water bodies, to flooded areas during the rainy season and returns to the permanent water bodies at the onset of the dry season.

Appearance: Length to 47 cm. Weight to 1.2 kg. Body compressed posteriorly. Upper jaw a little projecting. Extensive dorsal and anal fins. Spine of pectoral fins rough on its outer edge and serrated on its inner edge.

Diet: Feeds on insect larvae, earthworms, shells, shrimps, small fish, aquatic plants and debris.

Reproduction and Development: Spawn externally in southeast Asia during the rainy season, when rivers rise and fish are able to excavate nests in submerged mud banks and dikes of flooded rice fields. The mating pair manifests the 'spawning embrace' which is widely observed in other catfish species. The pair gently nudge each other in the genital region and flick their dorsal fins; male wraps his body around the female, then the female releases a stream of adhesive eggs into the nest. Guards nest.

Remarks: Can live out of water for quite some time and move short distances over land, sometimes migrating to other water bodies while using its auxiliary breathing organs.

A potential pest in areas other than its natural distribution. In the United States it is a nonindigenous invasive species, now established in Florida and reported in California, Connecticut, Georgia, Massachusetts, and Nevada.

In Florida, catfish have invaded aquaculture farms, and eaten stock fish. Aquafarmers have erected fences to protect their ponds.

An important food fish that is marketed live, fresh and frozen.

Upsidedown Catfish

Synodontis nigriventris (Mochokidae)
Squeakers or Upsidedown Catfishes

Distribution: Central Congo basin of Africa.

Habitat: Freshwater streams in schools of hundreds to thousands. Prefer rock caves or hollow logs for hiding during the day.

Appearance: Length to 10 cm. Ground color khaki, small reddish to black dots cover entire body. Body scaleless, head flattened, sides of body slightly compressed.

Diet: Omnivorous scavenger: Feeds mainly at night on insects, crustaceans and filamentous algae, plant debris, bowels of dead fishes. Grazes algae from undersides of cave ceilings or leaves with its little rasp-like teeth while in the inverted position, a posture also used while gleaning food from the water's surface. Also locates food on the substrate among debris such as rotting plants.

Reproduction and Development: Oviparous; parents tend their clutch.

Remarks: Swimming "upside-down" (ventral toward surface) is normal for adults of this species, which often breathe and feed at the surface.

One common name for the family refer to the group's propensity to make squeaking noises, especially when netted and taken from the water.

Armored Catfish aka Ripsaw Catfish

Oxydoras niger (Doradidae)
Thorny Catfishes

Distribution: South America: most river basins, especially Amazon and Orinoco River basins.

Habitat: Occurs over mud in streams and lakes. Form schools.

Appearance: Length to 1 m. Weight to 14 kg. Like all catfish, they lack scales. Like all members of their family, have bony plates that protect the head and hooklike scutes that run along the lateral line. Possess three pairs of barbels. A stocky brown cat. Sexes similar.

Diet: Feeds on detritus, insect larvae, crustaceans, and occasional plant material.

Reproduction and Development: Sexes separate. Fertilization external, seasonal spawning peak January to February. Adults non-guarders.

Remarks: Members of the family Doradidae are known as "talking catfishes" as they make a strange, creaking noise when removed from the water., a sound produced by movement of the pectoral spine within its socket and amplified by the swim bladder.

Most catfishes are not in this family. There are more than 30 families of "catfishes" comprising more than 2500 species; about 80 are doradids).

Perruno Catfish aka Leopard Catfish

Perrunichthys perruno (Pimelodidae)
Long-whiskered Catfishes

Distribution: South America: Lake Maracaibo basin, Colombia and Venezuela.

Habitat: Surrounding freshwater streams of Lake Maracaibo. Prefers areas with submerged tree roots and other refuges where it hides during the day.

Appearance: Max. size: 62 cm Sexes similar. The species is noted for the very long pair of barbels that extend from the upper jaw and two smaller pairs on the lower jaw. All can move independently. Dark brown, round splotches with thin, light brown markings cover the body. Dorsal fins stands tall when erect.

Diet: Mainly other fishes. A nocturnal predator.

Mortality/Longevity: Life span: about 20 years.

Remarks: Because it grows to large size quickly, this cat is best kept in the large tanks of public aquariums.

The leopard cat is the single species of its genus.

Redtail Catfish

Phractocephalus hemioliopterus (Pimelodidae)
Long-whiskered Catfishes

Distribution: South America: Amazon and Orinoco basins.

Habitat: Large freshwater rivers, streams and lakes.

Appearance: Length to 1.4 m. Weight to 44 kg. Body black with huge horizontal white band on sides. Caudal fin red.

Diet: Fish, crabs and fruit.

Reproduction and Development: External fertilization. Non-guarders.

Mortality/Longevity: Life span: c. 20 years.

Remarks:Because of its size, this cat is a popular game fish.

Has been introduced, but is not established in Florida, perhaps a good thing as the redtail is a voracious predator on smaller fishes.

Tiger Shovelnose Catfish

Pseudoplatystoma fasciatum (Pimelodidae)
Long-whiskered Catfishes

Distribution: South America: Amazon and Orinoco basins.

Habitat: Riverbeds, shady streams, flooded forest areas.

Appearance: Elongated, streamlined body with long snout; large mouth with three pairs of long barbels. Black spots and stripes on body and fins in irregular pattern; the pattern is banded, thus the common name. Usually silver to brown above; white to silver below. Can grow to 90 cm or more in captivity.

Diet: Nocturnal hunter; feeds on fish and crabs.

Reproduction and Development: Separate sexes, external fertilization. Does not guard eggs.

Remarks: Prized as food and game fish, and often found in South American food markets. Flesh is succulent.

Suckermouth Catfish

Hypostomus plecostomus (Loricariidae)
Armored Catfishes

Distribution: South America: Guianas. Has been introduced to several Asian countries for the aquarium trade.

Habitat: Freshwater coastal drainages.

Appearance: Body robust; caudal peduncle not depressed. Upper parts of head and body encased in longitudinal rows of scutes; lower surface of head and abdomen naked. Sucker mouth distinctive. Color is polymorphic; dark charcoal or light beige. Length to over 50 cm.

Diet: Algae and small crustaceans.

Reproduction and Development: Fertilization is external. Female deposits eggs on smooth rocks. Clutches of eggs are guarded by one or both parents. May deposit eggs in depressions.

Remarks: Cultured in ponds in Singapore and Hong Kong for the aquarium trade, where it is very popular. An excellent "housekeeper" of algae-prone tanks.

Midget Sucker

Macrotocinclus affinis, formerly *Otocinclus affinis* (Loricariidae)
Armored Catfishes

Distribution: South America: Brazil and other areas of the Amazon watershed.

Habitat: Heavily vegetated riverine areas.

Appearance: Max size: 5 cm. Elongated fish with a flat belly. Body is grey-green above, white below; brown, horizontal stripe runs midline. Down-facing mouth typical of bottom feeders. Lacks barbels and adipose fin. Tail fin is striped; other fins clear. Females are more robust.

Diet: Algae; mainly nocturnal feeders.

Reproduction: Eggs laid on plants, and hatch in about 2 days. No parental care.

Mortality/Longevity: Life span: 4–6 years

Sailfin Plecostomus

Pterygoplichthys gibbiceps (Loricariidae)
Armored Catfishes

Distribution: South America: Middle and upper Amazon and Orinoco basins.

Habitat: Demersal in freshwater streams, either fast-flowing or sluggish. Like most catfishes, they are active at twilight or nocturnally. Prefer concealed locations when resting near riverbanks or behind rocks.

Appearance: Length to 50 cm. Body attenuated. Dimorphic coloration: either dark brown or pale beige. Dorsal fin is higher than the body and forms an impressive sail when erect. Mouth has powerful lips which form a sucking apparatus (see Remarks below).

Diet: Feeds primarily on benthic algae and detritus; may also consume worms, insect larvae, fish eggs.

Reproduction and Development: Males construct horizonal burrows some 120–150 cm long that are used as nesting tunnels where eggs are laid and guarded by the male until

free-swimming larvae hatch and leave.

Remarks: Mouth and gill openings are ventral; despite this apparent "handicap" (always in contact with mud or gravel) Loricariid cats can feed and respire simultaneously.

Sucking mouth is used for propulsion, adhering to the substrate in fast flowing areas such as waterfalls, and moving forward cm by cm with short jerky movements.

Dorsal fin (when erected) is the reason for the common name "sailfin."

Sailfin Catfish aka **Sailfin Plecostomus**
Pterygoplichthys sp.(Loricariidae)
Armored Catfishes

Distribution: Native to South America: the Orinoco, Amazon, Parana and other river systems. Also established in Florida, Hawaii, Nevada, and Texas.

Habitat: Sluggish streams, floodplain lakes, swamps and marshes.

Appearance: Members of the genus are distinct from other members of the family due to their large dorsal fins with 9 or more long fin rays, the feature that gives them their common name "sailfin catfish." Rows of armor plating cover the body. Color usually dark brown with spots or wavy lines.

Diet: Primarily plant matter, may also scavenge. Often helpful in aquariums as algae eaters.

Reproduction and Development: See entry above.

Remarks: One of the most successful exotic species in Florida.

Because of their burrowing habitats, feeding habits, and fecundity, potential effects of *Pterygoplichthys* invasion include bank alteration and erosion, competition with native species, and disruption of aquatic food chains.

ORDER GYMNOTIFORMES (KNIFEFISHES)

Electric Eel
Electrophorus electricus (Electrophoridae)
Electric Eels

Distribution: Amazon Basin: Orinoco, and related areas in northern South America.

Habitat: Lowland backwaters and muddy river bottoms, never fast-flowing waters. During daylight, retreats to recessed hiding places shared with conspecifics.

Appearance: Large, long (to 2.5 m), round body. Very long anal fin. Weight to 20 kg.

Diet: Juveniles eat invertebrates such as shrimp; adults prey on fish and small mammals.

Reproduction: Males construct foam nests and guard the growing larvae until mid-January when the first seasonal rains flood the breeding area, causing the about 10 cm long young eels to disperse. Males outnumber females (3:1) and are considerably larger than females.

Mortality/Longevity: Life span: in captivity males to 15 years, females to 20+.

Remarks: Active nocturnally.

Unlike "true" eels in the Order Anguilliformes, they are obligate air breathers, taking up to 80% of their oxygen directly from the air, an adaptation for survival in poorly oxygenated water.

The long undulating anal fin allows the electric eel to move backwards or forwards.

About half the musculature has been converted into electric organs which produce up to 650 V. These eels use their electricity to stun the fish they prey upon, as well as for defense.

Though not an aggressive fish, can produce enough voltage to severely injure humans.

If an electric eel fires a series of charges, each successive charge is less powerful. Aquarists stimulate several discharges before attempting to handle the animal safely.

These eels also have two other, much smaller sets of electric organs, used for orientation, finding prey, and identification of foreign objects.

ORDER BATRACHOIDIFORMES

Humming Toadfish aka **Plainfin Midshipman**
Porichthys notatus (Batrachoididae)
Toadfishes

Distribution: Eastern Pacific Ocean along the West Coast of North America.

Habitat: Ranges from intertidal areas where they may remain out of water under rocks or seaweed to deeper water over sand and mud bottoms. Return to shallow intertidal waters to reproduce. Seasonally common in San Francisco, Suisun, and San Pablo Bays.

Appearance: Scaleless with eyes high on a large head, large mouth and small gills. Pelvic fins are forward of the pectoral fins; two separate dorsal fins. Olive brown to bronze or dark iridescent purple color on top and paler underneath. Up to 30 cm long. The dorsal fin holds a mild poison. Possesses photophores, which are arranged on the underside of the head in a U-shape and used to attract prey.

Diet: Omnivore: eats worms, crustaceans, mollusks and other fishes. Hides in rock crevices among bottom vegetation, or digs dens in bottom sediments to ambush prey. Diet provides the ingredients for fluorescence.

Reproduction and Development: After building and guarding a nest of rocks, the male entices females by humming his "love song," a loud sound produced by vibrating a set of sonic muscles on its air bladder six-thousand times a minute for more than an hour at a time. The female chooses her mate (we can only speculate about her preference for humming volume, length, or tone!), deposits her eggs in the nest and the male fertilizes and guards them. Males try to attract several females to the same nest.

Mortality/Longevity: Not endangered but are taken by local fishermen as a food fish and by trawlers as a source of fish meal and oil. They are prey for seals and sea lions.

Remarks: An Academy connection: For many years Sausalito residents complained of an annoying noise that kept them awake at night during the summer months. The cause was uncertain, but theories were rampant: underwater surveillance equipment, secret weapons testing, extraterrestrial intrusions were all put forth. Then in the early 90s the Academy's Senior Curator and then Director of Steinhart Aquarium John McCosker investigated and ultimately reassured irritated residents that the sound had no destructive intent, only a reproductive one.

Study of the fish's remarkable muscle endurance may lead to clues on fighting human muscle disease.

ORDER OPHIDIIFORMES

Red Brotula

Brosmophycis marginata (Bythitidae)

Livebearing Brotulas

Distribution: Eastern Pacific coast; Alaska to Baja California.

Habitat: Substrate of rocky areas at depths of 3¬–250 m, usually found at 50 m or more.

Appearance: Elongate fish. Red to reddish brown, often darker above, lighter below. Fins typically reddish with dorsal and anal fin margins bright red. Four threadlike pelvic fins extend from below the gill cavity. Lips pink. Max length: 46 cm.

Diet: Polychaete worms, small crustaceans and clams, and other invertebrates.

Reproduction and Development: Ovoviviparous; sexes separate. Males of the family Bythitidae have a copulatory organ (penis).

Remarks: This secretive little fish, usually hidden among rocks at considerable depth, is seldom seen by humans.

Flesh is reported to be sweet and fine-textured though rarely available from this hard-to-find species. One source noted the red brotula has never been caught by hook and line.

ORDER LOPHIFORMES

Frogfish

Antennarius sp (Antennariidae)

Frogfishes

Distribution: Tropical oceans worldwide.

Habitat: Rocky bottoms, coral reefs, and lagoons between 5–70 m.

Appearance: Color can be yellow, red, orange, brown, grey or black and spotted or mottled; up to 35 cm. Can change color over a few days to match its surroundings.

Diet: Small fishes, shrimps and crabs.

Reproduction and Development: Oviparous; external fertilization. Eggs are bound in a ribbon-like sheath of gelatinous mucus called an "egg raft" or "veil." No parental care.

Remarks: The frogfish, like anglerfishes in general, has a long filament attached to the head. The modified first spine of the anterior dorsal fin, this filament is decorated with an

irregular patch of flesh that dangles above the eyes and acts as a lure to attract prey for this lie-in-wait predator.

Closure of the wide mouth is triggered by contact with the lure when a fish or other food item ventures too close. Back-facing teeth that can be depressed to facilitate passage of large objects and the fish's ability to stretch both the already-huge jaws and the stomach to enormous size allow ingestion of prey up to twice as large as this angler's body!

Clingfish Family
(Gobiesocidae)
Clingfishes

The family totals about 150 species worldwide; only 2 - the northern kelpfish (Gobiesox maeandricus) and the kelp clingfish (Rimicola muscarum) are found in northern California.

Distribution: Mostly inshore fishes found in tropical and temperate oceans.

Habitat: Bottom-dwelling fishes, typicallt found on or under rocks or high up in the kelp. They possess an adhesive disc, partially formed by the pelvic fins, to cling tightly to rocks or blades of kelp even in strong currents or crashing waves.

Appearance: Most species are small, less than 10 cm length. The tapering body has a single, posteriorly located dorsal fin, fanlike caudal fin, no spines, and flattened head. Skin is smooth and scaleless, with a thick layer of protective mucus. Cryptic coloration.

Diet: Worms, small crabs, other crustaceans.

Reproduction and Development: In mating the male nudges the female's belly. If the female accepts him, the male moves parallel to her and quivers. Eggs are deposited on stones, algae, or other bottom material, and usually guarded by the male. Larvae are planktonic.

Mortality/Longevity: Usually, early maturity and short life span (about 2 years).

Conservation Status: All rocky shore creatures are at risk from coastal development and pollution such as oil spills and agricultural runoff, as well as careless visitors who can trample tide pool animals underfoot.

Remarks: Like a number of other bottom-dwelling fishes, clingfish lack swim bladders, an internal sac used by other fishes to control their position in the water.

Clingfish can adhere so tightly to a surface that a rock might be moved some distance by strong currents with the fish still attached!

ORDER ATHERINIFORMES

Madagascar Rainbowfish
Bedotia madagascariensis (Bedotiidae)
Madagascar Rainbowfishes

Distribution: Madagascar.

Habitat: It lives in shoals of 50–100 individuals among waterlogged wood in very strongly flowing water.

Appearance: Maximum size: 9 cm. Metallic blue and gold base color with small scattered black spots on the flanks.

Diet: Stomach content analysis reveals diet of mostly terrestrial insects. Thus dependent on overhead forest canopy for its insect food supply.

Reproduction and Development: In courtship, males, display their fins and colors; then male swims close to female above spawning site, and the pair propels eggs and sperm onto the substrate, to which fertilized eggs attach by adhesive threads. Spawn on rocks and roots as habitats are often devoid of aquatic vegetation. Do not guard nest. Depending on temperature, eggs hatch in about 10 days.

Conservation Status: IUCN: Near threatened. Threat is mainly from habitat loss and degradation.

Banded Rainbowfish
Melanotaenia trifasciata (Melanotaeniidae)
Rainbowfishes

Distribution: Northern Territories and Queensland, Australia.

Habitat: Mainly in small streams and waterholes in clear to moderately turbid water. Occurs over rocky or gravel bottoms or in well-vegetated areas, frequently around submerged logs and branches.

Appearance: Compressed body; small head. Males tend to be larger, deeper bodied, and more intensely colored. A conspicuous blue-black stripe runs from the snout, through the eye, and to the caudal fin. Red dorsal and anal fins edged in black. Length to 11 cm.

Diet: Crustaceans, worms, insects and insect larvae.

Reproduction and Development: When female produces eggs, male displays intense colors before fertilization takes place. Eggs are laid and develop among plants.

Mortality/Longevity: Life span: 5–8 years.

Topsmelt

Atherinops affinis (Atherinidae)
Silversides

Distribution: Southern British Columbia to Baja California.

Habitat: Usually, these fish are found at about 9 m around piers, rocky reefs, and kelp beds. In an ocean environment they may be found at depths up to 26 m. Also found in brackish bays and estuaries. Juveniles are better able to tolerate fresh water.

Appearance: Blue-grey to green above, silvery below with a blue-edged, silver line that runs the full length of the body. Lateral line lacking. Their pelvic fins are longer than those of other smelt in the San Francisco Bay and Delta. Average length: about 37 cm. Juveniles are translucent.

Diet: In the ocean, adults eat zooplankton and small crustaceans. In estuaries, they feed on plant material. Juveniles feed on algae and kelp fly larvae. They are diurnal feeders.

Reproduction and Development: Egg clusters are attached to a macroalgae and eel grass. Larvae are planktonic.

Mortality/Longevity: Maximum age: 6 to 9 years.

Remarks: They are called topsmelt for their habit of swimming near the surface where they form schools, often of thousands of individuals.

Topsmelt are able to tolerate saline levels 2 to 3 times that of the ocean, and are often found in salt evaporating ponds in San Francisco Bay.

Jacksmelt

Atherinopsis californiensis (Atherinidae)
Silversides

Distribution: Central Oregon to Gulf of California.

Habitat: Schooling fish that prefers shallow inshore waters, bays, piers, kelp beds; surface to 29 m.

Appearance: Length 33–38 cm. Greenish blue on back, silver shading below. Metallic stripe with blue border runs the length of the body.

Diet: Small crustaceans.

Reproduction and Development: Mature at 2 years and/or 15 cm long. Reproductive females spawn multiple times from October through March. Peak activity January through March. Spawning activity probably dependent on water temperature. Eggs the size of small BB's. Adhesive filaments attach large egg mass to shallow-water seaweeds.

Mortality/Longevity: Nine to 10 years, maximum: 11 years. Eaten by other fishes, marine mammals, and seabirds.

Remarks: One of the most common fish caught by pier anglers.

ORDER CYPRINODONTIFORMES

Redtail Killifish

Nothobranchius guentheri (Aplocheilidae)
Rivulines

Distribution: Africa: endemic to the island of Zanzibar. eastern Tanzania.

Habitat: Tropical freshwater, especially seasonal pools and streams.

Appearance: Males: gold face and underside, pale blue scales on sides outlined in red. Females: more subdued coloration.

Diet: Carnivorous, especially insect larvae and small crustaceans.

Reproduction and Development: Lay eggs in moist mud or sand before seasonal water evaporates. Adults die; however, eggs and embryos are able to withstand extended periods of drought and hatch whenever rains arrive.

Remarks: The lateral line of the killifish is able to sense ripples made insects struggling at the water's surface.

These and other "mosquito" fish have been studied for introduction to areas needing mosquito control. Possible adverse effects of introducing an exotic species are also being considered.

Patriciae Killifish

Pachypanchax patriciae (Aplocheilidae)
Killifishes

Distribution: Endemic to Madagascar: the monsoon forests of the northwest and the deciduous forests of the extreme north.

Habitat: Small tropical rivers and streams. Tolerates conditions from water deficient in dissolved substances to water with high concentrations of dissolved minerals, pH values from acidic to slightly alkaline. Bottom dweller.

Appearance: Max. size: 5.2 cm. Males display two color morphs: red and blue. Red males become less common and disappear completely as one moves from north to south. *P. patriciae* has a distinctly pointed snout and dorsal and anal fins that come to a sharp point in contrast to the dorsal and anal fins *P. arnoulti*, which are rounded.

Diet: Terrestrial and aquatic insects.

Mortality/Longevity: Preyed upon mostly by birds, dragonfly nymphs and other predatory insects as well as piscivorous fishes.

Conservation Status: Because of its wide distribution, this species presently faces no threats from competitors or introduced predators. Habitat loss threatens northern population. Classified as *Vulnerable* by IUCN.

Remarks: Named after Patricia Yazgi, recognizing her support of ongoing efforts to document and conserve Malagasy freshwater fishes.

The genus *Pachypanchax*, which currently has 6 described species, is endemic to Madagascar.

Golden Topminnow
Fundulus chrysotus (Fundulidae)
Topminnows and Killifishes

Distribution: River systems in the Gulf drainage of southeastern U.S.

Habitat: Warm freshwater; also river mouths and tidal rivers. Found in creeks, pools, small to medium rivers, forested wetlands, usually in areas of heavy submerged aquatic vegetation.

Appearance: Small fish to 7.5 cm. Has flattened head and back, upturned mouth, large eyes, and no lateral line. Sides flecked with gold.

Diet: Insects or other aquatic invertebrates captured near or at the surface.

Reproduction and Development: Eggs laid sporadically over a period of a week or more among the roots or stems of aquatic plants. Spawning late spring through summer.

Remarks: *Chrysotus* means "golden ear," a reference to the golden color of the gill covers.

Butterfly Splitfin aka Butterfly Goodeid
Ameca splendens (Goodeidae)
Goodeids

Distribution: Formerly in Central America.

Habitat: Was in freshwater to 2 m.

Appearance: Length: male to 8 cm, female to 12 cm. Males: silvery body, yellow vertical band on edge of caudal fin; females more drab, with small black dots on the sides:

Diet: Omnivorous, but require plant matter.

Reproduction and Development: Live-bearers. Fertilization internal. Part of the anal fin of males is separate and used in mating. Fry born with a primitive umbilical cord attached that provided nourishment from the mother during gestation. Cord drops off about 24 hours after birth.

Conservation Status: Probably extinct in the wild (IUCN). The Steinhart maintains a breeding colony.

Golden Topminnow
Fundulus chrysotus (Poeciliidae)
Poeciliids

Distribution: Found throughout Florida, along the coasts of Georgia, South Carolina and the Gulf Coast to Texas.

Habitat: Freshwater ponds, swamps, sluggish creeks and backwaters with extensive aquatic vegetation.

Appearance: The male caudal peduncle has brown-orange blotches and stipples which become more numerous at the caudal fin base. The back has a dark, narrow pre-dorsal stripe. Males have vertical bars and a scattering of red dots on the sides and flecks of iridescent blue or gold along the sides of the head and body. The fins have brown spots and the caudal fin is a faint tangerine color. Female bodies are a greenish olive color with translucent fins. Length: 2.5–5 cm.

Diet: A surface feeder on water beetles, insects and aquatic invertebrates.

Reproduction and Development: Spawning occurs in late spring through summer, with pairs depositing their eggs on roots or stems of floating plants. Eggs are extruded and fertilized singly with 10 –20 eggs produced over a period of a week or more.

Mortality/Longevity: Life span: 2 years.

Remarks: The name describes this fish. *Fundulus* means "bottom" and *chrysotus* means "golden ear," referring to the color of its gill covers.

Endler's Livebearer

Scientific name yet to be designated; *Poecilia endleri* has been suggested (Poeciliidae) Livebearers

Distribution: Northeastern Venezuela; may be extinct in the wild

Habitat: Formerly in a freshwater lagoon.

Appearance: A tiny, guppy-sized fish. The anal fin of the male, along with its internal supports of bone, muscle and cartilage, is highly modified into a copulatory organ. Female is less colorful.than the many-hued male.

Diet: Eat whatever food is available.

Reproduction and Development: Viviparous. Attain maturity quickly, allowing them to reproduce rapidly given favorable conditions.

Mortality/Longevity: Life span: probably up to 3 years.

Conservation Status: Apparently extinct in their natural habitat. Now live only in captivity.

Remarks: Dr. John Endler discovered this species in 1975 but died before his paper describing the species' provisional name was published.

This species appears to be "weedy" (has high reproductive rate at early age). Since it is apparently extinct in the wild, it illustrates that a "weed" is vulnerable to extinction, too.

Desert Pupfish

Cyprinodon macularius (Cyprinodontidae) Killifishes and Pupfishes

Distribution: North America: originally described from the lower Colorado River drainage, including Gila River system and south through Southern Arizona and California, USA (including Salton Sea) into Northern Mexico. Now occurs only at two protected locations: Quitobaquito Springs at Organ Pipe Cactus National Monument, Arizona, and a wildlife refuge at Anza-Borrego State Park, California, on the western side of the Salton Sea.

Habitat: Usually occurs over mud or sand in springs, marshes, lakes and pools of creeks; also in hot springs with temperatures up to 45° C and salinities up to 20.0 %. Able to tolerate the lowest oxygen levels of any fish species that has been studied.

Appearance: Length to 7 cm. Small, stout, deep-bodied; back silver to olive; sides silver with 6–9 dusky bars.

Diet: Primarily algae, supplemented with small invertebrates.

Reproduction and Development: Breeding males iridescent blue. Fertilization external. Females scatter eggs over substrate. Non-guarders. Hatchlings grow quickly; can reach 5 cm length in one year.

Mortality/Longevity: Life span: about 2 yrs.

Conservation Status: Listed as Endangered due to desert development and the introduction of exotic fish.

Remarks: Isolation, very small population size per breeding group, and short lifetime contribute to rapid speciation in pupfish..

ORDER BERYCIFORMES

Splitfin Flashlight Fish

Anomalops katoptron (Anomalopidae) Flashlightfishes

Distribution: East coast of Africa to the Philippines and Indonesia, north to southern Japan, south to the Great Barrier Reef.

Habitat: Steep drop offs near caves to 400 m.

Appearance: Length to 35 cm. Black with luminous organ under the eyes.

Diet: Zooplankton.

Reproduction and Development: Little known. Probably not an egg guarder.

Remarks: Light organ operates by rotation into a sac when not needed (*vs. Photoblepheron palpebratus* below); thus this fish can elect when to turn off its "lights."

Function of the glowing green light (provided by endosymbiotic bacteria) is reportedly used to communicate with conspecifics of the host.

Anomalops was discovered by the Academy's Senior Scientist and former Steinhart Aquarium Director John McCosker. On a trip to the Comoros Islands in 1977, Dr. McCosker was unable to collect his primary target, a living coelacanth; however, on a deep dive, he discovered, collected, and returned these flashlight fish to the Steinhart, the first aquarium in the world to display them.

Flashlight Fish aka **Eyelight Fish**
Photoblepharon palpebratus (Anomalopidae)
Flashlightfishes

Distribution: Philippines to Society Islands, north to Marshall Islands, south to Great Barrier Reef.

Habitat: Only observed on "moonless" nights on seaward reefs near or along steep drop offs with caves. 7 to more than 30 m. Hide in caverns during the day.

Appearance: Length to 12 cm. Black with blunt snout, large mouth and a forked tail. Luminous lime-green light organ under the eyes is diagnostic.

Diet: Zooplankton; small fish, crabs, and shrimp. Usually feeds in large groups away from the reefs at night.

Reproduction and Development: The bacteria shine only in the light organs of adults.

Remarks: A lime-green light is produced biochemically by symbiotic bacteria that live within the light organs below the fish's eyes.

The light attracts prey. The light may also allow this fish to observe prey, confuse predators and be a means of conspecific communication. (The function of bioluminescence is very much a hot topic).

A flap of skin moves over the light organ to "turn it off or on."

Soldierfish
Myripristis sp. (Holocentridae) Squirrelfishes and Soldierfishes

Distribution: Indonesia and the Philippines to the Hawaiian Islands, north to the Ryukyu Islands, south to New Caledonia.

Habitat: Reef flats and seaward slopes, 2–52 m. By day often school in large aggregations inside caves or under ledges and boulders. Non-migratory.

Appearance: Red with dark scale margins, red dorsal, anal and caudal fins; dark margin on posterior of gill cover. Length to 32 cm. Large eyes.

Diet: Feed mainly on polychaete worms; also on crabs, hermit crabs, and shrimp larvae.

Reproduction and Development: Fertilization external. Parents do not guard eggs.

ORDER INCERTAE SEDIS

Everglades Pygmy Sunfish
Elassoma evergladei (Elassomatidae)
Pygmy Sunfishes

Distribution: Southeastern U.S.

Habitat: Mostly temperate to subtropical freshwater swamps, marshes, and other shallow, slow-moving and densely vegetated waters.

Appearance: Females, young, and non-breeding males are a drab yellowish color with dark mottling, easily mistaken for dead leaves or the vegetation they use for cover. Breeding males are more colorful, turning almost black with iridescent blue spots.

Diet: Worms, crustaceans, and aquatic insects.

Reproduction and Development: To attract mates, males make elaborate courtship displays that include walking on their fins and dancing a fishy version of the twist. Females lay eggs on or in dense vegetation; the male guards the nest area until the fry hatch and scatter. Mature into young adults at about three months and begin spawning in about six months, usually in March and April.

Mortality/Longevity: Life span: ~ 1 year.

Remarks: The pygmy sunfishes are not true sunfishes (Centrachidae).

ORDER SYNGATHIFORMES

Shrimpfish aka **Razorfish**
Aeoliscus strigatus (Centriscidae)
Snipefishes and Shrimpfishes

Distribution: Indian and western Pacific oceans; Aldabra Atoll and Seychelles Islands to New Caledonia, north to southern Japan ; south to Great Barrier Reef, Australia.

Habitat: In small groups, swim and rest with head down near long-spined sea urchins, branching corals or other hiding places to 42 m.

Appearance: Length to 15 cm. Very thin body, ventral keel surrounded with contorted bony plates, long tubular snout. Coloration is silvery with brown mid-lateral stripe. In adults the trunk forms a long, powerful, flexible spine.

Diet: Minute planktonic crustaceans.

Remarks: The vertical resting posture of

this species is, anecdotally, an anti-predator adaptive response. Like many "just-so" stories pitched by biologists, this is likely the correct explanation.

Swim horizontally only when hunting. Otherwise, swim with head down and back facing the direction of travel.

If a rival enters their territory, they aim the sharp edge of the belly toward the adversary.

Janss' Pipefish

Doryrhamphus janssi (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: Indo-Australian tropical marine: Gulf of Thailand to the Solomons, north to the Philippines, south to Australia and parts of Micronesia.

Habitat: Tropical reefs: tide pools and rock crevices, also sheltered inner reefs, depth to 35 m.

Appearance: Elongate body with tube-like snout. Dark blue-brown shading on head and tail, orange-brown central body. Max. size: 14 cm.

Diet: An active cleaner, most often serving cardinal and damselfishes.

Reproduction and Development: Ovoviviparous. The male carries eggs in a brood pouch under the tail..

Remarks: Uncommon in its range.

Ribboned Pipefish

Haliichthys taeniophorus (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: Indo-Pacific: Indonesia south to Australia.

Habitat: Protected coastal shallows over or among algae, sea grasses, or floating weeds.

Appearance: Elongate body with bony knobs above the eyes and spines on body ridges. Max. size: 30 cm

Diet: Minute invertebrates and fish larvae.

Reproduction and Development: Ovoviviparous, male carries eggs in brood pouch under the tail.

Conservations Status: Not listed, but like other pipefishes and seahorses, their situation probably continues to decline.

Remarks: In spite of its name, this fish is not a true seadragon, but rather a member of the pipefish group; seadragons lack the brood pouch and prehensile tail characteristic of seahorses and pipefishes.

H. taeniophorus is the only member of its genus.

Seahorses

Hippocampus spp. (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Comments apply to all species of the genus.

Distribution: Indo-Pacific, Atlantic Ocean and Mediterranean Sea.

Habitat: Shallow tropical marine waters.

Appearance: Long and thin body enclosed in bony rings. Tubelike snout with terminal mouth. Lack pelvic fins. Length to over 16 cm. Colored brown, may have lighter spots. Prehensile tail.

Diet: Suck tiny planktonic prey, especially crustaceans, into their tubelike mouth. Locate prey with binocular vision.

Reproduction and Development: Female lays her eggs in the male's brood pouch, where they are incubated and hatched. Young expelled once capable of swimming.

Conservation Status: Many populations of seahorses are very endangered due to collection as an ingredient in the traditional Asian, especially Chinese, pharmacopeia. Also collected for the souvenir and aquarium trades.

Remarks: Evolutionarily, seahorses have sacrificed streamlining and speed for heavy armor.

Locomote with dorsal and pectoral fins; swim slowly in an upright posture.

The caudal peduncle has evolved into a prehensile "tail" for grasping plants.

Like most other syngnathids, seahorses may undergo color changes to blend with their surroundings, to indicate breeding readiness, or to indicate mood or stress.

Over 95% of the seahorses caught per year are used for traditional Chinese medicines used to treat a variety of ailments from impotence and infertility to asthma and skin diseases.

The present rate of harvest is unsustainable. Possible remedies that preserve both seahorses and useful medicines may be the synthetic production of these potions or an increase in farmed seahorse populations.

Potbelly Seahorse

Hippocampus abdominalis (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: Southwest Pacific around

Australia and New Zealand.

Habitat: Harbors and sheltered coastal bays among algae, seagrasses and rocky reefs.

Appearance: One of the largest seahorses (grows of up to 35 cm). As the common name suggests, the species is marked by a large, swollen belly. Individuals may be brown, yellow, grey, white, orange or mottled with dark spots on head and trunk. Males differ from females by having longer tails, shorter snouts, and darker markings as well as a yellow mark near the top of the brood pouch, which is extremely prominent (usually white).

Diet: Tiny crustaceans, such as amphipods and shrimp, sucked into the tube-like snouts and ingested whole.

Reproduction and Development: This species breeds in the austral spring and summer. Females seem to be attracted to males with the largest pouches, so to win the mating game, males create "potbellies" by pumping them full of water. The impressed female lays eggs in the selected pouch where they are fertilized by the male. As is the case with seahorse species in general, the eggs become embedded in the wall of the pouch; a placenta-like fluid removes waste products and supplies eggs with nutrients and oxygen.

Conservation Status: Threats include habitat loss, incidental by-catch in commercial fisheries, and collection for the aquarium and oriental medicine trades. Australia strictly controls catch and export. Like all seahorse species, listed Appendix II by CITES.

Remarks: The potbelly seahorse is one of the strongest swimming seahorse species.

Lined Seahorse

Hippocampus erectus (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: North and South American coastline from Nova Scotia to as far south as Argentina.

Habitat: Commonly found in sea grasses along coastal areas and in bays and salt marshes at depths of 0.5 –30 m.

Appearance: A deep-chested, hardy seahorse. Colors range from black-brown, gray, green, yellow, orange, and red. These colors are may change with surroundings, diet, stress, mood, or possibly other factors.

Diet: Zooplankton.

Reproduction and Development: As with all seahorses, male broods and cares for the young. *H. erectus* females spray several hundred eggs into the male brood pocket. Eggs hatch within about 20 days, and embryos continue to be carried within the pouch until they are capable of free swimming.

Like most seahorses, *H. erectus* is monogamous; a seahorse will mate exclusively with the same partner for life. Partners reaffirm their relationships with a ritual morning dance.

Conservation Status: Listed as "Vulnerable" by IUCN. This species is taken as bycatch in shrimp trawls ad is also affected by habitat degradation caused by pollution and coastal development,

Remarks: *H. erectus* is a weak swimmer. One estimate: crossing a bath tub would take an individual about 5 minutes!

The lined seahorse is traded for use as aquarium fishes, curios and traditional Chinese medicine.

Spotted Seahorse

Hippocampus kuda (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: Maldives to southwest Japan and northern Australia, east to Hawaii.

Habitat: To 68 m. Inhabit seagrass and marine algae areas of estuaries and seaward reefs; also on steep mud slopes in mangroves. Found pelagically attached to drifting *Sargassum* up to 20 km from shore.

Appearance: To 30 cm. Drab brown to black with sprinkling of small dark spots. Like all seahorses, its elongate body is enclosed with bony plates covered by scaleless skin, and a prehensile tail used to tether to plants, etc.

Diet: Minute invertebrates are sucked into the tubular snout.

Reproduction and Development: Female deposits eggs into male's brood pouch in which the eggs are fertilized and incubated. The orange-amber, pear-shaped eggs are embedded in the epithelial tissue lining of the pouch wall, and the surrounding capillaries supply oxygen to the 20–1000 larvae in incubating sacs; length of development is 20–28 days.

Mortality/Longevity: This species is being harvested at an alarming rate for use in traditional Chinese medicine, as it is highly valued.

Conservation Status: Vulnerable, CITES II. Trade is regulated by CITES with a minimum size of 10 cm allowed for this species in commerce.

Remarks: The seahorse has no caudal or ventral fins. Rapid oscillation of small dorsal fin propels the animal forward in the characteristic upright position. Small pectorals are used for steering. Defense is achieved by camouflage, stillness, and maneuverability, not by speed.

Longsnout Seahorse

Hippocampus reidi (Syngnathidae)

Pipefishes, Seahorses, and Seadragons

Distribution: Western Atlantic Ocean, North Carolina to Brazil.

Habitat: Usually or near coral reefs, in association with gorgonian corals, seagrass beds, mangroves, and Sargassum.

Appearance: Males often bright orange and females yellow; both may be covered in brown or white spots. Max. size:

Diet: Zooplankton.

Reproduction and Development: Like other species in their family, pairs generally mate for life. Highly ritualistic courtship may include dramatic color changes to pink or white and intricate dances leading up to the female's depositing up to 1,000 eggs in the male's brood pouch.

Conservation Status: Collected as aquarium fishes, folk medicine, and curiosities. Also taken a bycatch in shrimp trawl fisheries. Degradation of seagrass habitats, especially along the U.S. may be reducing their numbers locally. The entire genus Hippocampus is listed in Appendix II of CITES in 2002.

Leafy Seadragon

Phycodurus eques (Syngnathidae)

Pipefishes, Seahorses, and Seadragons

Distribution: Endemic to southern Australia.

Habitat: Among brown algae (kelp) in shallow, temperate water, associated with seagrass beds and rocky reefs.

Description: Yellow-brown to green with stripes around the body. Single dorsal fin; paired pectoral fins along sides of neck. Body laterally flattened, covered with armor-like plates instead of scales and with rows of long, sharp spines along the sides. Long, tubular snout. Most distinguishing feature is the elaborate leaf-like appendages of skin that hang off the head, body and tail. Up to 45 cm, 120 g.

Diet: Mysid shrimp, zooplankton and fish larvae.

Reproduction and Development: Like the seahorse, the male seadragon carries the eggs. He develops about 120 shallow depressions in a spongy section of the ventral surface of his tail. The female deposits her eggs in the depressions where they are fertilized and incubated until they hatch, in about 4 weeks. The hatching is staggered to assist with dispersal and avoid competition for food among the young. The hatchlings are vulnerable to predation by fish, crustaceans and anemones, but they are fast-growing, reaching a length of 20 cm in one year. It is speculated that while one female will approach only one male for mating, more than one female may use the egg storage capacity of a single male.

Conservation Status: IUCN: Listed as near threatened. Major threats of habitat loss, pollution, and over-collection are at least slightly mitigated by the number of offspring produced. Today, seadragons are protected under Australian law, and their export, even for educational exhibits in aquaria, is strictly regulated.

Remarks: With its extraordinary leaflike appendages the leafy seadragon is one of the best camouflaged animals on the planet. Almost indistinguishable from the surrounding kelp, it is invisible to predator and prey alike. Even its tubular snout looks like a kelp stem. It can change color due to age, habitat, diet or stress.

Unlike its seahorse relative that swims vertically, the seadragon swims horizontally. It is a very slow swimmer, as might be expected from its tiny fins, but is protected not only by its camouflage but by sharp spines that deter predators.

The leafy seadragon has the honor of being the official emblem of Australia.

Weedy Seadragon

Phyllopteryx taeniolatus (Syngnathidae)
Seahorses, Pipefishes, and Seadragons

Distribution: Endemic to waters off southern Australia.

Habitat: Kelp-covered rocky reefs.

Description: Orange-yellow to brownish-yellow, small pale dots on body with stripes, often brilliant blue, on neck. Leafy projections, purple with black edges, in varying numbers, along the body. Long, tubular snout. Dorsal fin near the tail, two tiny pectoral fins on neck.

Diet: Mysid shrimp and other small crustaceans, fish larvae. Like all syngnathids, seadragons lack teeth and a true stomach and to compensate must hunt and feed almost continually.

Reproduction and Development: Prior to mating the area of the male's tail where he will keep the eggs becomes slightly swollen, soft and spongy. The female actually pushes the eggs onto this area of the male's tail where they are fertilized. He carries the eggs for about 2 months. The young are born with a yolk sac still attached that sustains them for about two days, until their snout grows enough to feed.

Conservation Status: Threatened by habitat destruction, protected by federal and local legislation.

Remarks: The appendages of weedy seadragons are not as elaborate as those of leafy seadragons; however, their camouflage is also effective as they look like pieces of sea weed floating in the water.

Weedy and leafy seadragons share the same range and habitat and have the same conservation status. Both swim horizontally and reproduce and develop in the same way.

All syngnathids lack teeth; instead, they suck in their prey, similar to drinking through a straw.

Alligator Pipefish

Syngnathoides biaculeatus (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: Red Sea; South Africa to Samoa, north to southern Japan, south to eastern Australia.

Habitat: Protected coastal shallows over or among algae, seagrasses, or floating weeds. Juveniles occasionally found near the surface.

Appearance: Slender body; variably colored green to brown or grey, reportedly depending on habitat. Bony plates on skin form a series of protective rings. Distinct tubular snout. Shape and color provide excellent camouflage.

Diet: Minute invertebrates and fish larvae.

Reproduction and Development: Ovoviviparous. The male carries the eggs in a brood pouch and protectively located under his prehensile tail.

Mortality/Longevity: Utilized in the traditional and legal Chinese drug trade to extract Hailong, apparently an important ingredient within the traditional Chinese pharmaceutical cornucopia.

Conservation Status: IUCN: "Data Deficient."

Remarks: The conservation status above, courtesy the IUCN, is based on data collected more than 14 years ago. Like other pipefishes and seahorses, their situation probably continues to decline.

Bay Pipefish

Syngnathus leptorhynchus (Syngnathidae)
Pipefishes, Seahorses, and Seadragons

Distribution: Alaska to Baja California.

Habitat: Eel grass in bays and estuaries, including San Francisco and Monterey Bays.

Appearance: Slender elongated form resembling a tube that ends in a toothless mouth. Instead of scales, their bodies are covered with bony plates that form ridges. The female is larger than the male and may be 33 cm. long. The male's brood pouch is located beneath the tail.

Diet: Small invertebrates, especially crustaceans.

Reproduction and Development: Elaborate mating rituals occur between May and August culminating in the female depositing eggs in the male's brood pouch. Up to 225 eggs have been found in a pouch, in different stages of development indicating multiple deposits possibly by different females. Incubation period is 8–21 days depending on temperature. Young resemble small adults when they emerge. They must hide to avoid being eaten by the adults.

Mortality/Longevity: Known to be taken by striped bass.

Remarks: While feeding, they remain in constant motion to create the water currents that convey plankton to their small tubular mouths. They move by using dorsal fins, and steer by moving heads from side to side.

Used in Chinese medicine.

ORDER SCORPAENIFORMES (SCORPIONFISHES)

Rockfishes aka **Rockcods**

Sebastes spp. (Sebastidae/Scorpaenidae) Rockfishes and Scorpionfishes

This is a very large complex of species. Comments below apply to the entire genus, unless otherwise indicated.

Distribution: Central California to Baja California.

Habitat: In our area, common in clean bays, along shore, in kelp forests, and offshore to depths to 450 m, (some deeper). Rocky areas, others on offshore soft substrates.

Appearance: Basslike shape, compressed body, large mouth. Size varies by species. Most adults 15–30 cm, some species to at least 96 cm. Red and brown are the predominant colors. Most have spines on the head.

Diet: Carnivorous predators.

Reproduction and Development: Fertilization internal. Although rockfish are sometimes reported as being ovoviviparous (bearing live young without maternal nutrition), many recent studies have confirmed that they are a primitive viviparous group and supply nutrients to developing embryos. Female typically gives birth to many live larval stage fry, each about the size of an eyelash. Most, of course, are food for others with only a few reaching reproductive maturity.

Mortality/Longevity: Rockfish are among the longest-lived fishes, with most species living between 20–50 years. A number of species live to be well over 100 years old, and the oldest rockfish known was aged at 205 years, a rougheye caught off the coast of Alaska.

Conservation Status: Until recently, an important food fish taken commercially and by sportfishers. However, rockfish stocks, especially among certain species, are in steep decline. New regulations are now in place, in order to allow populations to recover. Since many rockfish species do not breed until 20 years or more and also have relatively few young, a recovery for many species may not happen during the lifetime of the reader of this text.

Remarks: The Scorpaenidae (scorpionfishes and rockfishes) is the largest family of fishes in our area, the Eastern Pacific coast, with more than 60 species (*Sebastes* spp.)

Dorsal, pelvic, and anal spines are slightly venomous. Level of toxicity varies by species.

Eschmeyer (CAS curator emeritus) and others recognize Sebastidae as a separate family that includes only the rockfishes. Others place rockfish together with scorpionfish in the single family Scorpaenidae.

Copper Rockfish

Sebastes caurinus (Sebastidae/Scorpaenidae) Rockfishes and Scorpionfishes

Distribution: Gulf of Alaska to central Baja California.

Habitat: Rocky or rock-sand bottoms, 10–180 m. Solitary, bottom-dwelling reef fish which frequently live near pinnacles and wrecks. Particularly abundant in shallow, protected bays and inlets, among rocks and kelp beds; also found around pilings and jetties or under floats. Juveniles found in loose aggregations in shallow weedy bays, around wharfs, or among floating drift associated with summer tidelines. Adults avoid warm water; thus live deeper in southern California than farther north. Juveniles tend to live in shallow (< 7 m) water.

Appearance: Length to 60 cm. Deep, stout body. Color highly variable; dark brown or olive to pink or orange-red above, with patches of pink-copper and occasionally yellow; bright white below. Fins primarily copper, often dusky. Juveniles are often more intensely colored than adults.

Diet: Juveniles consume plankton. Adults are mainly benthic feeders and prey upon fishes, crabs, mysid shrimp, prawns, amphipods, octopuses, polychaete worms and fish eggs.

Reproduction and Development: Fertilization internal. Viviparous. Larvae planktonic. Sexually mature at around five years.

Mortality/Longevity: Live to at least 55 years.

Starry Rockfish

Sebastes constellatus (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: San Francisco south to Baja.

Habitat: Coastal waters; usually on deep reefs at 24–275 m.

Appearance: Red-orange above, with 3–4 large whitish blotches on back; paler below. Small white dots cover most of the body. Max. length: 46 cm.

Reproduction and Development: Viviparous with planktonic larvae and pelagic juveniles.

Remarks: Occasionally caught by sport fishers; considered highly flavorful.

Splitnose Rockfish

Sebastes diploproa (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Southeastern Alaska to central Baja California.

Habitat: Common on sandy bottoms offshore. Juveniles in shallow water, adults deeper.

Appearance: Toothed knobs in front of the upper jaw with a deep notch between (thus the common name).

Diet: Krill, copepods, and squids.

Reproduction and Development: Viviparous, with planktonic larvae and pelagic juveniles that congregate around drifting kelp. Males mature at 7–10 years; females at 6–8.

Mortality/Longevity: Life span: up to 84 yrs.

Remarks: *Diploproa* is formed from two Greek words that together mean "double prow," a reference to this fish's distinctive facial feature.

From central California to Washington, deep-living adults are part of a major fishery, taken mostly by trawls.

Black Rockfish

Sebastes melanops (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Alaska to Baja California.

Habitat: Found in schools near rocky reefs in shallow water and in open water above deep banks.Nearshore to 360 m. May live above or on the bottom

Appearance: Black to blue black mottled with gray. Some individuals have lighter patches on back and a gray lateral stripe from head to tail. Lacks the dark head bands of the blue rockfish; also has more gray, a smaller mouth, and a longer jaw than the blue.

Diet: Fishes.

Reproduction and Development: Viviparous. Young are important prey species for various fishes, marine mammals, and birds. Prized by humans as a food fish.

Blue Rockfish

Sebastes mystinus (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Vancouver Island to northern Baja California.

Habitat: Inhabit kelp forests, shallow reefs and open water over deep reefs. They are found at depths of up to 550 m but are most abundant from 5–60 m. They are often seen schooling with other species of rockfish.

Appearance: Mottled blue-black to bright blue with two to four dark bands which curve around the front of the head. Sloping band from the eye toward the pectoral fin with a smaller band below. Rear edge of the anal fin is straight and slanted. Can reach 50 cm in length and live to 24 years.

Diet: Blue rockfish eat jellyfish, krill, copepods, fishes, hydroids and kelp. Larger blues eat relatively more fishes. Adults are preyed upon by other rockfish, lingcod, sharks, dolphins and sea lions.

Reproduction and Development: Fish mature between 6–9 years. Blues mate in October (internal fertilization) but the embryos do not begin to develop until December when the eggs are fertilized by the stored sperm. Embryos develop within the female and larvae are released into the water; usually in January. Larvae are planktonic for four to five months.

A reason for the decline in general rockfish numbers may be that the plankton on which the larvae feed have declined due to warming ocean temperatures, causing larvae to starve.

Remarks: Coppers are the most abundant rockfish in central California.

China Rockfish

Sebastes nebulosus (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Southeast Alaska to Redondo

Beach and San Miguel Island, Southern California.

Habitat: Rocky shores along exposed coasts, depth 3–138+ m. Lurk solitarily in caverns and among crevices, rest benthically on their fins. Often remain on their "homesite" for many years.

Appearance: Length to 45 cm, weight to 1.7 kg. Yellow speckles on head, yellow stripe extends from foredorsal fin to the length of lateral line.

Diet: Prey upon fishes, crustaceans (including amphipods, crabs and shrimps), brittle stars and mollusks (including gastropods, squid and octopuses).

Reproduction and Development: Fertilization internal..

Mortality/Longevity: Lives to at least 79 years.

Conservation status: See Rockfishes above.

Remarks: One of the tastiest rockfishes, but infrequently in markets because rarely caught.

All rockfishes have venomous spines on dorsal, pectoral and anal fins. Not so toxic as scorpionfishes venom, but still capable of inflicting a painful sting.

Sebastes is Greek for "magnificent." *Nebulosus* is Latin for "clouded."

Tiger Rockfish

Sebastes nigrocinctus (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Southeast Alaska to Southern California.

Habitat: Among rocky reefs to depths of 10 to 275 m; solitary; defend a home crevice or cave.

Appearance: Length to 60 cm. Weight to 2.2 kg. Colored red or pink, with five or six black or dark red bars on body. Pelvic and anal fins are black-tipped on juveniles.

Diet: Prey upon other fishes including rockfish and herring. Also eat shrimp, crabs, amphipods, polychaete worms and brittle stars.

Reproduction and Development: Fertilization internal. Viviparous. Juveniles pelagic.

Mortality/Longevity: Reported to live to 116 years.

Remarks: Rapidly change color when disturbed or when lighting changes.

Bocaccio

Sebastes paucispinis (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Alaska to Baja California.

Habitat: Deep rocky 40 – 300 m (130 – 980 ft) preferred, but are found in almost all habitats. Oil platforms are now a somewhat important artificial habitat for the species.

Appearance: World record: 90 cm, 9.5 kg. Long jaw which extends to the eye socket is distinctive. Adults' backs range in color from olive- to burnt-orange with pink & red stomachs. Juveniles are light bronze with small brown spots on their sides. Coloring darkens and spots disappear as they mature.

Diet: Other rockfish is preferred diet, but they will eat other fish and squid. Larvae feed on diatoms, dinoflagellates.

Reproduction and Development: Fish from age 1 – 3 years are relatively pelagic, become more demersal (bottom oriented) as they age. Maturity at 4–5 years of age. Like all rockfishes, bocaccio have internal fertilization, embryo development is internal, and the female gives birth to live larval young. Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. The female produces from 20,000 to over 2 million eggs.

Mortality/Longevity: Seabirds feed on juveniles. Marine mammals are common predators of adults. Life span: 45 to 50 years.

Conservation Status: Thought to consist of three partially isolated populations: southern population off California (species of concern), northern off Washington & British Columbia, and a Puget Sound / Strait of Georgia population that has been proposed for listing under the Endangered Species Act.

Remarks: Current decline due to overfishing, which was curtailed in 1998. Because the species is slow-growing and late maturing, recovery will take many years, but if fishery management plans continue to be followed, long-term risk of further decline in the population is low. These fish are still being caught as bycatch in other fisheries.

Rosy Rockfish

Sebastes rosaceus (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Puget Sound to central Baja, but rare north of California.

Habitat: Bottom-dweller, usually between 30–45 m, though occasionally deeper.

Appearance: 4–5 whitish blotches bordered by purple on the back; reddish to purple mottling on back, sides red, whitish below. Unlike the Starry Rockfish, is not covered with white dots. A relatively small rockfish; max. length: 36 cm.

Reproduction and Development: Livebearer.

Yelloweye Rockfish

Sebastes ruberrimus (Sebastidae/Scorpaenidae)
Rockfishes

Distribution: Eastern Pacific: Gulf of Alaska to northern Baja California.

Habitat: Rocky reefs and boulder fields from 15–475 m.

Appearance: Color: orange red to orange yellow, eye bright yellow; fins often with black tips; adults with light to white stripe on lateral line, juveniles (as in our exhibit) with 2 light stripes, one on the lateral line and a shorter one below. Max. length: 1 m; weight: 18 kg.

Diet: Fishes and crustaceans.

Reproduction and Development: Viviparous, like all rockfishes,

Mortality/Longevity: Yelloweyes are among the longest lived of rockfishes, living up to 118 years old!

Conservation Status: Survey data is not up to date, but today few yelloweye rockfish are being caught, suggesting a low population level.

Yelloweye is now given the highest priority for tracking catches, and is a federally-designated "overfished species" of special concern because of its slow growth, late maturation and long life. Federal studies suggest that yelloweye rockfish stocks will not recover to former levels for over 70 years.

Flag Rockfish

Sebastes rubrivinctus (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: Eastern Pacific: San Francisco, California, USA to Cape San Quentin, Baja California.

Habitat: Depth to 300 m. Juveniles shallower. Adults typically solitary and shelter in and around rocks, large sea anemones, ledge overhangs and in kelp.

Appearance: Length to 64 cm. Deep, fusiform, compressed. Adult colored white-pinkish with 4 dark red-orange to reddish-brown bars across back and base of tail. Bars darker on juveniles.

Diet: Benthic predators of crabs and hermit crabs, shrimps, fishes, octopuses.

Reproduction and Development: Fertilization internal. Livebearer.

Mortality/Longevity: Live to at least 18 years.

Remarks: A popular sportfish.

Sebastes is Greek for "magnificent." *Rubrivinctus* is formed from 2 Latin words that translate as "red banded."

Treefish

Sebastes serriceps (Sebastidae/Scorpaenidae)
Rockfishes and Scorpionfishes

Distribution: San Francisco to central Baja California.

Habitat: Inhabits areas with numerous caves, crevices and other protective recesses. Solitary and territorial; usually found between 6–40 m with a maximum depth of 45 m.

Appearance: One of the most striking, unusually marked rockfishes, with black stripes over a yellow body and red lips and chin. Compact body with large head spines. Spines are venomous. Maximum size is 40 cm.

Diet: Most probably either crepuscular (feeding at dawn and dusk) or nighttime ambush predator, feeding on shrimp, crabs and small fishes.

Reproduction and Development: Viviparous.

Red Lionfish

Pterois volitans (Scorpaenidae)
Scorpionfishes and Their Allies

Distribution: West-central Pacific; introduced in the Atlantic.

Habitat: Lagoon and seaward reefs from turbid inshore areas to depths greater than 50 m. Typically rests during the day under ledges.

Appearance: Length to 38 cm. Compressed body with a large head. Greatly enlarged pectoral fins and elongate dorsal fins. Vertically colored brownish bars interspersed with fine white lines.

Diet: A voracious nocturnal predator of small fishes, shrimp and crabs. Corners and traps prey with its widespread pectoral fins.

Reproduction and Development: Courtship in this species begins at twilight, initiated by the male. Usually solitary males congregate and often compete, sometimes intimitating competitors by charging with spines erect and forward facing. The female extrudes her 2,000–15,000 her eggs in tubes of mucus in a gelatinous mass. Shortly after her eggs are released, the tubes are engorged with seawater and penetrated by sperm. Eggs float on the surface and hatch to larvae 36–48 hours after fertilization.

Mortality/Longevity: Despite their venomous spines, lionfish are caught by humans for food.

Remarks: Venomous dorsal, anal and pelvic fin spines are capable of inflicting severe and painful wounds. Doctors suggest soaking the afflicted area in very hot water to denature the venom's proteins.

Some years ago, a red lionfish consumed its close relative, a zebra turkeyfish (*Dendrochris zebra*), in captivity at the Steinhart Aquarium.

Eschmeyer's Scorpionfish

Rhinopias eschmeyeri (Scorpaenidae)
Scorpionfishes and Rockfishes

Distribution: Indonesia and Western Pacific Ocean.

Habitat: Sheltered areas with a moderate current either in a bay or along external or deep reefs. Is a bottom dweller and lives in caves or under overhangs in brackish water.

Appearance: Deep, compressed body, concave snout, high eyes. Dorsal fin is sail-like with one or two small black spots. Very brightly colored in yellow, pink, brown, or red with skin flaps over eyes that aid in camouflage. Dorsal, anal, and pelvic fin spines bear venom glands. Not aggressive, but when threatened will erect dorsal spines.

Diet: Feeds on crustaceans and fishes. Remains stationary and snaps at prey, rapidly sucking both water and its intended meal into its large mouth.

Reproduction and Development: Internal fertilization; produces a floating gelatinous mass with imbedded eggs.

Conservation Status: A rare fish but conservation status unknown.

Remarks: This fish is named after the Academy's own William Eschmeyer, Senior Curator of Ichthyology, a world-renown expert in stonefishes and other scorpionfishes, and author of the *Field Guide to Pacific Coast Fishes* in the Peterson guidebook series and *The Catalogue of Fishes*, a database of the world's 28,000+ known fish species and a work of immense value to systematists and to those evaluating fish diversity worldwide.

It's possible our specimen is a different *Rhinopias* sp, but why not tell the good story.

California Scorpionfish

Scorpaena guttata (Scorpaenidae)
Scorpionfishes and Their Allies

Distribution: Santa Cruz, California to the Gulf of California.

Habitat: Tide pools to 183 m, usually at depth less than 30 m. Typically in rocky areas of bays and along shore, especially in crevices and caves. Most active at night.

Appearance: Stocky, large mouth; spiny head and large fan-shaped pectoral fin. Red to brown, pale mottled brown spots on body and fins. Length to 43 cm.

Diet: Small crabs, also shrimp, octopuses and small fishes.

Reproduction and Development: Migrate extensively during summer in order to form large spawning aggregations. Mature at two years old. Fertilization is internal. Females produce eggs imbedded in gelatinous walls of hollow pear-shaped structures, which are transparent or green. The "balloons" float near the surface and the eggs hatch in around five days.

Mortality/Longevity: Live to at least 21 years.

Conservation Status: Not on IUCN Red List but very likely being overexploited as a food fish.

Remarks: Individuals in very deep waters are darker red.

Dorsal, anal and pelvic fin spines are venomous.

Prized as a food fish.

Pink and Yellow Scorpionfish

Sebastapistes cyanostigma (Scorpaenidae)
Scorpionfishes and Their Allies

Distribution: Indo-Pacific.

Habitat: Coral reefs.

Appearance: Spotted, usually yellow and white on a pinkish red background.

Diet: Crustaceans and small fishes.

Remarks: A master of camouflage, this small fish hide among corals, changing colors to match its background. A viewer of the Fire Coral Tank where this little fish resides may look directly at the fish and still not see it.

A true scorpionfish, it uses the sharp venomous spines on its back for protection.

Deadly Stonefish

Synanceia verrucosa (Synanceiidae) Stonefishes

Distribution: Tropical marine waters of the Pacific and Indian oceans, ranging from the Red Sea to the Great Barrier Reef.

Habitat: Shallow water on sandy or rubble-strewn areas near reefs.

Appearance: Mottled greenish to mostly brown. Looking like a rock or lump of coral, they exhibit excellent camouflage; length to 40 cm.

Diet: Lie-in-wait predator; mainly eats small fish, shrimp and other crustaceans, striking with such incredible speed that only high-speed film can capture the event.

Mortality/Longevity: Predators include sharks and rays.

Remarks: Widely distributed in tropical waters, this stonefish is the world's most venomous fish. It has 12–14 grooved dorsal spines, each with a venom sack at its base.

Not aggressive, the stonefish uses its toxins in self-defense, most often when an overly curious, predatory, or non-observant victim ventures too close. Humans are usually envemomated because of inadvertently stepping on the well-concealed fish.

The venom is a potent cocktail of hemolytic, neurotoxic, and cardioactive proteins that can cause shock, paralysis, tissue death, and occasional human fatality, depending on the penetration depth of the spine. The pain is so severe, victims supposedly want to cut off afflicted body parts! Fortunately, a serum now exists that is effective if applied within a few hours after envenomation.

In Japan, the delicate flesh of stonefish is served as okoze, an expensive sashimi. Hopefully, no wayward venom sacs on the plate!

Kelp Greenling

Hexagrammos decagrammus (Hexagrammidae) Greenlings

Distribution: East Northern Pacific: Alaska to San Diego.

Habitat: Offshore kelp and inshore eel grass beds to 45 m.

Appearance: Length to 55 cm. Body color variable from light gray to brown. Dimorphic; males have irregular blue patches on head and to mid-section; females have small dark sports all over and are larger than males. Males and females originally thought to be separate species.

Diet: Diurnal predator on shrimp, crabs, worms, octopuses, snails, brittle stars, and small fishes.

Reproduction and Development: Males sexually mature by age 2; females by age 4. Spawn in fall and winter subtidally; males guard pale blue egg masses, often 4 or more at a time. Larvae pelagic. Rapid growth from juveniles to adults.

Mortality/Longevity: Can live at least 12 yrs.

Remarks: Territorial, especially during spawning. Primary predators: lingcod and harbor seals.

In Greek, *decagrammus* means "10 lines," a reference to the total number of lateral lines (5 on each side).

Rock Greenling

Hexagrammos lagocephalus (Hexagrammidae) Greenlings

Distribution: North Pacific from Bering Sea to Point Conception, infrequently observed south of San Francisco; western Pacific south to Japan.

Habitat: Shallow rocky coastal waters.

Appearance: To 60 cm. Reddish brown with darker mottling, often with red blotches on the sides.

Reproduction and Development: Females are oviparous (egg-laying). Sexually mature at 3–4 years and / or 29–35 cm.

Mortality/Longevity: Life span: to 8 years for males, 11 years for females.

Remarks: Like kelp greenling, adults are territorial.

Lingcod
Ophiodon elongatus (Hexagrammidae)
Greenlings and Lingcod

Distribution: Kodiak Island, Alaska to northern Baja California.

Habitat: Adults near rocks, mostly inshore between 10–100 m, but some much deeper. Young on sand or mud inshore.

Appearance: Large, elongate. Characterized by large mouth, long canine teeth, and long dorsal fin with notch. Cirrus above eye. Max length: 150 cm though usually 120 cm or less. Females larger.

Diet: Voracious predator on various invertebrates such as small octopuses and crabs as well as a variety of fishes, including herring, rockfishes, and bottom dwellers such as flounder.

Reproduction and Development: Males establish nesting sites in rock crevices or on ledges in nearshore spawning grounds. Females lay eggs and depart, leaving males to defend the nest. Larvae pelagic, until settlement as juveniles in nearshore areas.

Mortality/Longevity: Vulnerable to marine mammals, such as sea lions and harbor seals. Life span: males about 14 years; females up to 20 years.

Remarks: The lingcod is an adept color changer, transforming from light to dark or vice-versa in a flash.

A popular sport and commercial species, valued as a fine-tasting food fish. Flesh of lingcod, like greenlings, is often greenish; however, this color disappears with cooking.

Painted Greenling aka **Convictfish**
Oxylebius pictus (Hexagrammidae)
Greenlings

Distribution: Kodiak Island, Alaska to central Baja California.

Habitat: Shallow rocky areas, especially in tidal channels, also deep rocky areas to 50 m. Hover in water column, or may move from perch to perch. Adults territorial.

Appearance: Length to 25 cm, usually less. Colored with 5–7 broad, vertical reddish bars alternating with pinkish-brown undercolor. Prominent black pectoral fins with white spots. Two bands radiate back from eye, another forward. Females grow larger than males.

Diet: Solitary benthic feeders upon invertebrates such as crabs, shrimps and amphipods.

Reproduction and Development: Females mature at 3 years, most males mature at 2. Mate in winter. Female lays egg masses containing up to 2,200 eggs in nests on exposed rock surfaces which are aggressively guarded by male.

Mortality/Longevity: Males live to at least 8 years. Females live longer. Caught by sportfishers.

Remarks: Sometimes rest on *Telia* spp. anemones, apparently immune to their nematocysts.

Grunt Sculpin
Rhamphocottus richardsoni (Rhamphocottidae)
Grunt Sculpins

Distribution: Pacific Ocean, Japan north to Alaska, south to Santa Monica Bay, California.

Habitat: Rocky and sandy substrates, tide pools. Intertidal to 165 m.

Appearance: Short stocky body. Most of body covered with prickles. Head and body colored yellowish-beige, streaked with dark brown; ventral surface creamy yellow to pale red. Base of caudal fin is bright red. Fin rays mostly reddish. Length to 9 cm.

Diet: Crustaceans. Young consume zooplankton, invertebrate and fish larvae.

Reproduction and Development: Observations in captivity show that during spawning season the female chases the male until he is trapped in a rocky cavern. She keeps him captive until her eggs are laid; fertilization is external.

Remarks: Produces gruntlike sounds when removed from water, thus the common name.

Eyes operate independently.

Like most sculpins, rarely swims freely in the water column; instead usually "walks" with a hopping motion over the substrate by use of its large, fanlike pectoral fins. Frequently observed taking shelter in empty shells, including those of the giant barnacle, *Balanus nubilis*, as well as in cans and bottles.

Red Irish Lord
Hemilepidotus hemilepidotus (Cottidae)
Sculpins

Distribution: North Pacific: Kamchatka to the

Aleutian Islands, and south along the North American coast to Monterey Bay.

Habitat: Usually nearshore rocky areas, from intertidal to depth of 50 m.

Appearance: Variable color: usually reds, pinks, purples, browns, and whites. Can change coloration to some degree to match surroundings. Among the largest of the sculpins; max. length: ~ 50 cm.

Diet: Crabs, barnacles, mussels, occasional small fishes. Lie-in-wait predator that depends almost entirely on its camouflage.

Reproduction and Development: Gather in spawning areas each season; thought that the same pair frequent the same areas year after year. Pinkish eggs are laid, fertilized, and guarded by both parents.

Mortality/Longevity: Life span: ~ about 6 yrs.

Remarks: The genus is noted and named for its two distinct bands of scales, one on the back and a second below the lateral line (*Hemilepidotus* = "half scaled").

Prized for its excellent tasting flesh.

Spotfin Sculpin

Icelinus tenuis (Cottidae)
Sculpins

Distribution: Queen Charlotte Island, British Columbia to central Baja California.

Habitat: Sand bottoms, 33–375 m below the surface.

Appearance: 1st 2 spines of dorsal fin elongated, rounded caudal fin, small pelvic fins. Body light brown with orangish blotches above, white below. Dark saddles on back; dusky blotches on lower sides. Max. size: 14 cm.

Diet: Shrimps.

Scalyhead Sculpin

Artedius harringtoni (Cottidae)
Sculpins

Distribution: Eastern Pacific coast from Kodiak Island, Alaska to southern California.

Habitat: Intertidal and especially subtidal rocky areas, often around pilings to depths of 21 m.

Appearance: Underside of the adult head is orange with red bars radiating from the eye and a red spot near the tip of the first 2 dorsal fin spines. Scales appear on the head, sometimes on the cheek but not on the snout, a broad band of scales covers the back. Small cirrus (a thin flap of skin) above the front of the eye as well as head cirri more developed in males.

Diet: Small invertebrates.

Reproduction and Development: Internal fertilization; mature males have a slender tapered retractable penis. Male gives the parental care, becoming very territorial and guarding the eggs that are laid on rocks in the winter and spring.

Conservation Status: A common species within its area, but rarely seen because of its cryptic coloration.

Tidepool Sculpin

Oligocottus maculosus (Cottidae)
Sculpins

Distribution: Sea of Okhotsk and the Bering Sea to Los Angeles County, California.

Habitat: Sheltered areas and tide pools located in areas near rough surf; occurs in higher, more sheltered places. Can leave tide pools when aquatic conditions become inhospitable. Shows a strong tendency to return to its home pool if displaced.

Appearance: Length to 8.9 cm. Green to red above, with irregular dark saddles on the back; white or off-white tinged with green to blue below.

Diet: Preys on pelagic fish larvae, benthic arthropods including amphipods, copepods, isopods, as well as polychaete worms.

Reproduction and Development: Fertilization external. Male clasps female with his pectoral fins and fertilizes the eggs as they are being deposited onto substrate.

Remarks: Able to breathe air when out of water.

Fluffy Sculpin

Oligocottus snyderi (Cottidae)
Sculpins

Distribution: Endemic to the Pacific Coast from Alaska to Baja California.

Habitat: Temperate rocky intertidal pools, especially those with algae or eelgrass and a sandy substrate. They don't migrate but do move between pools. In Central California, dominant in sub- to mid-intertidal pools.

Usually found in depths less than 1 m.

Appearance: Coloration varies greatly from green to reddish brown to pink, depending on the color of the surrounding algae; sides spotted and mottled. Like many sculpins, they have no scales. Cirri line the base of the dorsal fin and the lateral line. The common name refers to a "fluffy" fleshy area behind the dorsal fin. Max. length: 9 cm; average weight: 8 g.

Diet: Worms, crustaceans, and other marine invertebrates. Larger males also prey on shrimp and crabs, and eat a greater diversity of food than do the females.

Reproduction and Development: Internal fertilization. Males have a prehensile first anal ray used to clasp females during copulation. Eggs are deposited on rocks and guarded by the male. They develop through larval, post larval, juvenile and adult stages. Reproduction occurs during periods of upwelling, when food is plentiful.

Mortality/Longevity: Life span: 1 to 2+ years.

Remarks: Fluffies display homing behavior in moving from one pool to another, and are often able to find their familiar pools from some distance.

Can breathe air for hours at a time, often in response to reduction in the tide pool's oxygen at night when plants respire.

Cabezon

Scorpaenichthys marmoratus (Cottidae)
Sculpins

Distribution: Southeast Alaska to Baja California.

Habitat: Inhabits rocky bottoms, especially near kelp beds and often along exposed coasts and in tidal passages. Found from the intertidal to depths of 90+ m.

Appearance: *Cabezon* (Spanish for "stubborn") have a bulbous head and a stout body. Color is marbled earthtones; males generally display red shades while females are usually greenish. Can change color, lighten or darken to blend in with the background. They are the largest members of the sculpin family. The largest recorded size is 100 cm in length and over 11 kg.

Diet: Lie and wait predator. With pectoral fins set low on the body and with a powerful tail, it quickly lunges after crabs, small lobsters, mollusks, small fish and fish eggs. Can swallow abalone whole and later regurgitate the indigestible shell.

Reproduction and Development: In central California males mature by age 4 and females by age 6. Cabezon gather in groups for spawning, which occurs off the California coast from October through April. Females lay 50,000 to 100,000 red, purple, amber or green eggs in large masses attached to rocks or logs in shallow water. Males aggressively guard the fertilized egg masses until they hatch in 2–3 weeks. The eggs are highly toxic to humans, other mammals and birds.

Mortality/Longevity: Life span: more than 13 years.

Remarks: Cabezon are popular with sport fishermen on the water and spear fisherman in the water.

Sailfin Sculpin

Nautichthys oculofasciatus (Hemitripteridae)
Sea Ravens or Sailfin Sculpins

Distribution: Alaska to San Miguel Island, southern California.

Appearance: Color varies, grayish on top with variously hued markings and occasionally red markings on dorsal fin. A dark streak runs across the head through the eyes. To 20 cm.

Habitat: Found at about 90 m, most often on rocky bottoms with algae; occasionally seen hanging upside down in rock crevices.

Diet: Small shrimps and other crustaceans. Typically moves and hunts by rippling the second dorsal fin and sculling with pectoral fins in a hopping motion toward prey.

Reproduction and Development: Female spawns in winter and spring, when eggs are laid on rocks and often among mussel beds. The male guards the eggs.

Remarks: The anterior dorsal fin is extended in front of the head when the fish swims and resembles a sail, hence the common name. Often the sailfin moves back and forth in the same rhythm as the movement of nearby seaweeds. Coupled with its cryptic coloration, this remarkable behavior disguises the fish from predators and prey.

A popular aquarium fish.

Northern Spearnose Poacher
Agonopsis vulsa (Agonidae)
Poachers

Distribution: Eastern Pacific: southeastern Alaska to southern California.

Habitat: On bottom, 18–200 m.

Appearance: Snout pointed with 2 forward pointing spines at tip. Brown above, white below with dark bars along side; pelvic fin brown with white tip. Max. size: 20 cm.

Diet: Small crustaceans and worms.

Remarks: Like most poachers, shape is elongate, and scales are modified into large fused bony plates. Uses large pectoral fins to move in bursts; pelvic fins nearly vestigial.

Like many bottom dwellers, lacks a swim bladder.

Pacific Spiny Lumpsucker
Eumicrotremus orbis (Cyclopteridae)
Lumpfishes

Distribution: North Pacific: from Japan to Alaska south to Puget Sound, Washington.

Habitat: Bottom-dwelling from inshore shallows to 145 m. Sometimes seen at low tide attached to rocks with its disc-like pelvic fins.

Appearance: Small globose body to 18 cm. Weight to 100 gm. Caudal fin slightly rounded. Body light to dark green or brown dorsally; light brown or plum ventrally; lips lavender. Tubercles in males dull orange or reddish brown; tubercles in females are larger and more numerous and pale green.

Diet: Small invertebrates including polychaete worms, crustaceans, mollusks.

Reproduction and Development: Females lay spongy masses of eggs that adhere to rocks and seaweeds. Males guard eggs following spawning.

Remarks: The large adhesive sucking disc with thickened fringed margin is composed of modified and ossified pelvic rays.

The family name Cyclopteridae translates from Greek as "circle wing," a reference to their circle-shaped pectoral fins.

Their roe is used as a substitute for expensive and/or unavailable caviar.

ORDER PERCIFORMES

SUBORDER PERCOIDEI (PERCHES)

Glassfish
Parambassis ranga (Ambassidae)
Asiatic Glassfishes

Distribution: South Asia from Pakistan to Malaysia.

Habitat: Freshwater rivers and streams in sluggish and standing water, also in brackish water.

Appearance: Transparent body that reveals bones and internal organs; the male develops a dark edge to the dorsal fin. Max. length: 8.0 cm.

Diet: Crustaceans, annelid worms, and other invertebrates.

Reproduction and Development: Fertilization is external. The female lays up to 500 eggs, and then the males fertilizes them. Fish breed prolifically during the rainy season. Thereafter, they build a nest and guard their young.

Mortality/Longevity: Prey for larger fishes, including snakeheads. Life span: 3–4 yrs.

Remarks: The Indian glassy fish is very common in the aquarium trade. Caught in subsistence fishing, but they rare in markets. Indian glassy fish sold to hobbyists and known as "disco fish" have often been "painted," which involves injecting colored dye into the fish's transparent tissue to make them more attractive. Fish thus treated are traumatized and susceptible to disease.

Giant Sea Bass
Stereolepis gigas (Polyprionidae)
Wreckfishes

Distribution: Humboldt Bay, California to Baja California.

Habitat: Rocky areas and kelp beds 7–50 m.

Appearance: Length to 2.5 m. Weight to 255 kg. Young colored red with black spots. Adults robust, slightly compressed, dark gray typically with large gray, brown or black spots on sides.

Diet: Carnivorous opportunist: spiny lobsters, rock crabs, squid, stingrays, small sharks, and various other fish species.. Most food items are organisms on or buried just below the substrate, drawn into the sea bass' mouth by

the suction created when the mouth is opened rapidly. Capable of only brief bursts rather than sustained speeds, the sea bass ambushes mid-water fishes from cover in rocks or kelp.

Reproduction and Development: Adults not reproductively active until about 12 years old. Single annual spawn. Eggs released into the plankton.

Mortality/Longevity: Very young are prey to a variety of marine mammals and other fishes. Mature individuals are preyed upon only by large sharks and humans. Life span: live to at least 100 years.

Conservation Status: IUCN Red Listed: Critically Endangered. Once a favorite of commercial and sport fisheries as well as spear fishers, giant sea basses, which are found in all-too-accessible nearshore habitats, were seriously overharvested. Protections in California went into effect in 1982, but the sea bass has remained scarce along the California coast, and was classified as critically endangered by the IUCN in 1996. Banning the use of inshore gill nets has probably reduced incidental catch, but because of the species' slow growth and reproduction rate, the California population, while showing signs of recovery, is still well below historic norms.

Remarks: "Bocalo," the Academy's giant sea bass, is the largest fish by weight in the Steinhart Aquarium. In September 2008, it weighed 75 kg (165 lbs) and was 1.2 m (4 ft) in length. As a truly giant sea bass, Bocalo has a way to go. The largest sea bass caught in California waters weighed 563.4 pounds (255 kg), and others have reached lengths of almost 7.5 feet (2.3 m). But then Bocalo is still young, probably about 28. Check the scales in 50 years!

Indigo Hamlet

Hypoplectrus indigo (Serranidae)

Sea Basses: Groupers, and Fairy Basslets

Distribution: Western Central Atlantic and Caribbean.

Habitat: Depth 3-45 m. Solitary over coral reefs near bottom.

Appearance: Length to 14 cm. About five deep blue bars of uneven width; second bar, below dorsal fin, much wider than others. Bright blue ventral fins, pectoral fins with alternating white bars.

Diet: Diurnal predator on small fishes and invertebrates.

Reproduction and Development: Simultaneous hermaphrodite. Form pairs at dusk to spawn.

Pacific Candy Basslet

Liopropoma swalesi (Serranidae)

Sea Basses: Groupers and Fairy Basslets

Distribution: Western Pacific.

Habitat: Caves, crevices, and rubble of coral reefs to depths of 25 m. Rarely seen in open water.

Appearance: White, covered with brilliant orange stripes. The second dorsal and anal fins have white-edged black eyespots.

Diet: Crustaceans and small fishes.

Reproduction and Development: Little is known about the life history of members of this genus because of their secretive nature.

Remarks: The genus is among the smallest of the serranid family,.

Kelp Bass

Paralabrax clathratus (Serranidae)

Sea Basses: Groupers and Fairy Basslets

Distribution: Eastern Pacific coast from southern Washington to southern Baja California. Most abundant south of Pt. Conception.

Habitat: Most often found near or in kelp beds or structures of any kind; shallow water usually from about 2.5 to 20 m.

Appearance: Brown to olive on back and sides with pale spots along sides.

Diet: Juveniles: plankton and small invertebrates, especially crustaceans. Adults: small fishes, octopuses, squid, crabs, shrimps, and algae. Known to form groups to prey on schooling fishes.

Reproduction and Development: Pelagic spawners. Spawning peaks during summer. Eggs hatch into larvae in 1–2 days; larvae metamorphose into juveniles in about a month. Max. length: 70 cm.

Mortality/Longevity: Life span: to at least 33 years.

Remarks: The kelp bass is a fine food fish, and among the most important recreational game fishes in southern California.

Kelp bass were eaten by Native Americans

in southern California; their bones have been found in Indian middens.

Peach Fairy Basslet
Pseudanthias dispar (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: East Indo-Pacific.

Habitat: Upper edge of steep reef slopes.

Appearance: Sexes dichromatic. Male: orange to yellow body, lavender to pink head and bright red dorsal fin. Female: orange to peach upper head, body, and fins; 2 narrow lavender-yellowish bars extend from eye to pectoral fin. Max. size: 9.5 cm.

Diet: Zooplankton. Occur in large feeding aggregations of mixed sexes, usually more females than males, 1–3 m above the substrate, picking plankton from currents that sweep the reef.

Reproduction and Development: Protogynous hermaphrodites. If a dominant male dies, the largest female of the group will change sex to take its place.

Mortality/Longevity: These small fish are snack food for many larger predators.

Remarks: Males erect dorsal fin as courtship display.

Anthias gather in huge schools of hundreds. Schools are made up of smaller "harems" consisting of a single dominant male, a few non-dominant males, and many females.

Red-cheeked Fairy Basslet
Pseudanthias huchtii (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: Western Central Pacific: common in the Philippines and Indonesia.

Habitat: Coral outcrops of clear outer reef slopes, where the species may be found in large aggregations.

Appearance: Males have prominent orange stripe from the eye to the middle of the pectoral fin; wide maroon band on the outer margin of the pelvic fin. Females and juveniles are greenish-yellow. Max. length: 12 cm.

Diet: Zooplankton.

Reproduction and Development: All *Pseudanthias* spp. are thought to be protogynous hermaphrodites. Broadcast spawners; fertilized eggs remain part of the zooplankton until they hatch, metamorphose, and settle.

Mortality/Longevity: Life span: 5 years or more.

Remarks: *Pseudanthias* spp. often congregate near or just above the reef wall for feeding, where strong currents deliver food to both corals and fish. Typically these little fish face into the current and swim at a stay-in-place speed. If the current changes, the shoal turns as well.

Lori's Anthias
Pseudanthias lori (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: West-Central Pacific.

Habitat: Near caves or ledges of steep outer reefs, 7-70 m. Typically in small groups.

Appearance: Length to 12 cm. Laterally compressed body. Orange-pink body, usually with 4 reddish semi-bands below the posterior segment of the dorsal fin.

Diet: Zooplankton.

Reproduction and Development: Females change sex into males for their terminal phase.

Squarespot Anthias aka **Squarespot Fairy Basslet**
Pseudanthias pleurotaenia (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: Indonesia to Samoa, north to Ryukyus, Japan and south to New Caledonia.

Habitat: Steep, current-swept seaward drop offs, 10–180 m, but typically below 25 m depth.

Appearance: Length to 20 cm. Sexually dichromatic. Male is orange-red to magenta, one large violet square on each side of its body (thus the common name), elongate third dorsal spine. Coloration and size of "square" highly variable among individuals; female less colorful.

Diet: Small crustaceans and fish eggs.

Reproduction and Development: All begin life as females. Males are sexually reversed females. Sex reversal is socially controlled.

Remarks: Usually in small (6–30 individuals)

aggregations of conspecifics; females far outnumber males in the groups.

Juveniles are solitary and remain close to shelter.

On many individuals, the magenta square spot appears to glow like a neon light.

Active diurnally. Nocturnally shelter within the reef.

Jewel Fairy Basslet aka **Lyretail Anthias**
Pseudanthias squamipinnis (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: Indo-West Pacific: Red Sea, South Africa, south to Australia, north to Japan.

Habitat: Shallows to 55 m; coral outcrops of clear lagoons, channels, and outer reef slopes. Often found in large groups.

Appearance: Various color patterns, including red, pink, orange, yellow, even purple. Males are typically more colorful, and have a larger dorsal fin spike than females.

Diet: Zooplantkton.

Reproduction and Development: Males territorial, haremic; like all *Anthias* species, are sequential, protogynous hermaphrodites. If male perishes, largest female will develop male reproductive organs and take its place.

Yellowstriped Fairy Basslet aka **Purple Anthias**
Pseudanthias tuka (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: Indo-Pacific: Philippines, Bali, Solomon Islands, Great Barrier Reef, southern Japan.

Habitat: Favors strong currents along the edge of drop-offs and steep outer reef slopes at depths of 30 m or more.

Appearance: Sexes dichromatic. Both sexes are a deep pink to purple; however, females have a bright yellow stripe on the back extending onto the caudal fin. Males have a purple blotch on the base of the dorsal fin, elongated fin rays, and a pointed snout Max. size: 12 cm.

Diet: Planktonic crustaceans and fish eggs.

Reproduction and Development: As in all *Anthias* species, if a dominant male dies, the largest female will usually change into a male and take his place.

Remarks: Usually found in large aggregations with many more females than males.

Fathead Anthias
Serranocirrhitus latus (Serranidae)
Sea Basses: Groupers, and Fairy Basslets

Distribution: Western Pacific, from the Moluccan Islands to Fiji, north to Japan and south to the Great Barrier Reef.

Habitat: Near coral reefs usually at depths of 18 m or more, either solitarily or in small haremic groups; also found near caves, ledges, and drop-offs, usually close to crevices where they retreat if threatened.

Appearance: Unlike its cousins the *Pseudanthias* species, the fathead anthias has a deep body and elongate pectoral fins. Predominantly pink, with heavy yellow-to-orange scale margins and facial markings. Max.length: 10 cm.

Diet: Zooplankton, small invertebrates, floating filamentous algae.

Reproduction and Development: Like all *Anthias* spp., is hermaphroditic. If a dominant male dies, the largest female will usually morph to take its place.

Remarks: This little fish is secretive and often seen swimming upside-down along the roofs of overhangs and caves. Their dimly lit tank in the Steinhart fits their common deep-water preference.

Unlike most *Pseudanthias* spp., which often live in large shoals, *S. latus* is usually found either solitary or in a small haremic group.

Harlequin Bass
Serranus tigrinus (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: Tropical western Atlantic and throughout the Caribbean: Bermuda and southern Florida, to northern South America.

Habitat: Most common in areas with rock or scattered coral, depth to 40 m.

Appearance: Snout long and pointed. Elongate body; stripes and bars on light background form irregular rectangles on body. Sometimes yellowish below. Colors and patterns, coupled with spotted dorsal and caudal fins, are the source of its common name. Max. length: 30 cm.

Diet: Mainly crustaceans and small fishes.

Reproduction and Development: Synchronous hermaphrodite. Territorial egg layer. Lives solitary or in pairs.

Remarks: Said to have an aggressive nature.

The Harlequin Bass is the most common

member of the genus *Serranus*, commonly known as "dwarf sea basses." The pointed snout and distinct color pattern make it easy to identify.

Chalk Bass

Serranus tortugarum (Serranidae)
Sea Basses: Groupers and Fairy Basslets

Distribution: Tropical western Atlantic: southern Florida, Bahamas, Honduras and Virgin Islands; throughout the Caribbean.

Habitat: Found over rubble, silty, or sandy bottoms. Often congregate in small groups hovering over a patch of coral rubble or an old conch shell. Will often hide in the substrate.

Appearance: Body color a light purple with bright blue to orange saddle bands along the back. Different specimens of this species can look very different from each other. Upper side is darker than the ventral side. Max. length: 8 cm.

Diet: Feeds on zooplankton.

Reproduction and Development: Like other members of the genus *Serranus*, the chalk bass is a synchronous hermaphrodite (has both male and female organs). The mated pair takes turns in which one acts as the male and the other the female through multiple matings, usually over the course of several nights.

Remarks: A non-aggressive species that adapts to aquarium life well.

Orchid Dottyback

Pseudochromis fridmani (Pseudochromidae)
Dottybacks

Distribution: Western Indian Ocean: known only from the Red Sea.

Habitat: Usually on vertical rock faces or beneath overhangs, taking refuge in small holes. Found at depths from 1–30 m.

Appearance: Rich lavender-red color with scales trimmed in blue. A black stripe extends from the mouth though the eye. Max. length: c. 6 cm.

Diet: Small planktonic or rock-dwelling crustaceans. The large mouth enables ingestion of food items larger than most taken by fish its size.

Reproduction and Development: Like the rest of their family, this dottyback is hermaphroditic, changing to either male or female. Fully adult super males have a pointed filament on their tails. Pairs have been known to breed in captivity.

Conservation Status: The orchid dottyback was greatly reduced in the wild, almost to the point of extinction until successful captive breeding.

Remarks: A shy fish that needs suitable hiding places.

Royal Dottyback

Pseudochromis paccagnellae (Pseudochromidae)
Dottybacks

Distribution: Indo-Pacific and western Pacific.

Habitat: Shallow coastal reefs to steep coral and sponge-covered drop-offs, especially areas with coral or rocky hiding places.

Appearance: Color: magenta and yellow with a sharp delineation between the two colors. Sexes similar; males may have brighter color. Max size: 12 cm.

Diet: Mostly small invertebrates, including worms, crustaceans, zooplankton.

Reproduction and Development: Females produce a spherical mass of eggs that adhere to a rocky substrate. After fertilization, the male guards and fans the eggs to provide oxygen until they hatch in about four days. Some dottybacks have bred in captivity, including the royal dottyback.

Remarks: Dottybacks often dive in and out of crevices. Watch our royal dottyback zip about its tank, appearing and disappearing.

With their sharp canines and feisty nature, dottybacks are excellent hunters and staunch defenders of their territory.

Royal Gramma

Gramma loreto (Grammatidae)
Basslets

Distribution: Caribbean, Bahamas, Bermuda.

Habitat: Small groups in caves, crevasses and under ledges, 1–60 m.

Appearance: Length to 8 cm. Bicolored: magenta anterior, brilliant orange posterior.

Diet: Feed on ectoparasites of other fishes.

Reproduction and Development: External fertilization. Prior to spawning, some males establish nest sites, using small holes and crevices in the substratum. Females travel to male nests for egg deposition around dawn.

Males guard and maintain nest.

Remarks: Often rests or retreats when alarmed to a stereotypic "upside down" posture near cave roofs.

Southern Blue Devil

Paraplesiops meleagris (Plesiopidae)
Roundheads

Distribution: Temperate Indian Ocean along the southern Australian coastline, from eastern Victoria to southwestern Australia.

Habitat: Rocky reefs and caves, in relatively shallow water from 15–25 m. They prefer deep cave systems, under projections and on ledges where a number of fish, ranging from small juveniles to mature adults, may inhabit the space.

Appearance: Large mouths and very large eyes, vivid light blue spots cover its dark blue/brown body, and elongated pelvic, anal and dorsal fins. Unlike many fish whose colors mute with age, these spots become a more vivid blue. Max length: 33–35 cm.

Diet: Other fishes and crustaceans. The blue devil is an ambush predator that is secretive and spends much of its time hiding. With its slow-moving manner, however, it can be both predator and prey.

Reproduction and Development: Members of the Paraplesiops genus lay eggs on the substrate where they are guarded until hatching by the male.

Remarks: The species tends to be shy. In an aquarium setting, it needs a space with numerous nooks and crannies to hide in. Look carefully in the rockwork to find our blue devil.

Human uses include commercial fisheries and commercial aquariums. Aborigines have long considered this fish a delicacy.

Redbreast Sunfish

Lepomis auritus (Centrarchidae)
Sunfishes

Distribution: North America: Eastern rivers of USA and Canada. Introduced to eastern and southern parts of Texas.

Habitat: Rocky and sandy pools of creeks and small to medium rivers.

Appearance: Olive to brownish gray along the back; belly ranges in color from yellow to orange and rust. Common length: 20 cm; max: 30 cm.

Diet: Terrestrial and aquatic insects, such as dragonflies and mayflies, as well as snails, crayfish, and small fish. Juveniles eat small benthic organisms, such as fly larvae.

Reproduction and Development: Typical of sunfishes, the redbreast male selects an area of sand and gravel in shallow water, and scrapes out a depression where the female lays her eggs. The male guards eggs and fry.

Mortality/Longevity: Life span: 5 years.

Remarks: A popular gamefish throughout its range.

This species should be called the "longear sunfish" as its ear (the opercle flap) is noticeably longer than the ear of the species so named.

In some areas where it has been introduced, the redbreast is displacing its longear cousin.

Longear Sunfish

Lepomis megalotis (Centrarchidae)
Sunfishes

Distribution: North America. Widely introduced as a game fish.

Habitat: Pools of sluggish streams over sand, gravel or rocks. Also warm freshwater lakes and reservoirs, almost always in shallow water with dense vegetation.

Appearance: Shape is perchlike. In direct sunlight sunfish have a brilliant sheen. A black extension of the upper gill cover is the "ear." Spinous dorsal fins. Length to 24 cm.

Diet: Carnivorous, tend to be generalists: aquatic insects, snails, crustaceans and small fishes.

Reproduction and Development: Spawn during the summer. Nest side by side arranged in dense colonies near shore. Male digs nest in gravel and defends territory during prespawning period. Female approaches nesting colony when nest completed. Mating pairs swim in circles over nest, stop for short intervals to release sperm and egg. Male may chase mate away from the nest, female may come back to the same nest or move on to mate with another male. After hatching, young are pelagic and drift at the surface for weeks before settling and moving inshore. Juveniles school in large numbers in shallow weedy areas and protected locations.

Mortality/Longevity: Preyed upon by the bowfin (*Amia calva*) and other fishes.

Remarks: A popular game fish with anglers.

Largemouth Bass

Micropterus salmoides (Centrarchidae)
Sunfishes

Distribution: Native to eastern North America and historically ranged from southern Canada to northern Mexico, and from the Atlantic coast to the central United States.

Habitat: Prefer quiet, shallow, clear water with lots of vegetation.

Appearance: Has large mouth, a notch between the two dorsal fins, and a dark stripe along the side of the body. Color variable, but usually a darkish green on the back and sides, fading to off-white on the belly. Sexually dimorphic (female is larger). Average weight: 1 kg. Max: weight: 10 kg. Max. length: ~95 cm.

Diet: Juveniles: zooplankton and aquatic insects. Adults: crayfish and other fish species, especially other sunfish species.

Reproduction and Development: Males prepare and build a crude nest in shallow water. Following an act of courtship, female lays eggs in the nest. The male guard the eggs until they hatch. The schooling fry remain close to their father for about a month.

Mortality/Longevity: The expected lifespan in the wild is 15 years (longest 25 yrs).

Remarks: *M. salmoides* is the most popular game fish in the United States.

This fish is a potential pest as it can eradicate indigenous species.

The generic name for the bass, *Micropterus*, means "small fin" and is a misnomer. The specimen from which the genus was named had a damaged fin, which gave the appearance of a small fin behind the dorsal fin!

Since the beginning of the twentieth century largemouth bass have been introduced successfully all over the world.

Black Crappie

Pomoxis nigromaculatus (Centrarchidae)
Sunfishes

Distribution: North America: native to freshwaters of central and eastern North America, today widely introduced throughout the U.S.

Habitat: Lakes, ponds, sloughs, and backwaters and pools of streams. Prefers clear water and sites with vegetation over mud or sand.

Appearance: Mottled black on light surface, wavy light/dark pattern on non-paired fins. Sexes similar. Max. size: ~ 50 cm.

Diet: Juveniles and small individuals feed on planktonic crustaceans and insect larvae. Large adults take small fishes. Feed mostly at dawn and dusk; hang around vegetation or submerged objects during the day.

Reproduction and Development: Prolific breeders. Like other sunfishes, black crappie are nest builders. Male sweeps out nest and attracts female, who may spawn several times with more than one male, laying 10,000–200,000 eggs. Male guards the nest until young can swim and feed.

Mortality/Longevity: Life span: up to 15 years, average closer to 7 years. Important food source for larger fishes. Turtles and birds feed on young.

Remarks: The species name, *nigromaculatus*, means "black spotted" (L.), an accurate description.

A highly regarded game fish prized for its flavor, it is stocked in lakes and streams in all the lower 48 states.

Yellow Perch

Perca flavescens (Percidae)
Perches

Distribution: West central Canada and the Hudson Bay area east to New Brunswick, south to South Carolina, and west to Kansas. Also found in the Atlantic, Arctic, and Great Lakes.

Habitat: Freshwater lakes as well as impoundments of larger rivers, also smaller ponds and rivers. Known in both brackish water and salt lakes. Prefers clear water, though can tolerate low oxygen levels.

Appearance: Background color yellowish overlaid by 6–8 dark vertical bars on the sides. Sexual dimorphism: females grow faster and become larger than males. Max. size: ~50 cm.

Diet: Insects, larger invertebrates, fishes and fish eggs. Diurnal feeder.

Reproduction and Development: Males and females congregate in shallow spawning grounds over sand, gravel, and vegetation. Female releases a gelatinous egg strand that may be up to 2 m long! One or two males

release milt over the eggs, which may number more than 100,000.

Mortality/Longevity: Life span: ~ 7 years. An important food source for top predators such as walleye, northern pike, and lake trout. Gulls and diving ducks take juveniles.

Remarks: Overwinters in deep water (often with a protective covering of ice as suggested in the Water Planet exhibit), then moves to shallower water in spring to spawn.

A popular game fish prized for its flavor.

The spread of lampreys into the Great Lakes and beyond during the first half of the 20th century severely impacted yellow perch populations as well as those of many other important game and commercial fish species.

Yellowstriped Cardinalfish

Apogon cyanosoma (Apogonidae)
Cardinalfishes

Distribution: Indo-West Pacific. Common from Australia to the Red Sea.

Habitat: Inhabits sheltered clear water areas of lagoon and seaward reefs. Associates in small to large aggregations under ledges, in holes, or even among long spines of sea urchins.

Appearance: Silver body highlighted with 6 orange-gold horizontal stripes. Pinkish to orange spot on base of caudal fin. Max. length: 8 cm.

Diet: Planktonic crustaceans and small invertebrates.

Reproduction and Development: Like all cardinalfishes, a paternal mouthbrooder. Has reproduced in captivity.

Remarks: Like all cardinalfishes, active at night, with large eyes adapted to gathering low light.

Threadfin Cardinalfish

Apogon leptacanthus (Apogonidae)
Cardinalfishes

Distribution: Red Sea to Samoa, north to Ryukyu, Japan, south to New Caledonia and east to Tonga.

Habitat: Assemble in huge groups at 1–20 m depth in sheltered lagoons, protected reefs and embayments among branching corals.

Appearance: Length to 6 cm. Whitish, translucent with frosty iridescence on back; iris is luminous blue. Yellow-edged blue bands and bars on rear of head and front of body. Long first dorsal fin tip.

Diet: Nocturnally feeds on benthic crustaceans.

Reproduction and Development: Mouth brooders; pair for courtship and spawning.

Flame Cardinalfish

Apogon maculatus (Apogonidae)
Cardinalfishes

Distribution: Western Atlantic: Canada to Massachusetts, Bermuda, Bahamas, Gulf of Mexico to Brazil.

Habitat: Coral reefs: also in other areas with protective cracks and crevices. Often hovers near and in holes.

Appearance: Aptly named for notable orangish/red color. Black spot under second dorsal fin. Black eyes bordered top and bottom with white stripes. Length to 11 cm.

Diet: Nocturnal predator on small benthic and planktonic invertebrates.

Reproduction and Development: Spawning may occur throughout the year with pairs forming and exhibiting complex courtship behaviors. Mouthbrooders, like all cardinalfish. Male does not eat for several weeks while carrying eggs and fry.

Remarks: Popular in the aquarium trade, but rarely seen during the day at the Steinhart. Check the darker crevices or come after 5:00 p.m.!

Redspot Cardinalfish

Apogon parvulus (Apogonidae)
Cardinalfishes

Distribution: Western Pacific: Japan to Indonesia.

Habitat: Around rocky reefs, especially in current-prone areas.

Appearance: Semi-transparent with distinctive large, red peduncular spot when adult. Max. length: 4 cm.

Diet: Microplantkton.

Reproduction and Development: Distinct paring during courtship and spawning; males are mouthbrooders.

Remarks: This species commonly forms large mid-water aggregations.

Seale's Cardinalfish

Apogon sealei (Apogonidae)
Cardinalfishes

Distribution: Western Pacific: Malaysia north to southern Japan, south to Australia; Palau.

Habitat: Found under ledges and among branching corals of sheltered reef lagoons; mostly to depths less than 10 m.

Appearance: Tan with thin mid-lateral stripe and small dark spot on tail. Max. length: 10 cm.

Diet: Small fishes and zoobenthos, including benthic crustaceans and mobile invertebrates.

Reproduction and Development: Males are mouth-brooders.

Dog-toothed Cardinalfish

Cheilodipterus isostigmus (Apogonidae)
Cardinalfishes

Distribution: Western Pacific: patchy distribution including South China Sea, Philippines, Borneo, Papua New Guinea.

Habitat: Occurs in lagoon reefs to depths of 12 m, usually in small groups among staghorn corals.

Appearance: Silvery body with black lateral stripes. Caudal peduncal yellow with black spot. Canine teeth at front of lower jaw. Max. length: 11 cm.

Diet: Small benthic organisms, invertebrates, and fishes. Like all apogonids, are paternal mouthbrooders; distinct pairing takes place during courtship and spawning.

Banggai Cardinalfish

Pterapogon kauderni (Apogonidae)
Cardinalfishes

Distribution: Apparently endemic to Banggai Islands, east of Sulawesi Island, Indonesia.

Habitat: Silty sand bottoms with seagrass. Often associated with *Diadema setosum*, the long-spined sea urchin. Adult banggais hover directly above the urchins, younger cardinalfish stay even closer to the urchins. All retreat among the spines when threatened.

Appearance: Length to 8 cm. Tasseled first dorsal fin, elongate anal and second dorsal fin rays, deeply forked caudal fin and striking color pattern. Light brown to off-white body with three bold vertical, black bands, including one that transverses the eyes. Tiny white flecks on fins and posterior of body.

Diet: Probably small benthic and planktonic crustaceans preyed upon nocturnally.

Reproduction and Development: The large eggs are about 2.5 mm in diameter. Males mouth brood up to 40 eggs. Retain the fry in the mouth after hatching. Tiny, fully formed juveniles are released after a month of mouth brooding.

Conservation status: The fragmentation of their habitat, their limited distribution, and over-collecting by the aquarium trade have put this fish at risk, and in 2007 it was listed as Endangered by CITES. The species is not yet on the IUCN Red List.

Various aquaria, including the Steinhart, are monitoring the trade impact upon Banggai cardinalfish. Captive breeding programs are in place to curtail the need for wild caught individuals.

Remarks: Mouth brooding is very unusual in marine fish.

Pajama Cardinalfish

Sphaeramia nematoptera (Apogonidae)
Cardinalfishes

Distribution: Indian and western Pacific oceans.

Habitat: Often found in reef areas of bays and lagoons along with other members of their species, sheltered among branches of *Porites* spp.

Appearance: Head yellow; wide black band encircling central body, and spots on the back half of the body. Eyes large and red.

Diet: Small fish and crustaceans. At night, leaves the protection of coral shelter to feed along the bottom at about 15 m.

Reproduction and Development: Sexes separate; exhibit distinct pairing during courtship and spawning. The male incubates eggs in his mouth, protecting them from predators.

Remarks: Note the large eyes, a common feature of nocturnal fishes that allows them to gather low light images.

Ocean Whitefish

Caulolatilus princeps (Malacanthidae)
Tilefishes

Distribution: British Columbia to Peru, including the Galapagos Islands.

Appearance: Yellowish brown above and lighter below with a yellow tail. Dorsal and anal fins are long with blue and yellow stripes. Length: 55–102 cm; weight: to 3.2 g.

Habitat: Offshore rocky reefs, depths to 10–90

m. Found on muddy bottoms, soft sand as well as rocky bottoms.

Diet: Worms, shrimp, octopus, squid, small fishes.

Reproduction and Development: Spawning may occur 2–3 times from November through March; eggs and larvae are pelagic.

Mortality/Longevity: Life span: up to 13 years.

Remarks: A large commercial fishery existed in the 1920s &'30s.

Malacanthid species live in burrows or mounds which they construct.

Purple Sand Tilefish

Hoplolatilus purpureus (Malacanthidae)
Tilefishes

Distribution: Western Central Pacific: Philippines and Solomon Islands.

Habitat: Sand and rubble patches of steep seaward slopes, usually between 35–70 m.

Appearance: Slender, tubular, purple body with red-edged forked tail; long, continuous dorsal and anal fins. Max. length: 13 cm.

Diet: Zooplankton.

Reproduction and Development: Egg layers. Have spawned in captivity.

Remarks: Their popular name "sand" tilefish comes from their lightning-quick ability to diving into burrows they fashion in rubble substrates.

Solitary or form small groups.

Yellow and Blueback Fusilier

Caesio teres (Caesionidae)
Fusiliers

Distribution: Indo-Pacific: East Africa to Micronesia, Samoa and Line Islands; southwestern Japan to Great Barrier Reef, Australia.

Habitat: Active diurnally over upper edges of steep slopes, coastal seaward and patch reefs to 5–50 m; primarily around coral reefs, with a preference for coralline lagoons.

Appearance: Length to 40 cm. Slender, torpedo-shaped body; silvery-blue, yellow from back to lower tail base and tail, pectoral fin base black. Tail deeply forked.

Diet: Zooplankton.

Reproduction and Development: Spawning occurs near the surface, typically in deep channels during an outgoing tide at sunset or a full moon. Oviparous; buoyant, spherical eggs are pelagic, thus non-guarded.

Remarks: Congregate in large aggregations, often with other species of fusiliers.

Bluestreak Fusilier

Pterocaesio tile (Caesionidae)
Fusiliers

Distribution: Indo-Pacific: East Africa to the Marquesas, north to southern Japan, south to New Caledonia, and throughout Micronesia.

Habitat: Outer reef slopes and in clear, deep lagoons, to 60 m depth.

Appearance: Elongate body. Broad iridescent blue mid-lateral band; dark olive above. Turns bright red along lower half of body at night. Max. size: 30 cm.

Diet: Zooplankton taken from midwater.

Reproduction and Development: Oviparous; small pelagic eggs.

Remarks: Usually form dense schools along outer reef slopes and in clear deep lagoons, to 60 m.

Caught commercially, primarily as tuna baitfish.

Siamese Tigerfish

Coius (Datnioides) microlepis (Coiidae)
Tiger Perches

Distribution: Southeast Asia: Thailand, Borneo, Sumatra

Habitat: A bottom dweller in brackish waters.

Appearance: An arrowhead-shaped fish with a silvery brown body and vertical jet black bars on its body. The number of black bars depends on geographic location. Fish from the Asiatic mainland have 6 bars, and those from the Indo-Australian archipelago have 7. Max. length: 45 cm.

Diet: A predatory carnivore. As it approaches a potential meal, the tigerfish slowly sways from side to side, as if sighting the prey and then strikes using its large mouth.

Reproduction: Egg layer.

Remarks: In Thailand, the fish is sought after for its flavorful flesh. Highly regarded by aquarists.

Striped Large-eye Bream

Gnathodentex aurolineatus (Lethrinidae)

Distribution: Widespread in the Indo-Pacific

and Central Pacific.

Habitat: Subtidal coral reef flats, lagoons, and seaward reefs at depths over 30 m.

Appearance: Dorsal area brown with narrow silver stripes; head and upper sides mainly silver to gray, brownish-orange on lower sides. Prominent golden yellow blotch below posterior of dorsal fin. Max. length: 30 cm.

Diet: Nocturnal feeder on benthic invertebrates, including crabs, snails, and small fishes.

Reproduction and Development: Often form large aggregations for pelagic spawning.

Remarks: During the day, up to several hundred individuals aggregate between coral heads or in gullies, hovering motionless in compact mass.

Opaleye

Girella nigricans (Kyphosidae)
Sea Chubs

Distribution: Oregon to southern Baja California.

Habitat: A resident intertidal species with strong homing behavior. Can leave tide pools if aquatic conditions become inhospitable. Also found near or over rocky reefs and in kelp beds up to about 30 m depth. Dense schools form in the spring season in kelp forests. Young are pelagic.

Appearance: Ovally rounded football-shaped profile. Olive-green, frequently shaded with blue or gray; often the snout has a white-colored area. Can display a silvery-white spotted pattern over the entire body; one to three white spots on back. Bright blue to blue-green eyes. Young are blue dorsally, silver ventrally. Max length: to 66 cm.

Diet: Feeds diurnally, mainly on seaweeds; occasionally take invertebrates (shrimps, amphipods, jellyfish, etc.)

Reproduction and Development: Spawns April to June; female sheds eggs into the water column. Young-of-the-year move into tide pools from June until winter season, the smallest in the most elevated pools. After 1–2 years the juveniles migrate to subtidal reefs and kelp forests.

Mortality/Longevity: A popular sportfish, also a mild, good-eating fish, sold commercially as "perch."

Halfmoon

Medialuna californiensis (Kyphosidae)
Sea Chubs

Distribution: Vancouver Island, British Columbia to Gulf of California. Most common south of Point Conception, California.

Habitat: Common on nearshore rocky reefs and in kelp beds. Most abundant from 3–20 m.

Appearance: Slate blue to blue black, silvery belly; dusky area above gill cover. *Medialuna* and common name refers to the half-moon shape of the tail. Scales extend over part of dorsal fin. Max. length: 20 cm.

Diet: Seaweed, sponges, small invertebrates. Diurnal feeders.

Reproduction and Development: Females oviparous.

Mortality/Longevity: Taken by California sea lions, northern fur seals, loons, cormorants, and bald eagles among others.

Remarks: A popular sport fish, especially from Santa Monica south. Also a small commercial fishery, as flesh is of excellent quality. Typically found in schools or loose aggregations.

Mono

Monodactylus argenteus (Monodactylidae)
Moonyfishes

Distribution: Indo-West Pacific: Red Sea and East Africa to Samoa, north to southern Japan, south to New Caledonia and Australia.

Habitat: Bays, mangrove estuaries, tidal creeks, and lower reaches of freshwater streams.

Appearance: Adults bright silver with yellowish dorsal and tail fins. Round to triangular-shaped, laterally compressed body. Small juveniles more colorful with yellow over most of the dorsal fin and two vertical black bands over the head. Max. size: 27 cm.

Diet: Planktonic and benthic invertebrates.

Reproduction: Batch spawner.

Remarks: Territorial; adults form schools; juveniles solitary or in small groups.

Bank Butterflyfish

Chaetodon aya (Chaetodontidae)
Butterflyfishes

Distribution: Western Central Atlantic: North Carolina and northeastern Gulf of Mexico to

Yucatan in Mexico; unknown in Bahamas and Antilles.

Habitat: Deep, offshore banks. Depth range: 20- 170 meters.

Appearance: Deep, compressed body, with yellow on all fins except the pectoral fins. Vertical dark bars on the eyes and near the caudal fin. Prominent dorsal spines make these fish unappetizing to most fish-eating predators.

Diet: Algae, plankton, coral polyps, small crustaceans and worms.

Reproduction: Broadcast spawner; forms pairs during breeding.

Conservation Status: Not at risk; bred successfully around the world for the aquarium trade.

Remarks: Typically found in pairs and active during the day. At night they may sleep inside large sponges.

Is shaped to hover and navigate holes and crevices in the reef. It has a small protruding mouth and many small teeth in both jaws to reach and eat food items unavailable to many other fishes.

Saddle Butterflyfish

Chaetodon ephippium (Chaetodontidae)
Butterflyfishes

Distribution: Indo-Pacific.

Habitat: Lagoons and seaward reefs to 30 m in coral rich, clear waters.

Appearance: Yellowish grey with a large black spot on the upper rear sides bordered below by a broad white band; orange area from snout to ventral fins, wavy blue lines on the lower sides. Adults have a filament extending posteriorly from the dorsal fin. Max length: 30 cm.

Diet: Filamentous algae, small invertebrates, sponges, coral polyps, and fish eggs.

Reproduction and Development: Sexes separate; form pairs during breeding. Scatter eggs in the open water or on the substrate. Do not guard eggs.

Klein's Butterflyfish

Chaetodon kleinii (Chaetodontidae)
Butterflyfishes

Distribution: Indo-Pacific.

Habitat: Deeper lagoons, channels and seaward reefs 4–61 m, usually below 10 m. Solitary, pairs, occasionally in groups.

Appearance: Length to 15 cm. Compressed body. White band on caudal peduncle. Adult posterior body brown to yellow. Head white, eye transversed with a black vertical stripe. Colors highly variable among populations.

Diet: Primarily octocorals (esp. *Sarcophyton* spp.), also algae and zooplankton.

Reproduction and Development: Oviparous. Nonguarders

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Raccoon Butterflyfish

Chaetodon lunula (Chaetodontidae)
Butterflyfishes

Distribution: From East Africa throughout the Indo-Pacific, south to Australia, east to Hawaii.

Habitat: Shallow reef flats of lagoon and seaward reefs, to depth of 30 m.

Appearance: A large butterflyfish (up to 20 cm), oval shape. Most have oblique stripes on the flanks, and large black bar over the nose and eyes that makes the eyes difficult for a predator to see and is reminiscent of a raccoon's mask.

Diet: Omnivore. Feeds on coral polyps, worms, crustaceans, plankton, algae.

Reproduction and Development: Oviparous. Pairs form during breeding period.

Mortality/Longevity: Preyed upon by larger fish, invertebrates, and humans. Life span: 5–7 years.

Remarks: *Chaetodon* means "bristletooth," and has a dental array well-suited to its diet.

Has a great fondness for coral polyps, which makes our Steinhart denizen a better fit for the Color Cluster's "Hiding the Eye" tank, which contains no corals. There it feeds on other invertebrates rather than the Main Tank's prized corals!

Reef Butterflyfish

Chaetodon senentarius (Chaetodontidae)
Butterflyfishes

Distribution: Tropical western Atlantic Ocean: North Carolina to Brazil, including Gulf of Mexico and Caribbean Sea.

Habitat: Coral reefs, usually from shallows to 40 m.

Appearance: Silver body, yellow and black

dorsal fin, and yellow tail; two vertical black bars, one on the head through the eye and a black bar across the caudal peduncle. Max length: c. 15 cm.

Diet: Coral polyps, polychaete worms, shrimps, amphipods and hydroids.

Reproduction and Development: Broadcast spawners. Form pairs during breeding. The female releases 3,000–4,000 eggs. The fertilized eggs are small, transparent, and hatch within a day into minute, translucent silvery-grey larvae.

Mortality/Longevity: Preyed upon by larger fish, such as moray eels, snappers, and groupers. If it can't find cover, will defend itself by facing its predator with dorsal spines erected, suggesting a sharply distasteful meal.

Remarks: Typical of butterflyfishes, its mouth is adapted to feeding in crevices. The teeth are curved at the tips and designed for scraping and nipping at the small invertebrates. Teeth are in several rows in each jaw, giving the appearance of a brush. Origin of name: chaeto = "bristle" and donte = "tooth."

Vagabond Butterflyfish

Chaetodon vagabundus (Chaetodontidae)
Butterflyfishes

Distribution: Indo-Pacific.

Habitat: Reef flats, lagoon, and seaward reefs to depths of 30 m.

Appearance: Black bands over head, rear body and tail. The soft dorsal, anal and caudal fins are yellow. Max length: 23 cm.

Diet: Omnivorous; feed on algae, coral polyps, sea anemones, crustaceans and polychaete worms. Both male and female defend a feeding territory against other pairs of their species, but are not particularly aggressive toward other species.

Reproduction and Development: Oviparous, monogamous. Open water egg scatterers. Pelagic larvae settle in shallow back reef habitats.

Remarks: Vertical line going through the eye disguises the eye and makes it harder for a predator to figure out which is the front of the fish and which is the back, perhaps giving the butterflyfish a brief chance to escape while the predator hesitates.

Copperband Butterflyfish

Chelmon rostratus (Chaetodontidae)
Butterflyfishes

Distribution: Andaman Sea to Papua New Guinea, north to Ryukyu Island, south to Northwest Australia and Great Barrier Reef.

Habitat: Estuaries, coastal reefs, silty inner reefs, 1–30 m. Solitary or in pairs.

Appearance: Length to 19 cm. Deep, highly compressed body. Beak-like mouth. Body whitish with 4 vertical orange bands. Black false eyespot on terminal orange band.

Reproduction and Development: Planktonic eggs hatch after a couple days. Larval stage lasts several weeks to perhaps 2 months. During a distinctive late larval stage the head and body are covered with bony plates.

Remarks: Distinctive snout used for prying into the crevices of coral.

A food fish marketed locally. Reported to be "not good" from a culinary standpoint.

Western Talma

Chelmonops curiosus (Chaetodontidae)
Butterflyfishes

Distribution: Southern and Central Western Australia.

Habitat: Coastal rocky reefs.

Appearance: Deep bodied, compressed fish with long pointed snout. Silvery gray with five vertical brown bars. Max. size: 26 cm.

Diet: Invertebrates and algae.

Longnose Butterflyfish

Forcipiger longirostris (Chaetodontidae)
Butterflyfishes

Distribution: Indo-Pacific from East Africa to Indonesia, Philippines, Hawaii and French Polynesia; southwest Japan to Great Barrier Reef.

Habitat: Non-migratory; usually found, alone or in pairs, in the outer reefs from 3–70 m.

Appearance: Yellow with black upper head and silvery white below; extremely elongated snout; black spots on breast, spot on anal fin below tail base. Individuals occasionally turn dark brown, a color phase that does not seem to be related to sex or reproduction. Maximum size: 22 cm.

Diet: Mainly small crustaceans.

Reproduction and Development: Monogamous; form breeding pairs. Ovoviviparous,

broadcast spawners, with eggs and larvae passing through an extended planktonic stage.

Remarks: Sometimes confused with the common longnose butterflyfish (*Forcipiger flavissimus)*, which is similar in size and color but has a shorter snout.

Pyramid Butterflyfish
Hemitaurichthys polylepis (Chaetodontidae)
Butterflyfishes

Distribution: Eastern Indian Ocean and the Western and Central Pacific Ocean.

Habitat: Outer coral reef usually close to drop-offs, at depths 3–60 m.

Appearance: Brown to black head and a large white pyramid-shaped area on its side. Scales pearlescent. The dorsal and anal fins are yellow; caudal fin white. Max. length: 18 cm.

Diet: Plankton.

Reproduction and Development: Ovoviviparous. Form pairs during breeding.

Remarks: Occur in large schools that feed several meters above the edges of steep outer reef slopes.

Unlike many other butterflyfishes, this species does not feed on coral polyps, so is considered a good choice for aquaria with live corals.

Bannerfish aka **False Moorish Idol**
Heniochus diphreutes (Chaetodontidae)
Butterflyfishes

Distribution: Indo-Pacific; widely distributed from the Red Sea and the east coast of Africa to Hawaii.

Habitat: Outer reef slopes, 15–210 m; in the tropics typically found in cool upwelling water.

Appearance: White with pair of black bands, second band terminating at end of anal fin. Elongate dorsal fin filament. Length to 21 cm.

Diet: Zooplankton.

Reproduction and Development: Ovoviviparous; form pairs during breeding.

Remarks: Form large schools, and also occur in small groups or solitary. Elongate dorsal fin filament, which gives this group of fishes their "bannerfish" moniker; is the fourth dorsal spine.

Often called the "false" Moorish Idol for its markings similar to the Steinhart's iconic species; however, the flowing dorsal fin and larger size of the Idol are distinctive differentiations.

Cherubfish
Centropyge argi (Pomacanthidae)
Angelfishes

Distribution: Bermuda, Florida, Bahamas, Yucatan and Central American coast to Guianas.

Habitat: Nocturnally active in pairs or small groups in rubble areas near rocky or coral reefs, occasionally walls. Depth 9–105 m, commonly deeper than 30 m.

Appearance: Length to 8 cm. Small, oval angelfish. Dark blue body, yellow-orange face, blue ring around eye.

Diet: Algae.

Mortality/Longevity: Preyed on by other fish such as yellow-finned tuna

Remarks: This small angelfsh darts into crevices when frightened or pursued by predators.

Coral Beauty aka **Dusky Angelfish**
Centropyge bispinosus (Pomacanthidae)
Angelfishes

Distribution: Indo-Pacific.

Habitat: Coral lagoons and seaward reef slopes at about 9 m.

Appearance: A dwarf angelfish that rarely exceeds 10 cm. Color variable, though most often light orange or purple with vertical bars on the sides of the body.

Diet: Mostly algae, but also some small invertebrates.

Reproduction and Development: Thought to be a protogynous hermaphrodite.

Remarks: A shy species found in lagoons and seaward reef slopes. Note the Steinhart's Coral Beauty is often found peering warily from behind coral protection.

The smallest of the marine angelfishes.

Flame Angelfish
Centropyge loricula (Pomacanthidae)
Angelfishes

Distribution: Tropical lagoons and reefs of the Indian and Pacific Ocean.

Habitat: Marine coral reefs; shy, stays near shelter; depth from 15–60 m.

Appearance: Typically bright orange-red color; black blotch near the head and 4–5 black bars across the body; flaring caudal fin about half the body height. Orange-red dorsal and anal fins tipped in alternating purple-blue and black bands. Males are brighter and larger than females. Max. length: 15 cm.

Diet: Algae and marine invertebrates on the reefs.

Reproduction/Development: Like angelfish in general, this species begins life undifferentiated sexually, matures to female, and may subsequently develop as a male with one or more females in a territorial harem. After a short mating ritual, both sexes rise in the water column to shed and fertilize gametes that develop within the plankton.

Mortality/Longevity: Preyed upon by many reef fishes.

Remarks: Members of the genus *Centropyge* are the dwarf or pygmy angelfishes.

Territorial males may determine dominance by grappling with interlocked jaws, a behavior humans sometimes mistake for a fishy kiss.

Lemonpeel Angelfish

Centropyge flavissima (Pomacanthidae) Angelfishes

Distribution: West-central Pacific.

Appearance: Yellow dwarf angelfish with blue eye ring, blue margin to opercular cover and to dorsal, anal, and caudal fins. Max. size: 14 cm.

Habitat: Coral reefs in shallow lagoons.

Diet: Algae and corals.

Reproduction and Development: As with other dwarf angels, they are sequential protogynous hermaphrodites. They start out sexually undifferentiated, develop into females, and with environmental influences, may develop into males. Males are typically larger.

Mortality/Longevity: Reported 11 years in captivity.

Remarks: *C. flavissima* is the model for the juvenile Lemonpeel Mimic Tang (*Acanthurus pyroferus)*. Mimicry is presumably an advantage as the adult angelfish has a sharp spine, while the young mimic has a small, still ineffective weapon.

Lamarck's Angelfish aka Blackstriped Angelfish

Genicanthus lamarck (Pomacanthidae) Angelfishes

Distribution: Indo-Pacific: ranging eastward to Vanuatu, from the Solomon Islands and New Hebrides north and westward to southern Japan, and southward to the Great Barrier Reef.

Habitat: A tropical reef dweller; at depths from 10–35 m.

Appearance: Sexually dimorphic; white or silver body with horizontal black stripes from eye to speckled lyre tails. Females have bolder stripes, one extending into the tail. Males have a yellow spot on the forehead, longer more pointed caudal fin and jet black pelvic fins; females' pelvic fins are white. Max. length: 25 cm.

Diet: Plankton.

Reproduction/Development: Males maintain harems, scatter pelagic eggs after mid-water mating rituals. The eggs and larvae drift, then settle onto the reef at the time of metamorphosis to the juvenile stage.

Remarks: They prefer the top to middle of their depth range unlike most other angelfishes.

Males and females are so distinct that sexes were once considered separate species. One of the few angelfish to display sexual dimorphism.

Their genus, *Genicanthus*, is distinctive among angelfish for their lyre tails, an adaptation to open water, fast swimming. They are also the only group of angelfish that feed on plankton.

Swallowtail Angelfish aka Blackspot Angelfish

Genicanthus melanospilos (Pomacanthidae) Angelfishes

Distribution: Western Pacific.

Habitat: Outer reef slopes rich in coral growth interspersed with sand, also in caves or along the bases of boulders, 20–45 m. Typically in male/female pairs or small groups of females with one male, 1–2 m above the bottom at the base of drop offs.

Appearance: To 18 cm. Sexes are dimorphic. Male: white with about 15 narrow, black bars, gold spots on tail and dorsal fins. Female: upper body and head yellow, lower body light

blue; no bars; two prominent black, forking stripes in caudal fin.

Diet: Primarily zooplankton, supplemented with benthic invertebrates and algae.

Reproduction and Development: Spawn at sunset. Mating activity is less if there are no currents to disperse the spawn.

Remarks: *Genicanthus* spp. are the only angelfishes in which the sexes are distinctly colored. Elongated tail that ends in two filaments bequeaths the swallowtail its name.

Queen Angelfish

Holacanthus ciliaris (Pomacanthidae)
Angelfishes

Distribution: Bermuda, Florida, Bahamas, Caribbean, Gulf of Mexico to Brazil.

Habitat: Offshore reefs, 2–70+ m. Travel solitarily or in pairs among sea fans, sea whips and corals.

Appearance: Deep-bodied and strongly compressed. Length to 45 cm, weight to 1.6 kg. Dorsal and anal fins trail. Adults have blue to greenish-blue ground color, yellow edges on scales. Tail and pectoral fins bordered in yellow. Dark blue lips.

Diet: Adults feed primarily on sponges; also algae, tunicates, hydroids and bryozoans. Juveniles glean ectoparasites from other fishes.

Reproduction and Development: Juveniles have vertical blue bands on an orange-red body. As the fish grows, the bars increase in number before gradually disappearing.

King Angelfish

Holacanthus passer (Pomacanthidae)
Angelfishes

Distribution: Tropical reefs of the eastern Pacific from the coast of Peru north to the Gulf of California and as far west as the Galapagos Islands.

Habitat: Commonly found around shallow rocky and coral reefs at depths of 3 to 27 m. Juveniles are generally found in shallower water

Appearance: Bodies of both males and females are a dark blue with a vertical band of white behind the pectoral fins, and yellow tails. The pelvic fins of the male are white while the females are yellow. Juveniles are primarily yellow with iridescent blue edged fins, blue stripes toward the posterior of the body with orange around the eyes. Rays of the dorsal and anal fins taper down and end in long filaments. Max size: 30–35 cm.

Like all angelfish, have a blunt snout and a large strong spike at the anterior most bone of the operculum.

Diet: Sponges, tunicates, sessile invertebrates, zooplankton and graze on benthic microalgae. Feed during the day, are lethargic at night.

Reproduction and Development: Form monogamous pairs. During the late summer spawning cycle the females become more territorial and the pair will mate daily. A pair can produce millions of fertilized eggs which will drift in the water column for about 20 hours at which time those that survive hatch as finless fry living off their yolk sac until it is completely absorbed. The fry then eat small zooplankton until their size requires larger prey. Some juveniles display cleaning behavior.

Conservation Status: One of the most abundant fish in the Sea of Cortez and not considered to be threatened.

Remarks: King Angelfish are popular aquarium fish but are difficult to keep.

Emperor Angelfish

Pomacanthus imperator (Pomacanthidae)
Angelfishes

Distribution: Indo-Pacific.

Habitat: Juveniles solitary under ledges and holes of outer lagoon patch reefs or semi-protected areas of exposed channels and outer reef flats. Subadults occupy reef front holes or surge channels. Adults occur near ledges and caves in regions of robust coral growth on clear lagoon, channel or seaward reefs 3–70 m. Adults typically in male/female pair or solitary.

Appearance: Length to 40 cm. Juvenile with concentric white circles, also distinguished by a white dorsal fin margin; adult pattern emerges at about 10 cm: vivid, alternating yellow and blue stripes and yellow tail; blue-edged eye mask, broad blue-edged black bar behind head.

Diet: Sponges and other encrusting organisms such as tunicates. Young and adults may clean much larger fishes such as sunfish.
Reproduction and Development: Haremic. Form pairs.

Mortality/Longevity: More than 5 years in captivity.

Remarks: When alarmed, can produce low-frequency drumlike noises that are loud enough to startle divers.

Frequently exported through the aquarium trade.

Bluegirdled Angelfish

Pomacanthus navarchus (Pomacanthidae)
Angelfishes

Distribution: Indo-Pacific from Indonesia to Papua New Guinea, up to the Philippines and south to the lower Great Barrier Reef, and parts of Micronesia.

Habitat: Coral abundant areas in clear lagoons, channels and sheltered outer reef slopes at depths of 3– 40 m.

Appearance: Adults are bright yellow on the sides and back and the dorsal and caudal fins. The head, ventral side, pectoral and pelvic fins are a bright blue with light blue spots. Narrow light blue bands run across the face and a broad dark blue band extends around the caudal peduncle. The fins are edged in light blue. Max length: 28 cm.

Diet: Sponges and tunicates.

Reproduction and Development: Generally solitary except when spawning, they form small groups with a dominant male and several females. The dominant female can change sex should the dominant male die.

Mortality/Longevity: Life span: c. 15 years.

Conservation Status: This species is a highly prized aquarium fish, but not listed as threatened or endangered.

Amazon Leaf Fish

Monocirrhus polyacanthus (Nandidae)
Leaffishes

Distribution: Amazon River basin of Peru, Brazil, Bolivia, Colombia, and Venezuela.

Habitat: Shallow, nearshore areas with dense vegetation and slow-moving or still water.

Appearance: Can change colors to blend more completely into its surroundings. Body shape, coloration and fin rays mimic leaf shape.

Diet: Carnivore, mainly feeding on other fish. Lie-in-wait predator, using camouflage to capture unsuspecting prey that ventures too close. Also can move toward prey using its transparent pectoral fins, making it almost impossible to see. Prey, some almost as large as the leaf fish itself, are sucked in as the large mouth opens.

Reproduction and Development: Males guard eggs, which are laid on leaves or other flat surfaces.

Redspotted Hawkfish

Amblycirrhitus pinos (Cirrhitidae)
Hawkfishes

Distribution: Western Atlantic.

Habitat: Moderately common in rocky areas and among rubble, often in crevices and shallow caves.

Appearance: Pale body bisected by broad brownish vertical bars with lighter, narrow stripes between. Head covered with bright red spots. Max. length: 9.5 cm.

Diet: Feeds primarily on small crustaceans, particularly copepods, shrimps and shrimp larvae, crabs and crab larvae as well as polychaetes. Like other members of its family, has short, conical teeth, effective in grasping small prey items.

Remarks: Like all hawkfishes, perches on rocks and corals waiting for food to come by, often hopping from spot to spot using its large pectoral fins as landing pads.

Falco's Hawkfish

Cirrhitichthys falco (Cirrhitidae)
Hawkfishes

Distribution: Western Pacific, from the Philippines to Japan, Samoa, the Barrier Reef, and New Caledonia; as far east as Hawaii and the Galapagos.

Habitat: Shallow coastal to outer reef flats and slopes at depths up to 45 meters. Typically rest at the bases of coral heads, perched high enough to see prey and predators.

Appearance: Whitish body with red spots that form diagonal bands. Two thin red lines extend downward from the eye. Yellow tufts of cirri are present near the tips of dorsal spines. The male is larger than the female. Max. length: 7 cm.

Diet: Shrimp, worms, and other small prey, located by excellent eyesight.

Reproduction and Development: Haremic, usually found with one male presiding over

a territory of 2–7 females. Hawkfish are protogynous hermaphrodites; if the male is killed or missing, a female will change to male and adopt his role. Male regularly visits females in his territory. If she is receptive to his courtship, which may last an entire day, they swim together, eventually upwards in an arc, releasing eggs and sperm simultaneously. Eggs and larvae remain in the plankton for about 3 weeks, a fairly long time and perhaps the reason for this species wide distribution.

Mortality/Longevity: Life span: up to 15 years

Longnose Hawkfish

Oxycirrhites typus (Cirrhitidae)
Hawkfishes

Distribution: Widely distributed throughout the Indo-Pacific and Red Sea, from South Africa to the Hawaiian Islands, north to southern Japan and south to New Caledonia. Also found in the eastern Pacific from the Gulf of California to northern Colombia and the Galapagos Islands.

Habitat: Non-migratory tropical marine fish, found at depths from 10–100 m. Inhabit the steep outer reef slopes that are exposed to strong currents. Hide in large gorgonians and corals.

Appearance: White body with red striping that runs both horizontally and vertically. Very long snout and a tuft of cirri, (small, thin appendages, often subdivided into branches) near the tip of each dorsal fin spine. Max. length: 13 cm.

Diet: Small crustaceans.

Reproduction and Development: Pelagic spawning has been observed from the field.

Remarks: Members of this family (Cirrhitidae) seem to be monogamous. However, in reality they probably practice facultative monogamy. In this mating system, males are limited in their ability to acquire and maintain females, and thus have only a single mate, but may acquire additional females if conditions for doing so are favorable.

Flame Hawkfish

Neocirrhites armatus (Cirrhitidae)
Hawkfishes

Distribution: Tropical Pacific Ocean, from southern Japan to the Great Barrier Reef, and through Micronesia.

Habitat: Inhabits surge swept reef fronts and underwater terraces to a depth of 11 m. Hides in the branches of live corals.

Appearance: Flame red body with a black field under the dorsal fin and a dark ring around their eye. Mature adults have higher, more rounded body than young individuals. Max. length: 9 cm.

Diet: Carnivorous, feeds mostly on small crustaceans and other invertebrates.

Reproduction and Development: Protogynous hermaphrodite. One of the females will become a male if dominant male dies or leaves the group. Oviparous; pelagic spawners. Haremic; male stakes out a territory where he lives with 2–7 females.

SUBORDER LABROIDEI

Midas Cichlid

Amphilophus citrinellus (Cichlidae)
Cichlids

Distribution: Central America: Atlantic slope of Nicaragua and Costa Rica. Also established in Florida.

Habitat: Max. length: 30 cm.

Appearance: Though coloration is variable, the species is typically grey to olive brown with some that are bright orange to orange-red as adults. Mature males are larger, and sport longer fins and a distinct hump on the head, especially pronounced during breeding season.

Diet: Small animals and plants that encrust hard substrates, as well as snails, small fishes, insect larvae and other bottom-dwelling invertebrates.

Reproduction and Development: Typically spawn on the ceiling of caves or deposit eggs on other hard surfaces. Both parents aggressively guard eggs and fry. Active fry feed on mucus secretions produced by the skin of the parents.

Mortality/Longevity: Life span: 15+ years.

Remarks: This species is closely related to *Amphilophus laibatus*, which can hybridize with *A. citrinellus*.

Red Devil Cichlid

Amphilophus labiatus (Cichlidae)
Cichlids

Distribution: Atlantic slope of Mexico and Ni-

caragua; in Lakes Nicaragua and Managua.

Habitat: Lakes; rarely enters streams or rivers.

Appearance: Body pinkish-red. Very long, reddish pectoral fin. Length to 24 cm.

Diet: Small fishes, snails, insect larvae, worms and other bottom-dwelling organisms.

Reproduction and Development: Fertilization is external. Female lays 600–700 eggs and guards the clutch.

Convict Cichlid

Archocentrus nigrofasciatus (Cichlidae)
Cichlids

Distribution: El Salvador to Guatemala.

Habitat: Adults inhabit flowing water from small creeks and streams to the shallows of large and fast flowing rivers; prefer rocky habitats and in the various cracks and crevices or among roots and debris in warm pools of springs.

Appearance: Length to 10 cm. Laterally compressed silvery body with eight black bands. Dorsal midsection of body burnt orange.

Diet: Worms, crustaceans, insects, fish and plant material.

Reproduction and Development: 100–150 eggs deposited and vigorously guarded and cared for by both male and female.

Macmaster's Dwarf Cichlid

Apistogramma macmasteri (Cichlidae)
Cichlids

Distribution: Colombia's Meta and Orinoco rivers.

Habitat: Slow-moving or still water, usually with vegetation and caves, rocks, and/or trees for hiding places.

Appearance: Deep bodied and laterally compressed. Males are strikingly colored and ornamented, with long filaments on their dorsal and anal fins. Males are 2–3 times as long as the females and up to 10 times as heavy. Length: 2.5 cm to 11 cm.

Diet: Carnivorous.

Reproduction and Development: Usually haremic, the male visits females in turn, since each female is out of phase with the others. Females set up individual cavities where they deposit their eggs. Each changes her color to bright canary yellow with black markings when breeding. Both males and females are very aggressive toward others of their gender during the breeding season. Female normally guards the fry; male defends a wider territory.

Mortality/Longevity: Life span: 3–5 years.

Remarks: At the larval stage, the higher the water temperature, the higher the proportion of males develop in the group.

A shy, cautious fish. Often difficult to find in the Piranha tank as it frequently hides within the rockwork along the tank's edges.

Red Oscar

Astronotus ocellatus (Cichlidae)
Cichlids

Distribution: Amazon basin; introduced to Florida.

Habitat: Shallow, slow-moving water with mud or sandy bottom; seeks cover in grasses, sunken branches or logs.

Appearance: Length 33–40 cm. Olive green to gray or brown mottled body overlaid with random sized and shaped red blotches; dark eyespot on peduncle ringed in orange. Males slightly larger and brighter in coloration than females; juveniles marked distinctively with white or orange bars on body and randomly placed white spots on head.

Diet: Smaller fishes, crustaceans, gastropods, aquatic insects and their larvae.

Reproduction and Development: Breeding pair will clear spawning site before eggs are laid and defend nest as eggs mature; hatching (typically three to four days after eggs are deposited) depends on temperature. Young guarded by adult pair as long as possible.

Remarks: May have 2000 eggs in a clutch. Oscars generally sluggish by temperament, but may have short bursts of great speed. A popular food fish in South America.

Peacock Bass

Cichla ocellaris (Cichlidae)
Cichlids

Distribution: Amazon, Orinoco, and La Plata basins in South America. Currently established in southern Florida.

Habitat: Warm freshwater.

Appearance: Elongate body with deeply notched dorsal fin, large mouth with projecting lower jaw. Color: olive-green fading ventrally to yellow-white, with three dark vertical bars

on sides and series of dark spots in between. A large black spot encircled by silver adorns the caudal fin. Max. length: 60 cm.

Diet: Diurnal feeders on other fishes. High-speed pursuit predators.

Reproduction and Development: Substrate spawner. Both parents guard their clutch for about 9 weeks. Like most cichlids, breeding pairs are highly territorial and aggressive.

Remarks: Legally introduced to Florida. Are considered a prized sport and food fish.

Speckled Pavon

Cichla temensis (Cichlidae)
Cichlids

Distribution: South America: Amazon and Orinoco basins. Introduced to Florida and Texas.

Habitat: Occupies deeper littoral areas in lagoons and sandy and rocky banks of the main river channel.

Appearance: Length to 99 cm. Weight to 12.2 kg. Ventral surface usually white. Three, wide, dark horizontal bars on body. Body typically covered with a series of white longitudinal dots. Dark false eyespot on emarginated caudal fin.

Diet: Adults feed mainly on small fish (especially characids less than 10 cm).

Reproduction and Development: External fertilization. Build and guard nests. Very high reproductive rate; females produce 9000–15,000 eggs per kg and spawn every other month.

Remarks: Commercial gamefish, also collected for the aquarium trade.

Pike Cichlid

Crenicichla lepidota (Cichlidae)
Cichlids

Distribution: South America: extreme southern Amazonia in Brazil, Paraguay, Uruguay and northern Argentina

Habitat: Riverine.

Appearance: Dorsal surface dark, ventral surface whitish, prominent horizontal blackish stripe from head to tail. Length to 18 cm.

Diet: Insects, worms, and other fishes. Ambush predators.

Reproduction and Development: Females reach sexual maturity at 14 cm, males at 18 cm. Fertilization is external. Nests are guarded.

Ringtail Pike Cichlid

Crenicichla saxatilis (Cichlidae)
Cichlids

Distribution: South America: coastal drainage of Suriname, French Guiana, Guyana, Venezuela, and Trinidad.

Habitat: Freshwater streams; sometimes captured in rivers during the dry season.

Appearance: Max. length: 25 cm. Sometimes referred to as "spangled pikes" due to the sparkling white specks that decorate their bodies.

Diet: Aquatic insects, fish, and plant material.

Reproduction: 300-400 eggs are laid and fertilized, often in a large cave. After 4–6 days the eggs hatch; another 5 days later the young fish are swimming free.

Mortality/Longevity: Life span: 5–6 years.

Remarks: A formidable predator, this species is kept only with larger fish for obvious reasons.

Earth-eater Cichlid

Geophagus altifrons (Cichlidae)
Cichlids

Distribution: South America: Amazon basin.

Habitat: Freshwater.

Appearance: Length to 22 cm. Protruding mouth. Head has red weblike markings. Spiky fins.

Diet: Common name derived from this fish's almost constant digging in the sand for prey.

Reproduction and Development: Fish in this genus are mouth brooders. The parents take turns brooding and spit the fry into the partner's mouth when their shift is over.

Remarks: Genus name translates as "earth-eater." This common name applies to many species.

A small, but popular food fish.

Texas Cichlid

Herichthys cyanoguttatus (Cichlidae)
Cichlids

Distribution: Originally restricted to the lower Rio Grande drainage in Texas and south to northeastern Mexico. Introduced to central Texas and central Florida.

Habitat: Pools and open runs of rivers; prefers warm water and areas with vegetation.

Appearance: Light grey with many small

turquoise to white dots over the body. A single black spot on central side and second spot on the caudal peduncle; three black bars behind central spot. Max. length: 30 cm.

Diet: Worms, crustaceans, insects, and plant matter. Sorts through mouthfuls of gravel, eats the small animals, and spits out the rest.

Reproduction and Development: Form pairs. Female cleans off space, often on a flat rock, to lay eggs which male then fertilizes. Both parents protect eggs and fry. Female assists hatching by helping young out of egg sacs.

Cichlids in the gar tank often reproduce and pairs can be seen aggressively guarding their young.

Mortality/Longevity: Life span: up to 15 years.

Remarks: Considered a game fish in Texas and Mexico.

This species is the only cichlid native to the U.S.

Turquoise Severum

Heros severus (Cichlidae)

Cichlids

Distribution: Amazon River basin to Upper Orinoco River drainage in Colombia and Venezuela.

Habitat: Lakes, standing water, or slow moving water with copious vegetation.

Appearance: Compressed body is silvery; five black vertical bars punctuate the lower half of its flanks, a sixth extends to its dorsal fin. Length to 20 cm.

Diet: Fruits, seeds, green algae and detritus.

Reproduction and Development: Fertilization is external. Female deposits up to 200 eggs on stones or roots. Both parents guard the eggs. Larvae are taken into the mouth for safekeeping. Paternal care can last up to six weeks.

Chocolate Cichlid

Hypselecara temporalis (Cichlidae)

Cichlids

Distribution: South America: Amazon River basin.

Habitat: Slow-flowing, freshwater.

Appearance: Length to 30 cm. Pinkish body.

Diet: Algae, supplemented with planktonic and terrestrial invertebrates.

Reproduction and Development: Sexes separate. Fertilization external. Eggs are deposited upon vertical substrates and guarded by both parents.

Remarks: Minor commercial fishery.

Katria

Katria katria (Cichlidae)

Cichlids

Distribution: One of 17 cichlid species indigenous to Madagascar.

Habitat: Freshwater pools, slow flowing runs and rapids with predominantly sand and gravel substrate, with a few very large rocks.

Appearance: Unique pigmentation and coloration pattern consisting of two prominent black vertical bars on an iridescent golden background. Max length: 5.5 cm.

Diet: Invertebrates, plants.

Reproduction and Development: Substrate spawner. Pairs of *Katria* have been observed guarding either eggs or small juveniles close to the top of the rocks in the Nosivolo River in November, 2005.

Conservation Status: IUCN Listed: Vulnerable. This species has a restricted distribution within the Nosivolo and Mangoro rivers, but its habitat is in very good condition and it does not have to deal with either exotic predators or competitors. Given the lack of evidence for decline in quality of habitat or population size (it is a very common species within its range), this species is assessed as *vulnerable* on account of its restriction to a single location.

Marakely

Paratilapia polleni (Cichlidae)

Cichlids

Distribution: Endemic to Madagascar.

Habitat: Freshwater; occurs on both slopes of Madagascar at altitudes up to 1500 m and exhibits tolerance for a broad temperature range (15–40° C).

Appearance: Mid-sized cichlid, growing to 30 cm in length; males grow up to a third again as large as females; black velvet basic coloration with pattern of blue and gold spangling. Distinct spot present in dorsal fin of juveniles and sexually quiescent adults.

Diet: Carnivorous; juveniles feed chiefly on planktonic crustaceans and insect larvae; larger fish are crepuscular predators with a preference

for small fish but also take invertebrates as opportunity presents.

Reproduction and Development: (The following extended narrative is intended as a sampling of the complex reproductive behavior of cichlids, a distinctive feature of the family that has promoted their evolutionary success.)

Marakely are monogamous, biparentally custodial substratum spawners. Pairs defend a territory and overt courtship begins a few days before spawning. Both sexes assume velvety black base coloration as spawning approaches; both also excavate gravel pit and increasingly exclude other fish from area. Pair spawns on bottom of excavated pit, placing eggs directly upon the gravel; each ovoid egg has a long adhesive fiber that adheres to other egg fibers, forming a rope of eggs (up to a thousand) rolled into an egg mass. Male patrols perimeter of territory. Fry become fully mobile four days post-hatching. Both parents are actively involved in their defense, following the school of fry, retrieving stragglers by mouth and spitting them back into the school. Parental care continues for about three weeks.

Remarks: A Marakeley captive breeding program is supported by many aquariums and zoos.

Mtoto Zebra

Lamprologus brevis zebra (Cichlidae)
Cichlids

Distribution: Africa: endemic to Lake Tanganyika.

Habitat: Sandy bottom areas with shells.

Appearance: Golden tan with darker verticalstripes on the sides, yellow and white accents on fins, and pale yellow markings on the face. Males longer than females and somewhat more robust. Max. length: c. 6 cm.

Diet: Tiny brine shrimp, other zooplankton and organic bits.

Reproduction and Development: Bonded male and female spawn and protect eggs and fry in a carefully chosen and stoutly defended shell. Fry stay close to the shell for the first 3 weeks. Breed readily in captivity.

Remarks: See Black Calvus for more information on Lake Tanganyika.

Jaguar Cichlid

Parachromis (Nandopsis) managuensis
(Cichlidae)
Cichlids

Distribution: Central America: Honduras to Costa Rica.

Habitat: Lakes, with preference for turbid water and mud bottoms; also found in springs and ponds over detritus and sand bottoms.

Appearance: Body has a light background with black markings all over; series of large black spots on along the sides. Males tend to be larger and have pointed anal and dorsal fins. Length: males to 40 cm; females to 30 cm.

Diet: Small fishes and invertebrates; a voracious predator that makes a meal of any fish small enough to fit into its unusually large mouth!

Reproduction and Development: Oviparous, spawns in batches. Female lays eggs on an open, flat surface such as slate. After fertilization, the female fans the eggs and the male guards the site. Both are aggressive defenders of young.

Mortality/Longevity: Life span: 15+ years.

Remarks: Highly regarded as a food fish.

Like all cichlids, have well-developed pharyngeal teeth.

Popular in the aquarium market, probably their route to Florida introduction through pet release.

Common Kribensis

Pelvicachromis pulcher (Cichlidae)
Cichlids

Distribution: Africa: Endemic to southeastern Nigeria and the coastal zone of southern Cameroon.

Habitat: Warm brackish or freshwater, both slow and fast moving. Prefers areas with gravel or sandy substrate and dense vegetation.

Appearance: A small (dwarf) cichlid with several color morphs such as yellow, red, green, blue and even an albino variety. Both sexes have dark longitudinal stripe running from the mouth to the caudal fin and pink to red abdomens. Gold-rimmed eyespots are common on dorsal and caudal fins. Male is larger, with more elongate and pointed pelvic, anal and caudal fins. Max. size: males, 11 cm; females, 7 cm.

Diet: Diatoms, green algae and other plants; also small worms, crustaceans and insects.

Reproduction and Development: In the

wild, breeds in holes excavated under aquatic vegetation. Female protects eggs, male defends territory. During the spawning season the female sports a brilliant red belly. The species breeds readily in aquaria; today virtually all Kribensis available in the pet trade are captive bred.

Mortality/Longevity: Preyed upon by larger fishes. Life span: c. 5 years.

Remarks: This shy fish digs and hides in burrows or shelters in vegetation.

Orinoco Angelfish aka Altum Angelfish

Pterophyllum altum (Cichlidae)
Cichlids

Distribution: South America: Amazon basin, in the upper Rio Negro drainage; Orinoco River basin.

Habitat: Rivers.

Appearance: Extremely compressed silvery body with two broad dark vertical bands. Remarkably long trailing pelvic fins. *Altum* refers to the dramatic height of their dorsal and anal fins. Length to 18 cm.

Reproduction and Development: External fertilization. Monogamous; pairs persist until partner dies or is separated. Clutch-tending guarders.

Mortality/Longevity: Preyed upon by other fishes. Subject to bacterial diseases and protozoan, fungal and worm infestations.

Remarks: Popular in the pet aquarium trade due to its unique appearance.

Rarely spawn in captivity.

Their narrow profile allows altums to hide between tree roots in water along riverbanks.

Freshwater Angelfish

Pterophyllum scalare (Cichlidae)
Cichlids

Distribution: South America: Amazon and River basin.

Habitat: Swamps and flooded forests in dense riverine vegetation.

Appearance: Disc-shaped, laterally compressed body with vertical dark stripes. Long training pelvic fins, and elongate dorsal and anal fins. Max. length: 18 cm.

Diet: Benthic crustaceans and small fish.

Remarks: Same as Altum Angelfish above.

East Coast Saroy

Ptychochromis grandidieri (Cichlidae)
Cichlids

Distribution: Eastern drainages of Madagascar.

Habitat: Fresh water in areas of high forest as well as brackish water.

Appearance: Up to 21 cm long. Golden-yellowish or greenish.

Reproduction & Development: Egg layers; both male and female care for fry. Rate of breeding would allow population to double in less than 15 months.

Conservation Status: Not endangered. However, environmental degradation is widespread throughout their range, and in some localities numbers are greatly reduced.

Lionhead Cichlid

Steatocranus casuarius (Cichlidae)
Cichlids

Distribution: Africa: Malebo Pool (Stanley Pool) and the Lower Congo River basin.

Habitat: Freshwater, in still water zones of fast flowing streams; demersal.

Appearance: Length to 10 cm. Males have a bump on head. Blotchy coloration.

Diet: Small invertebrates and minimal amount of algae.

Reproduction and Development: Pairs bond for life. Fertilization is external. The female produces 20–150 eggs, which are typically laid in caves; eggs and young are guarded by both parents.

Remarks: An under-developed swim bladder and its habit of swimming with a sudden, jerky movement adapt this species to live in fast current. The lionhead cichlids, now found in the large Cafe tank, typically hide out under the wood and vegetation in the center of the tank.

Golden Tilapia

Tilapia brevimanus (Cichlidae)
Cichlids

Distribution: Native to western Africa. Aquacultured in southeastern U.S.

Habitat: Fresh to brackish water.

Appearance: Yellowish-grey, with 8–9 dark bars on back and sides. Upper side of head dark brown; dark band running from eye to corner of mouth. Pectoral fins transparent;

dorsal and caudal marked with light spots. Max. size: 25 cm.

Diet: Mostly vegetation, also detritus, insects and insect larvae. Fry feed on zooplankton.

Reproduction and Development: Substrate spawner. Eggs laid and hatched in a nest dug by the male and female. Parents guard the eggs and fry.

Remarks: Tilapia species have been introduced around the world as important food fishes for humans. They are disease-resistant, reproduce easily, eat a wide variety of foods and tolerate poor water quality with low dissolved oxygen levels. In some cases, they have become problematic invasive species that have wiped out whole populations of other species by outcompeting them for food or feeding on fish larvae.

Hornet Tilapia

Tilapia buttikoferi (Cichlidae)
Cichlids

Distribution: Native from Guinea-Bissau to West Liberia in Africa. Introduced widely throughout the world, primarily as a food fish.

Habitat: Tropical rivers and streams.

Appearance: A robust fish with deep, oval body of yellowish-grey color, with brownish-black bars. The head is yellow and the throat black. It has transparent pectoral fins and black pelvic fins. Color may change with mood. Males are larger than females. Max length: c. 40 cm.

Diet: A voracious, aggressive predator on other fishes, even larger individuals, (perhaps the reason only a single Hornet Tilapia resides in the Swamp tank). Also eats plant matter. An omnivorous and voracious eater; feeds on fish and crustaceans and vegetable matter.

Reproduction and Development: Mouth brooders. Female carries the eggs in her mouth for several weeks before releasing and continuing to guard fry.

Remarks: A territorial, belligerent, hardy, pugnacious and fierce fighter, it takes on all competitors for food.

After salmonids and carps, tilapia and their close relatives—all fast growing, easily bred, and mostly herbivorous species—are the most important fishes in a aquaculture by the gross weight of production.

Black Belt Cichlid

Vieja maculicauda (Cichlidae)
Cichlids

Distribution: Atlantic slope of Central America, Guatemala to Panama.

Habitat: Inhabits stagnant water of rivers, lakes, or slow-flowing streams with roots and branches that provide shelter. Tolerates brackish water at the mouth of rivers, a characteristic that may account for the wide dispersal of the species.

Appearance: Up to 30 cm in length. Oval and laterally compressed, the male is white with a black band around the pectoral area (thus the common name) and red caudal fins with blotches of red from the head to the pelvic fin. In contrast, the female is grey with a red tail. Fins have spiny rays that serve to discourage predators.

Diet: Vegetarian: benthic detritus, aquatic and terrestrial vegetable matter.

Reproduction and Development: After the couple performs some ritualistic circling, the female, who has turned a dark color, will lay up to 1,000 eggs in a cavity she has prepared. The eggs are often attached in the tiny hair roots of trees along the shore. The fry, guarded by both parents, are free-swimming after a week.

Mortality/Longevity: Life span: 7-8 years.

Barred Surfperch

Amphistichus argenteus (Embiotocidae)
Surfperches

Distribution: Bodega Bay, California to northern central Baja California.

Habitat: Sandy beaches in surf; found in trawl catches up to 73 m.

Appearance: Length to 43 cm. Travels in small groups. Silvery or white; 8–10 rust-colored vertical bars on side with spots in between.

Diet: Crabs; clams, and other invertebrates.

Reproduction and Development: Live bearer. Males make "figure-eights" around females before mating. Five-month gestation period; females can produce 4–110 young. Juveniles are born in spring and summer and are about 4.5 cm at birth.

Mortality/Longevity: Life span: to 9 years.

Redtail Surfperch
Amphistichus rhodoterus (Embiotocidae)
Surfperches

Distribution: Vancouver Island to Monterey Bay.

Habitat: Sand beaches and rocky shores in surf.

Appearance: All fins reddish. Faded brown bars on the side. Silvery overall with pale olive shading above. Caudal fin broadly forked; dorsal fin distinctive for the long dorsal spines that contrast with shorter soft rays. Max. size: 41 cm.

Diet: Worms, crabs, other small crustaceans, and fishes.

Reproduction and Development: Females viviparous and reproductively mature at 3–4 years; males mature at 2 years. Females enter bays and estuaries to spawn.

Mortality/Longevity: Life span: up to 9 years.

Remarks: This shallow water schooling fish is an important sport fish, the surfperch most often caught from central California northward. Comprises 10–30% of the total recreational catch in this area.

Redtails also support a sizable commercial fishery, and comprise almost 75% of the commercial surfperch catch.

Shiner Surfperch
Cymatogaster aggregata (Embiotocidae)
Surfperches

Distribution: Wrangell, Alaska to Baja California.

Habitat: Usually in shallow water around eelgrass beds, piers, pilings and oil platforms. Also in calm waters along exposed coast. Enters brackish and fresh waters. Lives in loose schools to depths of 146 m.

Appearance: Length to 18 cm. Thin-bodied. Colored silvery, with rows of dark spots on scales forming vague black stripes on sides, crossed by 3 vertical yellow bars.

Diet: Small crustaceans, crab larvae, polychaete worms, as well as planktonic copepods, amphipods, fish eggs, algae and diatoms.

Reproduction and Development: Usually mate during the summer; young born the following spring or summer. Internal fertilization. Viviparous; young embryos are nourished internally and are quite large as newborns. Litter size varies from 4–25. Some males are sexually active immediately after their birth. Females grow faster than males.

Mortality/Longevity: Preyed upon by kelp bass, sand bass, halibut, harbor seals and humans. Live to at least 6 years.

Remarks: Little commercial value, but often used as baitfish.

Kelp Surfperch
Brachyistius frenatus (Embiotocidae)
Surfperches

Distribution: Northern British Columbia to central Baja California.

Habitat: Among giant kelp, usually in kelp canopy to 30 m.

Appearance: Upturned snout, oblique mouth, and head profile concave at the eye. Brassy or golden brown, nearly matching the color of kelp. Darker above, often with blue spots or streaks. Among the smaller surfperches; max. length: 22 cm.

Diet: Juveniles and small individuals: zooplankton. Larger adults: small crustaceans, usually those that live on kelp as well as parasites from other fishes, particularly blacksmith.

Reproduction and Development: Livebearer. Breed in fall and early winter, spawn in spring.

Black Surfperch
Embiotoca jacksoni (Embiotocidae)
Surfperches

Distribution: Fort Bragg, California to Punta Abreojos, Baja California.

Habitat: Nearshore reefs and kelp forests. Also over sand, and in estuaries near algae. Usually within 1 m of the substrate.

Appearance: Almost never black. Length to 39 cm. Deep, very compressed body. Colored various shades of brown, red, green above, yellowish below, darker bars on sides, blue bar on base of anal fin. Often sports a mustache-like black bar on upper lip.

Diet: Worms, crustaceans and mollusks. Also are cleaner fish of conspecifics as well as other species.

Reproduction and Development: Summer is the peak breeding season. Fertilization is internal. Viviparous; young embryos are nourished internally and are quite large as newborns.

Mortality/Longevity: Prey of leopard sharks.

Remarks: Species name *jacksoni*, is after A.C. Jackson, who, in the 19th century, first noted

that surfperches gave birth to live young.

Striped Surfperch
Embiotoca lateralis (Embiotocidae)
Surfperches

Distribution: Wrangell, Alaska to northern Baja California.

Habitat: Rocky coasts and kelp forests, estuarine eelgrass beds, occasionally in sandy surf near rocks. Depth to 21 m.

Appearance: Length to 38 cm. Reddish orange with brilliant neon blue stripes. Iridescent blue streaks and spots on head and gill cover.

Diet: Amphipods, shrimps, crabs, worms, other small benthic invertebrates, fish eggs and larvae.

Reproduction and Development: Fertilization internal. Viviparous. Mature at 2–3 years (~25 cm). Females produce 11–92 young per litter.

Mortality/Longevity: Preyed upon by rockfish.

Remarks: Fished commercially, also by sportfishers and speared by divers.

Walleye Surfperch
Hyperprosopon argenteum (Embiotocidae)
Surfperches

Distribution: Vancouver Island, British Columbia, Canada to central Baja California.

Habitat: In surf on sand beaches and over sand near rocks, to 18 m. Often in dense rapidly swimming schools.

Appearance: Length to 30 cm. Thin-bodied, football-shaped profile. Silver, often with bluish or greenish tints; may display dusky bars and black edges on caudal and anal fins.

Diet: Small crustaceans.

Reproduction and Development: Fertilization internal. Viviparous; bear 5–12 young; newborns about 3.8 cm long.

Remarks: Taken commercially and as a sport fish.

Rainbow Surfperch
Hypsurus caryi (Embiotocidae)
Surfperches

Distribution: Cape Mendocino to northern Baja California.

Habitat: Rocky shores, often at the edges of kelp beds; occasionally over sand but not found in the surf zone.

Appearance: Orange and blue horizontal stripes on body; larger orangish bars on back. Fins tinged with orange with black blotch on soft dorsal and anal fins. Belly flat and long. Max. size: 30 cm.

Diet: Isopods, amphipods and other crustaceans; also snails and brittle stars.

Reproduction and Development: Females viviparous and give birth to as many as 22 young, each about 5 cm at birth.

Conservation Status: Not particularly abundant, but not protected.

Remarks: Divers in Monterey Bay report rainbow surfperch cleaning ocean sunfish (*Mola mola*).

Dwarf Surfperch
Micrometrus minimus (Embiotocidae)
Surfperches

Distribution: Bodega Bay, California to Central Baja California.

Habitat: Rocky tide pools to 9 m, often among seaweeds.

Appearance: Length to 16 cm, typically much smaller (thus the common name). Silvery blue or greenish on back, greenish to silver shading below. Black triangle at base of pectoral fin. Irregular dark stripe along side, crossed by bar-like dark blotches.

Diet: Algae and small crustaceans.

Reproduction and Development: Like all surfperches, fertilization is internal, aided by the thickened front part of the male's anal fin. Embryos are nourished by the mother prior to delivery. Litters are very small in number. Like all surfperches, offspring are born as juveniles, not larvae.

Mortality/Longevity: Occasionally taken by fishers using baited hooks.

Rubberlip Surfperch
Rhacochilus toxotes (Embiotocidae)
Surfperches

Distribution: Eastern North Pacific: Cape Mendocino, California to Central Baja California.

Habitat: Generally favor inshore waters with rocky shelves and extensive kelp beds.

Appearance: Silvery blue to purplish on dorsal surface; pectoral fins yellowish; pelvic fins black or dusky fringed with black; prominent lips thick, pink or white. The largest of the surfperches, up to 47 cm long.

Diet: Oral "winnowers" sifting out thin-shelled invertebrates from the substrate; occasionally eat mollusks and algae.

Reproduction and Development: Like all surfperches, are viviparous with young highly developed and free-swimming at birth.

Remarks: Overall population decline. Small commercial fishery in Southern California; most caught by sport fishermen who seek out the larger, mature females.

Pile Surfperch
Rhacochilus vacca (Embiotocidae)
Surfperches

Distribution: Southeastern Alaska to north central Baja California.

Habitat: Rocky shores, pilings, kelp beds, underwater structures to 46 m.

Appearance: Length 25–30 cm; maximum 42 cm. Silvery sides; deeply forked caudal fin.

Diet: Hard-shelled mollusks, crabs and barnacles.

Reproduction and Development: Live bearer. Fecundity increases with age, averaging from 11–60 young.

Mortality/Longevity: 7–10 years.

Remarks: Specialized pharyngeal dentition that enable pile perch to crush hard shells persuades some ichthyologists to place the species in its own genus (Damalichthys).

Clark's Anemonefish
Amphiprion clarkii (Pomacentridae)
Damselfishes

Distribution: Indo-Pacific: Persian Gulf to Micronesia, New Caledonia and Fiji. Also Southwest Japan to northern Australia.

Habitat: Depth 1–55 meters in outer reef slopes, less typically inhabit lagoons. Symbiotic with 10 species of sea anemones. Non-migratory.

Appearance: To 12 cm. Black to entirely orange with pair of white or pale blue bars. Second bar wide; tail white or yellowish; other fins variably black to yellow-orange. There is also an orange variation: some are entirely pale orange, other than the two white bands; others have a dark patch on rear body. (See remarks)

Diet: Primarily planktonic copepods and benthic algae.

Reproduction and Development: Members of the genus are monogamous; oviparous, benthic spawners. Parents create a nest and male guards eggs. All are protandrous hermaphrodites with one sexually active pair dominant over a group of juveniles. If the female dies, her male partner develops into a female to take her place, and the largest juvenile grows rapidly and sexually matures into the breeding male. The maturation of the smaller juveniles is stunted by the adult pair's presence.

Remarks: Coloration is apparently influenced by the host sea anemone species.

Symbiotic with several anemones found in the Steinhart including *Entacmaea quadricolor*, *Heteractis crispa, H. magnifica.*

False Clownfish aka Nemo
Amphiprion ocellaris (Pomacentridae)
Damselfishes

Distribution: Tropical Pacific Ocean.

Habitat: Coral reefs. Sleep and feed among the tentacles of their host anemone.

Appearance: Length to 9 cm. Adults are orange with three broad vertical white bands, thin black margins on fins. Female larger than male.

Diet: Primarily zooplankton, especially copepods, also filamentous algae.

Reproduction and development: Breeds continuously at the Steinhart. Adhesive eggs are laid on a patch of cleared rock near the host anemone's base and guarded by the male. Eggs hatch after 10 days. The tiny transparent planktonic larvae swim away from the anemone. Two weeks later the larvae metamorphose into small fish. Protandrous hermaphrodites; some individuals mature as males, and all females are sex-reversed males. In the absence of a female the breeding male will turn into a female.

.**Remarks:** Often confused with *Amphiprion percula*, *A, ocellaris* is the true Nemo of *Finding Nemo* fame.

That said, Marlin, Nemo's father, under natural conditions, would have changed into a female following the death of Nemo's mother and remained near his host anemone, rather than swimming to Sydney. But then the film makers wouldn't have had a heart-rending narrative for the film.

The name "Nemo" has found its way into FishBase (www.fishbase.org) as a common name for this species in the USA!

Common Clownfish

Amphiprion percula (Pomacentridae)
Damselfishes

Distribution: Solomon Islands, Vanuatu, New Guinea and Great Barrier Reef, Australia.

Habitat: Lagoon and seaward reefs, including turbid coastal locations at depths 1–15 m. Symbiotic groups of this clown occur with three anemone species (*Heteractis magnifica*, *H. crispa* and *Stichodactyla gigantea*). Each group of orange clownfish consists of a breeding pair and up to 4 non-breeders.

Appearance: Orange with three horizontal white bars, middle bar sideways T-shaped, variable amount of black edging on bars and fins. Length to 11 cm.

Diet: Primarily zooplankton.

Reproduction and Development: Each group of clown anemonefish consists of a breeding pair and 0 –4 non-breeders. Within each group there is a size-based hierarchy: the female is largest, the male is second largest, and the non-breeders get progressively smaller as the hierarchy descends. If the female dies, the male changes sex and becomes the breeding female, while the largest non-breeder becomes the breeding male. The maintenance of size differences may avoid conflicts, because subordinates do not become a threat to the dominant breeders.

Remarks: Clownfishes and anemones display a classic case of mutualism. Clownfish gradually (matter of minutes to days) acquires a covering of mucus by brushing against the tentacles of its host. The mucus provides a blanket of chemosensory camouflage that prevents firing of the host anemone's nematocysts.

The symbiotic trade off: The clownfish actively discourages other anemone-nibbling fishes from approaching and also provides the anemone with bits of food from its sloppy eating habits. The clownfish gains protection among the anemone's nematocysts.

Pink Anemonefish

Amphiprion perideraion (Pomacentridae)
Damselfishes

Distribution: Eastern Indian Ocean to western Pacific Ocean; Indonesia to Marshall Is. In eastern Micronesia. Southwest Japan to northwest Australia, New Caledonia.

Habitat: Reefs from 3–30 m. Pursue a symbiotic life with at least 4 anemone species, but most commonly with the typically large (to 1 m diameter) mature magnificent sea anemone, *Heteractis magnifica.* Also associates with *Heteractis crispa*, *Macrodactyla doreensis* and *Stichodactyla gigantea.*

Appearance: Pinkish-orange coloration varies in saturation of color by individual. Distinctive narrow white head bar, narrow white dorsal stripe from eyes to tail. To 10 cm length.

Diet: Zooplankton, primarily copepods, as well as filamentous algae.

Reproduction and Development: Protandrous hermaphrodites. Like all anemonefishes, sex and growth are controlled by the dominant female. Elliptical eggs are laid on rocks close under the host anemone's mantle. The male fish guards the eggs. Upon hatching the larvae drift in the plankton.

Blue Chromis

Chromis cyanea (Pomacentridae)
Damselfishes

Distribution: Florida, Bahamas, Bermuda, Caribbean, Gulf of Mexico.

Habitat: Outer reef slopes and exposed patch reefs from 3–60 m.

Appearance: Length to 15 cm. Body is brilliant blue, nape and back often dark. Slender tail is deeply forked and has dark borders.

Diet: Zooplankton, primarily copepods.

Reproduction and Development: Female lays demersal eggs, which are guarded by the male.

Mortality/Longevity: Preyed upon by other fishes such as groupers and trumpetfishes.

Remarks: Often found in large aggregations.

Bicolor Chromis

Chromis dimidiata (Pomacentridae)
Damselfishes

Distribution: Indian Ocean: Red Sea, Kenya, Tanzania, South Africa, Mauritius, Réunion, Sri Lanka, Thailand, and Christmas Island.

Habitat: Lagoon and seaward reefs, 1–36 m depth. Occur in large aggregations near shore, over reef tops and upper edges of slopes.

Appearance: Length to 9 cm. Brown or black head and forebody; white rear body and tail.

Diet: Zooplankton, plants.

Mortality/Longevity: Eaten by bigger fish.

Bicolor Chromis
Chromis margaritifer (Pomacentridae)
Damselfishes and Anemonefishes

Distribution: Indian and Pacific oceans: Christmas Island and northwestern Australia in the eastern Indian Ocean to the Line and Tuamoto Islands.

Habitat: Coastal reefs, among mixed algae-coral reef or rocky reefs. Found on exposed seaward reefs; less abundant in lagoons and channels.

Appearance: Dark brown, almost black, with white rear body including tail and rear dorsal and anal fins. Caudal fin lobes end in two filaments. Black spot at base of pectoral fin. Spine tips of the dorsal fin are blue. Max length: 9 cm.

Diet: Zooplankton, algae. Feeds in large groups.

Blacksmith
Chromis punctipinnis (Pomacentridae)
Damselfishes and Anemonefishes

Distribution: Monterey Bay to central Baja California.

Habitat: Large schools of hundreds of individuals are common during the day above nearshore rocky reefs to 45 m. Shelter at night on or near crevices, again often in groups.

Appearance: Gray-blue or gray on sides with black spots on rear of body. Length about 30 cm.

Diet: Zooplankton (copepods and other crustacean larvae and eggs).

Reproduction and Development: Males prepare nest sites in overhangs or small caves of reefs, and guard eggs. Females oviparous. Spawn summer or fall.

Mortality/Longevity: Predators include other fishes (including kelp bass, moray eels, and lingcod), marine mammals (harbor seals, California sea lions), and birds.

Ternate Chromis
Chromis ternatensis (Pomacentridae)
Damselfishes

Distribution: Red Sea, East Africa to Samoa, Japan south to New Caledonia and the Great Barrier Reef.

Habitat: Over *Acropora* coral in upper margins of clear lagoon and outer reef slopes at depths of 2–36 m.

Appearance: Colored brown with silvery white to bluish lower parts, black borders on forked tail. Length to 10 cm.

Diet: Plankton. Feed in huge aggregations above reefs.

Reproduction and Development: Females lay elliptical, demersal eggs that are guarded by the male.

Mortality/Longevity: Preyed upon by larger fishes, for example groupers.

Green Chromis aka Blue Green Chromis
Chromis viridis (Pomacentridae)
Damselfishes

Distribution: Indo-Pacific.

Habitat: Reef flats, shallow lagoons, sheltered seaward reefs to 12 m. Huge aggregations above branching corals, often well above the bottom. Swarms of juveniles occur above smaller isolated coral heads.

Appearance: Length to 9 cm. Adults sea-foam green in color. Courting males develop blackish dorsal rays and upper pectoral rays. Caudal fin deeply forked with very long, trailing tips.

Diet: Plankton.

Reproduction and Development: Elliptical demersal eggs are guarded by the male.

Sapphire Devil
Chrysiptera cyanea (Pomacentridae)
Damselfishes

Distribution: Indo-West Pacific: eastern edge of Indian Ocean and Western Australia to New Guinea, Indonesia, Philippines, Taiwan and Ryukyu Islands.

Habitat: Rubble and coral of clear sheltered lagoons and subtidal reef flats.

Appearance: Brilliant light-blue color. Exhibits marked sexual dichromatism: juveniles and females usually have small black spot at rear base of dorsal fin and in some areas (e.g., Micronesia) lack yellow; males have bright yellow snout and tail, orange in some regions, and lack black spot. Size up to 8.5 cm.

Diet: Omnivore. Feeds on algae, pelagic tunicates and copepods. In the wild, stakes out a territory and "farms" the algae that grow in the area.

Reproduction and Development: Damsels

pair off and the breeding pair establishes a territory, which they defend vigorously. Female damselfish releases eggs, which the male fertilizes by releasing sperm over them. Yolk-sac larvae have planktonic development.

Remarks: Damselfishes are laterally compressed and, like their cichlid relatives, are characterized by single nostril on each side of the snout rather than the usual two.

Damselfishes often occur in high population densities, and as a group are known to be aggressive and territorial.

Yellowtail Blue Damselfish

Chrysiptera parasema (Pomacentridae)
Damselfishes

Distribution: Western Pacific.

Habitat: Coral-rich areas of sheltered lagoon and inshore coral reefs. Inhabits rubble beds on lagoon reefs. Occurs in small groups on *Acropora* patches.

Appearance: Small, blue-bodied fish with a yellow tail; 7–9 cm in length. Colors become less contrasting with age.

Diet: Omnivore.

Reproduction and Development: Damsels pair off and the breeding pair establishes a territory, which they defend vigorously. Female damselfish releases eggs, which the male fertilizes by releasing sperm over them. Yolk-sac larvae have planktonic development.

Remarks: Have been bred in captivity.

Southseas Devil

Chrysiptera taupou (Pomacentridae)
Damselfishes

Distribution: Great Barrier Reef to Samoa, east to Northern California.

Habitat: Lagoon and offshore reefs, 1–10 m.

Appearance: Length to 8 cm. Deep, compressed body. Small terminal mouth. Continuous dorsal fin. Body primarily blue. Belly, pelvic, anal, posterior dorsal and caudal fins yellow. Spinous dorsal fin yellow on mature males, blue on mature females.

Diet: Benthic algae, zooplankton.

Blacktail Damselfish

Dascyllus melanurus (Pomacentridae)
Damselfishes

Distribution: Western Pacific: Indonesia, Philippines to northern Great Barrier Reef and Coral Sea; also eastern Caroline Islands.

Habitat: Among branching corals in inshore and lagoon reefs to 68 m. Form groups, typically in shallow water.

Appearance: Deep and compressed body; white with three black bars, rear two-thirds of tail is black; large white spot between eyes extends to lips. Pectoral fins transparent. Length to 8 cm.

Diet: Plankton, including larval shrimps and crabs; algae, ostracods, amphipods, pelagic tunicates, copepods, and fish eggs.

Reproduction and Development: Lay demersal eggs that are guarded by the male. After hatching, larval stage lasts 22–24 days. Recent research suggests this species is a protogynous hermaphrodite.

Remarks: Hide among *Acropora* branching corals when threatened, though adults have an aggressive temperament.

Garibaldi

Hypsypops rubicundus (Pomacentridae)
Damselfishes

Distribution: Monterey Bay, California to southern Baja California.

Habitat: Rocky bottom reefs and kelp beds, intertidal to more than 30 m. Often near crevices and caves.

Appearance: Length to 36 cm. Adults are perched-shaped and brilliant orange. Juveniles have iridescent blue markings.

Diet: Sponges, bryozoans, anemones and worms.

Reproduction and Development: Female produces 15,000-88,000 eggs, depending on their size. Male clears a sheltered nest, removing all but red algae, and aggressively guards the nest.

Mortality/Longevity: Lives to at least 17 years.

Conservation Status: California law protects the garibaldi from sport or commercial fishing. If inadvertently caught, the fish must be released alive.

Remarks: This species is the official fish of the State of California.

Adults patrol their territories. The distinctive markings of the juveniles may alert aggressive adults to their status and negate an attack. Common name is a reference to the redshirts worn by the armies of Giuseppe Garibaldi, a fighter for Italian unification.

Neon Damselfish

Neoglyphidodon oxyodon (Pomacentridae)
Damselfishes

Distribution: Indo-Pacific, the Indo-Australian Archipelago, including the Philippines, Indonesia and the Ashmore Reef in the Timor Sea.

Habitat: Mature reefs with abundant populations of branching corals. Commonly found in the current-swept reef flats up to depths of about 3 m.

Appearance: Easily identified by its velvety dark blue body and brilliant electric-blue horizontal stripes on its face and upper body. A vertical yellowish-white stripe divides the body just in front of the dorsal fin. As the neon damselfish ages the body stripes fade becoming an overall grayish blue to black in color. Max length: 15 cm.

Diet: A wide variety of foods including zooplankton and algae.

Reproduction and Development: Characteristic of the Family Pomacentridae, the males assume the parental care of the eggs.

Conservation Status: This species is listed as low to moderate vulnerability. Its popularity as an aquarium trade fish may be a reason for its low populations.

Remarks: These damselfish can be found sleeping in the shelter of coral heads at night.

Goldbelly Damselfish

Pomacentrus auriventris (Pomacentridae)
Damselfishes

Distribution: Western Central Pacific from Micronesia to Indonesia.

Habitat: Mainly around inner reef slopes at depth of 2–15 m. Congregate in small groups, close to the bottom, in areas of mixed rubble, coral, and algae.

Appearance: Electric-blue back with a golden yellow belly. Max length: 5.5 cm.

Diet: Algae and some zooplankton.

Reproduction and Development: Damselfish are substrate spawners. In most species, the male establishes a territory, selects and prepares a site, such as a piece of rubble with a smoothed wall crevice, a coral surface, or a rocky ledge. Once a spawning site has been prepared, the male attracts a female into his territory with excited swimming and distinct movements The female will lay her adhesive eggs onto the prepared site, and the male will fertilize them. The male may continue to mate with several different females. Depending on the species some damselfish males guard the eggs, while others do not.

Remarks: Because they are hardy and inexpensive, damselfish are often used to condition new aquariums and establish the nitrification cycle.

Spine-cheek Anemonefish

Premnas biaculeatus (Pomacentridae)
Damselfishes

Distribution: Indo-West Pacific: Indo-Australian Archipelago including India, Burma, Thailand, Malaysia, Indonesia, Philippines, New Guinea, New Britain, Solomon Islands, Vanuatu, and northern Queensland, Australia.

Habitat: Lagoon and seaward reefs, 1–16 m. Exclusively with the sea anemone *Entacmaea quadricolor.* Usually in pairs.

Appearance: Length to 17 cm. Juveniles orange-colored; color deepens with age. Male smaller, bright red with three brilliant white bars, sometimes barely visible. Female becomes maroon or almost black with subdued bars. Conspicuous spine on cheek.

Diet: Zooplankton and algae.

Reproduction and Development: Protandrous hermaphrodite. Like *Amphiprion* species, are monogamous. Female is to about 2–3 times the size of her male partner.

Remarks: This fish has been successfully bred and reared in captivity.

Beaugregory

Stegastes leucostictus(Pomacentridae)
Damselfishes

Distribution: The genus *Stegaste*s is composed of nearly 33 species with a wide tropical distribution. Several, such as the Beaugregroy, are known in the Caribbean.

Habitat: Shallow rock and coral reefs.

Appearance: Even within a particular species, individuals and populations may display marked color ranges, making it difficult to identify an exact Stegastes species.

Diet: Members of the genus are exclusively herbivores. Their grazing on algal beds, both in the wild and in aquaria, helps control algal growth.

Reproduction and Development: Damselfishes

lay elliptical eggs, which are normally guarded by the male.

Remarks: Like many damselfishes, *Stegastes* are highly territorial and pugnacious.

Maori Wrasse aka **Humphead Wrasse**
Cheilinus undulates (Labridae)
Wrasses

Distribution: Much of the tropical and subtropical Indo-West Pacific.

Habitat: Larger adults are typically found on outer or deep reefs and in the more open area around steep coral or cliff walls, channel slopes, boulder-rich habitats and in lagoon reefs up to 100 m deep. Adults frequently shelter in caves or crevices at night. Smaller individuals and juveniles prefer a more cryptic environment of dense branching corals, and areas of bushy macroalgae or seagrasses.

Appearance: A distinctive hump on the forehead above the eyes becomes more prominent with age. Lips are fleshy and thick. Adult coloration varies from bright electric blue to green, purplish blue, or a dull bluish green with a yellow posterior margin tapering to the caudal. Scales are large. Juveniles are a pale green with elongate dark spots forming bars on its scales and 2 black lines extend from the eyes. Males much larger than females. Max length: males - 2 m; females - 1 m.

Diet: Primarily mollusks (particularly heavy-shelled gastropods), crustaceans, fish, echinoderms and other invertebrates. One of very few predators to feed on toxic animals such as sea hares, boxfishes and the crown-of-thorns sea star.

Reproduction and Development: This species is very slow to sexually mature; females are sexually mature between 5–7 years, males around 9 years. Maori wrasses are protogynous hermaphrodites producing eggs before sperm. Spawning occurs with small groups of adults aggregating in the downward currents of reefs. Eggs are pelagic.

Mortality/Longevity: Individuals are exceptionally long-lived with males reaching 25 years, females around 30 years.

Conservation Status: IUCN Red List: Threatened, mostly because of high fishing pressures in the center of its range in southeastern Asia. Also, highly valued by the aquarium trade. Data suggests declines over 10–15 years in exploited areas of 10-fold or more. Today, much of catch is juvenile fish, the preferred market size of this large-growing species. The Maori's long maturation time and the severe reduction of sexually mature individuals reduces the potential for population increase.

Remarks: The Maori wrasse is the largest member of the family Labridae.

Harlequin Tuskfish
Choerodon fasciatus (Labridae)
Wrasses

Distribution: Western Pacific, disjunct distribution. North: Ryukyus to Taiwan; South: New Caledonia to Queensland.

Habitat: Seaward reefs, 5–35 m. Usually solitary. Patrol a large territory. Active diurnally.

Appearance: Length to 30 cm. Vertical, broad, bright orange bands interspersed with blue bands. Black caudal peduncle, white tail. Dorsal and pelvic fins orange.

Diet: Mollusks, echinoderms, crustaceans, worms.Tuskfish have protruding canines used for moving rubble to expose invertebrate prey and prying mollusks from the substrate. Hard-shelled prey crushed by pharyngeal teeth.

Reproduction and Development: Pelagic spawners, initial males spawn in large groups; terminal males are usually territorial and pair spawn with females of their choice. Females change sex into males for their terminal phase.

Exquisite Fairy Wrasse
Cirrhilabrus exquisitus (Labridae)
Wrasses

Distribution: East Africa to Tuamotus, north to Izus, southern Japan and south to Great Barrier Reef, Australia.

Habitat: Over rubble or low patch reefs in areas of current, also on reef edges and near rubble zones in 5–35 m depth.

Appearance: Length to 12 cm. Post-juvenile initial phase to 7 cm and colored shades of brown; large black spot on base of upper tail. Terminal phase individuals colored shades of green, bright red margins on dorsal and anal fins, narrow blue stripe from mid-body to tail, large black spot on base of upper tail, two or three blue line marks on head.

Diet: Zooplankton in the water column, well above the substrate.

Reproduction and Development: Pelagic spawners, like all wrasses.

Remarks: Like all wrasses, active diurnally, rest nocturnally.

Frequently in moderately large groups of mixed sexes during feeding.

Males often display to each other.

Yellowfin Fairy Wrasse

Cirrhilabrus flavidorsalis (Labridae)

Wrasses

Distribution: Western Central Pacific: Philippines and Indonesia.

Habitat: Found among branching corals and rubble on protected reef slopes, at depths 12–30 m.

Appearance: Brightly colored; dichromatic and sexually dimorphic. Colors variable depending on mood and stage. Terminal male: white to pinkish with red upper head; 2 wide red bars on forebody and yellow margin on dorsal fin. One of the smallest wrasses. Max. size: 10 cm.

Diet: Carnivorous; various small invertebrates; does not harm stony or soft coral polyps.

Reproduction/Development: Protogynous hermaphrodite. Dominant female morphs to male if dominant male is lost or dies. The dominant male and selected female release their gametes together in a complex mating ritual.

Remarks: Like all fairy wrasses, this one is a very energetic, free swimmer but never far from a crevice to dart into. At night, it creates a mucous cocoon masking its appearance and scent.

Male fairy wrasses are typically more brightly colored than the females.

Lubbock's Fairy Wrasse

Cirrhilabrus lubbocki (Labridae)

Wrasses

Distribution: Indo-Pacific: Philippines, Celebes, and Indonesia.

Habitat: On outer reefs in coral rubble or finely branch coral, at depths of 20-25 m.

Appearance: Found in various colors: pink, red, and purple. Orange to yellow upper head, dorsal fin a bright yellow in adults. Females less colorful. Max. size: 7.5 cm.

Diet: Zooplankton.

Reproduction/Development: Protogynous hermaphrodites: in the absence of the male, the dominant female morphs to male. Dominant males have harems of several females. Like all fairy wrasses, are pelagic spawners and do not guard young.

Remarks: Fairy wrasses (*Cirrhilabrus* spp.) are all sexually dichromatic (males typically more colorful, especially during courtship) and somewhat sexually dimorphic (males slightly larger, with longer, more pointed unpaired fins).

Fairy wrasses are diurnally active, wrapping themselves in mucous cocoons at night and walling themselves up in reef crevices to hide.

Like all wrasses, they have protrusible mouths, with teeth of the lower jaw jutting outward.

The wrasse family (Labridae) is known from the Paleocene (65 to 55 million years ago).

Redeye Fairy Wrasse

Cirrhilabrus solorensis (Labridae)

Wrasses

Distribution: Found in the Western Central Pacific and Indonesia.

Habitat: Coastal to outer reef lagoons on rubble and coral habitats.

Appearance: Highly variable. The eye is bright red. Males usually have a dark band along the end of the gill covering. Change color and sex with growth. Females are able to change sex into an often brilliantly colored terminal male phase. Max. size: 11 cm.

Diet: Natural diet consists of zooplankton. In captivity they eat small shrimp, worms, and invertebrates, as well as chopped meat.

Reproduction and Development: In general wrasses spawn following a mating ritual during which the male flashes his colors to a harem of females. He selects a gravid female and they swim in a loop and at the highest point release the gametes. A second male may perform what is known as streak spawning, where he swims into the loop of a spawning pair and releases his sperm at the same time.

Remarks: The cornea of the eye of fairy wrasses is divided into two segments, essentially forming a double pupil. It is thought that the center pupil is a close-up

lens that lets the fish have a magnified view of their small prey.

Bird Wrasse
Gomphosus varius (Labridae)
Wrasses

Distribution: Indo-Pacific: East Africa to Hawaiian Islands, north to southern Japan, south to Australia.

Habitat: Found in lagoons and seaward reefs at depths 2–30 m.

Appearance: The common name refers to the fish's long snout, which is said to resemble a bird's beak. This species, like many wrasses, changes appearance as it matures. During the juvenile phase it is blue above and white below. The snout is short. In the next phase, called the initial phase, most or all are females, and they are white with a black spot on each scale. The caudal fin is black and the top of the snout is orange. During the terminal phase, a dominant male becomes blue green. The caudal fin has a bright blue crest. The male can grow to 30 cm. Females to about 20 cm.

Diet: Although its mouth is small, it can grasp prey in its strong jaws and smash it against the substrate until its meal is broken into bit-sized pieces. In captivity, brine and mysid shrimp and worms satisfy this non-avian "bird".

Reproduction and Development: Males are territorial, and females live within these territories. The male will perform a mating dance and then both sexes release gametes. The larvae are planktonic.

Remarks: Like other wrasses, the bird wrasse can be recognized by its characteristic swimming pattern: the pectoral fins move up and down in a "flying" motion.

Yellow Wrasse aka Canary Wrasse
Halichoeres chrysus (Labridae)
Wrasses

Distribution: East Indo-Pacific: Christmas Island to Marshall Islands; north to Japan, south to Australia.

Habitat: Sand and rubble edges of reefs. Depth 6–60 m; usually below 20 m.

Appearance: Length to 12 cm. Color canary yellow, head with distinctive light-green bands. Males have a single white-rimmed black spot on dorsal fin; females have two black, light yellow-rimmed spots.

Diet: Small worms, snails, crustaceans; may eat parasites off other fishes.

Reproduction and Development: Pelagic spawners; protogynous hermaphrodites.

Remarks: Relatively uncommon; often form small groups.

Adult male and female appear similar, very atypical of wrasses.

Like many wrasses, these fish typically burrow in the sand at night or anytime to escape predators.

Yellowhead Wrasse
Halichoeres garnoti (Labridae)
Wrasses

Distribution: Western Atlantic; Bermuda and southern Florida to southeastern Brazil.

Habitat: Commonly found on shallow and deep reefs and exposed ledges at depths from 2–80 m.

Appearance: Adults are blue above the lateral line and have a yellow belly. Juveniles are yellow with a silvery blue stripe along the side. Terminal male: head and forebody varies from bright yellow to yellowish tan; dark blue to green rear body and tail; two or more lines radiate from rear of eye. Max. size: 19 cm.

Diet: Various invertebrates.

Reproduction and Development: Protogynous hermaphrodite. During breeding males form leks (a gathering of males to attract females by competitive display).

Mortality/Longevity: Preyed upon by other fishes such as groupers and snappers.

Remarks: Curious; easily attracted by divers.

Diurnal; swim constantly during the day and rest at night.

Pastel Green Wrasse
Halichoeres chloropterus (Labridae)
Wrasses

Distribution: West Central Pacific: Philippines to the Great Barrier Reef.

Habitat: Shallow protected coral reef on silt, sand and rubble bottom.

Appearance: Juveniles lime green; females pale green above and white below, with a thin dark line on the base of the pectoral fin. Terminal males greenish with pink spots of the side of the body, and irregular bands of pink and green on the head. Max. size: 19 cm.

Diet: Hard-shelled prey, including mollusks, crustaceans, and sea urchins.

Pinstriped Wrasse
Halichoeres melanurus (Labridae)
Wrasses

Distribution: Western Pacific Ocean.

Habitat: Sheltered reefs to 2–15 m.

Appearance: Juvenile to 11 cm. Alternating yellow to orange and blue horizontal stripes, small black spot on dorsal fin, large blue-edged black dots on mid-dorsal fin, similar but smaller markings on upper tail base. Adults to 12 cm. Alternating horizontal green teal and orange stripes. Three to 6 narrow turquoise bars on upper side, large yellow spot on base of pectoral fin, black tail tip.

Diet: Small invertebrates including polychaetes, copepods, isopods and foraminiferans.

Reproduction and Development: Protogynous hermaphrodite; largest female in a male's territory typically completes sex change within 2–3 weeks of male's disappearance.

Mortality/Longevity: Preyed upon by lizardfishes and other fishes.

Remarks: A recent study showed that sex change for this species, if recent, is reversible. When a dominant male was reintroduced to a territory, the newly sex-changed male reverted to its former female role.

Two-tone Wrasse
Halichoeres prosopeion (Labridae)
Wrasses

Distribution: Western Pacific; east to Indonesia and Sumatra, north to southern Japan, south to Great Barrier Reef.

Habitat: Lagoons and seaward reefs.

Appearance: Adults green-blue in front fading to light yellow behind. A dark spot behind the eye; dorsal fin with large black spot near the front. Unlike most wrasses, no obvious differences between sexes. Max. size: 13 cm.

Diet: Small crabs, shrimps, worms, and other benthic invertebrates.

Remarks: Like many wrasses, quickly buries in sand when threatened or alarmed.

Rock Wrasse
Halichoeres semicinctus (Labridae)
Wrasses

Distribution: Pt. Conception, California to Guadalupe Island off central Baja California.

Habitat: Close to rocks near patches of sand; tide pools and down to 24 m.

Appearance: Cigar-shaped fish with prominent, forward-pointing teeth; large scales. Greenish above, yellow below. Males have dark bar behind base of yellow pectoral fin. Wavy blue lines may radiate from the eye. Dark flecks on back, especially noticeable in young individuals. Max size: 38 cm.

Diet: Small invertebrates, taken during the day.

Reproduction and Development: Protogynous hermaphrodites.: individuals function first as females, then about 5% change to males at length of about 30 cm.

Remarks: Sleeps at night buried in sand, with head protruding, and will dart to a sandy refuge during the day if startled.

Striped Cleaner Wrasse
Labroides dimidiatus (Labridae)
Wrasses

Distribution: Indo-Pacific.

Habitat: Virtually all coral reef habitats: inner lagoons and subtidal reef flats to seaward reefs, 0.5-40 m, typically near branching corals. Active diurnally. Aggressively territorial. Nocturnally retires to small crevices in the reef, enclosing itself in a mucus cocoon. Remains in stations where other fish come to be cleaned.

Appearance: Length to 11.5 cm. Elongate body, tubular mouth. Anterior of body yellowish, posterior very pale blue. Widening horizontal black band from mouth, through eye to end of tail.

Diet: Coral polyps, crustacean ectoparasites and mucus gleaned from other fishes.

Reproduction and Development: External batch spawns in pairs, also haremic. Pelagic spawners: initial males spawn in large groups, terminal males are usually territorial and pair spawn with females of their choice. Females change sex into males for their terminal phase when the dominant male is removed. Sex change complete within 14–18 days. Do not guard eggs.

Mortality/Longevity: Can live to at least 4 years.

Remarks: The most common cleaner wrasse on reefs.

Pick external parasites from other fishes. Also clean the wounds of other fishes by removing scar tissue. Clean the gills and even enter the mouth of the host.

Advertise their services with an undulating "invitation dance."

Mimicked by the fin and scale nipping blenny *Aspidontus taeniatus,* the bogus cleaner wrasse.

Star of the movie *Shark Tale.*

Leopard Wrasse

Macropharyngodon meleagris (Labridae)
Wrasses

Distribution: Indo-Pacific: Eastern Indian Ocean to western Pacific and the islands of Oceania.

Habitat: Subtidal reefs and outer lagoons, at depths of 0–30 meters.

Appearance: Sexual dichromism. Females are white with black or brown irregular spots with white to blue margins over the body. Males have orangey-red background with green mottling. Max. length: 15 cm.

Diet: Gastropods, other hard-shelled prey and foraminiferans.

Remarks: Wrasses can be recognized by their characteristic swimming pattern. Their pectoral fins move up and down in a "flying" motion.

Señorita Wrasse

Oxyjulis californica (Labridae)
Wrasses

Distribution: Salt Point, northern California to south-central Baja California.

Habitat: Found in kelp and other seaweeds and over rocky reefs, usually at shallow depths.

Appearance: Cigar-shaped fish with large scales and protruding teeth. Orange to brownish, a few are more pink or yellow. Large black marking at base of caudal fin.

Diet: Feeds during the day on small invertebrates; on occasion acts as a cleaner, picking parasites from other fishes. Known to clean giant sea bass, garibaldi, kelpfish, and many other fishes. Juveniles feed on plankton and pick hydroids and other small food items off algae.

Reproduction and Development: Oviparous; pelagic spawner. Unlike most wrasses, they do not change sex.

Mortality/Longevity: Eaten by birds, such as Brandt's cormorants, and sea lions.

Live about 7 years and grow to about 25 cm.

Remarks: Popular in the aquarium trade.

At night, señoritas seek out a nearby sandy area and bury themselves with a headfirst dive into the sand, ultimately sleeping with head protruding.

Red-tailed Flasher Wrasse

Paracheilinus rubricaudalis (Labridae)
Wrasses

Distribution: Western Central Pacific: Fiji and Vanuatu.

Habitat: Coral reefs, depths to 45 m.

Appearance: Adults reach 2 to 3 inches in length. The species has a red tail and a broad red zone with a single filament on its dorsal fin. Males have a reddish area on their distal anal fin. The reddish stripes on their sides turn whitish and their body becomes bright yellow while they are displaying. Males from Fiji have a narrow bluish vertical stripe on their caudal fin that is never seen on specimens from Vanuatu. The color of the female is subdued compared to the brilliance of the male.

Diet: Plankton feeders; need to feed often (three times a day) in captivity.

Reproduction: Like all *Paracheilinus* species, the red-tailed flasher wrasse is a protogynous hermaphrodite. All specimens are born as females and the dominant females develop into males when there is a shortage of males. The dominant female will for instance develop into a male if the male in her group falls prey to a predatory fish. The transformation from female to male can take as little as 10–14 days. Flasher wrasses scatter their eggs in the open water. The actual spawning is preceded by a "dance" where the male follows the female until both fish rapidly swim upward into the water column and simultaneous release egg and milt. The eggs and larvae are carried by the current until the fry become free swimming and make their way to the bottom.

Remarks: First described in 2003.

John E. McCosker, Academy Senior Curator and former Steinhart Aquarium Director, is the ichthyologist credited for naming members of the genus *Paracheilinus* "flasher wrasses," the common name derived from male's brilliant "flashing" behavior, or rapid color changes, observed during courting and mating.

Flasher wrasses create a mucous cocoon over their bodies for sleeping.

Sixline Wrasse
Pseudocheilinus hexataenia (Labridae)
Wrasses

Distribution: Indo-Pacific: Red Sea south to South Africa and east to the Tuamoto Islands, north to the Ryukyu Islands, south to Lord Howe and the Austral islands.

Habitat: Seaward reefs among coral branches; dense coral habitats on shallow reef crest or slopes 2–35 m.

Appearance: To 7.5 cm. Violet with six horizontal orange stripes on side. Small black dot on upper tail base.

Diet: Primarily small crustaceans, snails, and flatworms.

Reproduction and Development: Pelagic spawners; protogynous hermaphrodites.

Mortality/Longevity: Preyed upon by grouper and other finfish.

Remarks: Usually occurs in small loose groups.

A shy species, usually swimming among the protection of coral branches.

Like most wrasses, inactive at night.

Mystery Wrasse
Pseudocheilinus ocellatus (Labridae)
Wrasses

Distribution: West to central Pacific ocean.

Habitat: On coral reefs, 20–60 m, usually near the substrate.

Appearance: The genus is known as the "lined wrasses," but unlike others in the group, the mystery wrasse has vertical rather than horizontal lines. Body reddish-pink, stripes white. These lines may fade as the fish matures. Distinct black ocellus (eye spot) on each side of the caudal fin, often surrounded by yellow may confuse predators. Max. size: 10 cm.

Diet: Carnivorous: Fish egges, small crabs, mollusks, sea urchins, and other benthic invertebrates.

Mortality/Longevity: Predatory fishes such as grouper, lionfish, and scorpionfish find lined wrasses a tasty meal.

Remarks: First described in 1999, its life history is not well known. Because of its handsome coloring and hardy nature, it has become increasingly popular with aquarists.

California Sheephead Wrasse
Semicossyphus pulcher (Labridae)
Wrasses

Distribution: Monterey Bay, California to Cabo Saint Lucas, Baja California.

Habitat: Solitary or in small groups in kelp forests and shallow reefs to 55 m, typically 3–30 m.

Appearance: Length to 91 cm, weight to 16 kg. Fusiform, deep, compressed. Adult males with head, posterior body and caudal fin black, mid-body brick red, chin white.

Adult females reddish-brown. Caudal fin almost square. Juveniles brick red on sides with white stripe.

Diet: Varies. Hard-shelled prey (sea urchins, barnacles, clams, gastropods, mussels, lobsters and crabs) crushed with tooth-plates in rear of mouth. Also take octopuses and various worms; can pry prey from substrate with canine teeth.

Reproduction and Development: Protogynous hermaphrodite. Individuals initially female, change to males at about 30 cm and 8 years old. Sex change metamorphosis takes less than one year.

Mortality/Longevity: Can live to more than 50 years, although this rarely happens now. A popular food fish. Giant sea bass, as well as various marine mammals such as California sea lions and harbor seals, consume this species.

Conservation Status: Not on IUCN Red List. Populations shrinking in southern California due to fishing pressure and reduction of kelp beds. Large males now rare.

Remarks: Juvenile sheepheads may act as cleaner fish symbionts to other fish.

Adults have steeply sloping foreheads, thus the common name.

Sixbar Wrasse
Thalassoma hardwicke (Labridae)
Wrasses

Distribution: Tropical Indo-Pacific: East Africa west to the Line and Tuamoto islands and from southern Japan in the north to the Austral islands in the south.

Habitat: Shallow lagoons and seaward reefs, along slopes and drop-offs to moderate depths, ranging from 0-15 m.

Appearance: Adult is pastel blue to pale green with six dark, vertical bars on their body, the

last two saddling the tail. The head has a distinct 'daisy' print around the eyes made of a few different pastel colors (e.g., pink bands radiating from the eye) in larger adults. Terminal males are gaudier than primary males. Max length: 20 cm.

Diet: Carnivore on benthic and planktonic crustaceans, other motile invertebrates and small fishes.

Reproduction/Development: Protogynous hermaphrodite; pelagic spawner.

Remarks. Occur in small, loose groups.

Rainbow Wrasse

Thalassoma lucasanum (Labridae)
Wrasses

Distribution: Tropical marine waters from the central Gulf of California to the Galapagos Islands.

Habitat: Shallow reefs at depths of about 48 m as well as near-bottom substrate.

Appearance: Distinctive yellow and red lateral stripes with the less common larger males displaying a blue head with a broad yellow vertical stripe behind the head. Like most wrasses, is cigar-shaped with a pointed snout, thick lips, a protractile mouth and protruding canine teeth. Max. length: 15 cm.

Diet: An efficient carnivore that congregates during the day in groups to feed on a wide variety of small crustaceans, algae and egg masses.

Reproduction and Development: Rainbow wrasses utilize two types of reproduction and two types of males. Those displaying the red and yellow striped pattern are both males and females, and reproduce by broadcast spawning. They rise in large numbers to the top of the water column, release eggs and sperm, and quickly return to the safety of deeper water..

Terminal males are those identified with blue heads and yellow vertical stripe. This male forms a harem and selects each female with which to spawn. Normally each population of these wrasses has only one sexually mature terminal male. Should that male be removed, a female newly transformed into a terminal male will quickly take its place.

Remarks: Not fished commercially.

Moon Wrasse

Thalassoma lunare (Labridae)
Wrasses

Distribution: Indo-Pacific; Red Sea to East Africa to the Line Islands, northwest to southern Japan, and southwest to northern New Zealand.

Habitat: Marine reefs to a depth of 20 m. Also lagoons, coastal reefs, protected seaward reefs, and estuaries.

Appearance: Adult's caudal fin is a large yellow crescent edged in purple and blue, the source of the species common name. Body dark green to blue with vertical red lines on scales; pectoral fins a bright pink surrounded by neon blue. The head is distinctive for its bright irregular pink and violet bands radiating from the mouth towards the body, a kind of fluorescent camouflage. Terminal males most colorful. Max. length: 25 cm.

Diet: Crustaceans, snails, and other small benthic invertebrates; also fish and snail eggs.

Reproduction/Development: Protogynous hermaphrodites. The terminal male has priority access to food and spawning females. Because eggs are fertilized externally during mass spawning, some lesser males may mix their gametes into the spawning cloud.

Remarks: Typically a peaceful fish with only the dominant males becoming aggressive in territorial or mating disputes.

When frightened this fish will hide in the reef or bury itself in the sand; also buries in sand to sleep.

SUBORDER ZOARCOIDEI

Northern Ronquil

Ronquilus jordani (Bathymasteridae)
Ronquils

Distribution: Bering Sea to Monterey Bay.

Habitat: On bottom, usually among rocks, 3–165 m.

Appearance: Males orange above, with vague dark bars on side; olive-green below. Females olive-green above, paler below. Like all ronquils, body elongate, dorsal and anal fins long, caudal and pectoral fins rounded. Max. size: 18 cm.

Diet: Small invertebrates of the plankton and benthos.

Reproduction and Development: Males known to guard the brood.

Remarks: Secretive habits make this species rarely seen.

Ronquils are known only from the North Pacific.

Monkeyface Prickleback

Cebidichthys violaceus (Stichaeidae)
Pricklebacks

Distribution: Southern Oregon to north-central Baja California.

Habitat: Common in tide pools and shallow rocky areas to 24 m. Hide in territorial crevices and rock shelters, venturing out around 5 m to feed.

Appearance: Length to 76 cm. Large and long compressed eel-like body. Adults usually uniformly colored black, olive or gray, except for black streaks across eyes. Dorsal and anal fins edged with red. Fleshy hump above eyes pronounced in reproductive males.

Diet: Primarily crustaceans, esp. amphipods; also worms, clam siphons and algae. Red and green algae are the preferred diet of 5–8 cm juveniles.

Reproduction and Development: Spawn during the spring at 3–4 years old. Female lays large egg masses in rocky crevices. Eggs guarded until hatching. Male and female grow at the same rate for their first 8 years. Thereafter male grow faster.

Mortality/Longevity: Live to at least 18 years. Juveniles preyed upon by birds such as great egrets and great blue herons. Occasionally sold in fish markets.

Remarks: Sometimes placed in a separate family (Cebidichthyidae).

Largest fish species in the intertidal zone of the eastern Pacific.

Able to breathe air. If in an moist environment, can remain out of water for 35 hours or more.

Not a true eel of the Order Anguilliformes.

Decorated Warbonnet

Chirolophis decoratus (Stichaeidae)
Pricklebacks

Distribution: North Pacific from Kamchatka, Russia, to the Bering Sea and Alaska, south to Humboldt Bay, California.

Habitat: Usually among seaweed on rock bottoms from the subtidal to 90 m.

Appearance: Body is eel-like; pale brown with whitish-cream markings. Dark bars run down from eyes; prominent dark bars on dorsal, caudal, and anal fins. "Decorated" by large cirrus in front of each eye and by dense cirri on head and spines at front of dorsal fin. The effect resembles feathers of a chieftain's warbonnet.

Diet: Small animals that swim or crawl near its lair.

Remarks: This secretive fish is rarely seen out of the small rocky crevices where it hides.

Mosshead Warbonnet

Chirolophis nugator (Stichaeidae)
Pricklebacks

Distribution: Aleutian Islands to southern California.

Habitat: Usually subtidal rocky areas to about 80 m. Often hides in crevices or tubeworm holes with only head protruding. Max. size: c. 18 cm.

Appearance: Brown or reddish brown. Numerous cirri on top of the head, all about the same length. About 12 black eyespots (or sometimes short bars) on the dorsal fin. Dark streak below the eye.

Diet: Known to eat small mollusks and probably other items.

Remarks: Pricklebacks are long, compressed, and somewhat eel-like, and are so named because, in most species, all rays of the dorsal fin are spiny.

Penpoint Gunnel

Apodichthys flavidus (Pholidae)
Gunnels

Distribution: Kodiak Island, Alaska to Santa Barbara Island, southern California.

Appearance: They have long, narrow ribbon-like bodies with light spots along the sides. Their coloration is red, brown or green. A spine with a groove in front of the anal fin resembles a penpoint, hence the common name. To 46 cm.

Habitat: Tide pools and tidal to subtidal areas, especially among algae, such as rockweed or other kelps.

Diet: Small mollusks and crustaceans.

Reproduction and Development: Spawning occurs from January to April in nearshore waters. The female lays sticky eggs onto a

substrate where they will be guarded by the male for 2.5 months. Pairs have been observed coiled around egg masses.

Mortality/Longevity: Preyed on by other fishes and seabirds.

Remarks: Color phases seem to vary with surroundings, controlled by two distinct body pigments with individuals often reflecting the green, brown, or red of the algae where they are collected.

Breathe air when out of water at low tides while hiding in crevices or algae.

Apodichthys [Gr.] means "fish without feet," a reference to this genus' lack of pectoral fins.

Rockweed Gunnel

Apodichthys fucorum (Pholidae)
Gunnels

Distribution: Eastern Pacific; British Columbia to central Baja California.

Habitat: Intertidal areas, commonly found in rockweed (Fucus) and other algae growing in tide pools and subtidal areas.

Appearance: Body eel-shaped, lacking pelvic fins and possessing much reduced pectorals. Colors range from dark red, light green in the intertidal to light brown or tan in kelp areas. Red morphs tend to associate with red algae, green ones with green algae. Long dorsal fin usually joined to the caudal fin. Max. length: 22.5 cm.

Diet: Small crustaceans and mollusks.

Remarks: A. fucorum is able to remain out of water for extended periods of time, protected under rocks or seaweed and able to breathe air for up to 24 hours if kept moist.

Ecologically, gunnels are important forage fishes for birds and commercially important flatfishes.

Wolf Eel

Anarrhichthys ocellatus (Anarhichadidae)
Wolffishes

Distribution: Sea of Japan and Aleutian Islands to Imperial Beach, California.

Habitat: Adults live on bottom, usually among rocks in subtidal locations; often in dens. Depths from barely subtidal to 226 m.

Appearance: Length to 2.4 m. Weight to 18 kg. An eel-like fish (large, elongate, compressed body) with no pelvic fins. Large pectoral fins. Colored mostly gray to brown, occasionally greenish. Round dark spots with pale rings on body and fins. Juveniles often orangish with dark spots merging into stripes at rear of body.

Diet: Crabs, sand dollars, marine snails and fishes.

Reproduction and Development: Eggs laid in rocky protected areas and guarded by both parents. Juveniles initially pelagic, living near the top of the water column for 2 years. They then settle to an active life over the benthos, eventually locate a rock shelter hideaway and become less active. A male-female pair will occupy the same shelter for years, apparently mating for life. Females reproductive at 7 years. Male butts his head against female's abdomen during courtship. He externally fertilizes the 10,000 eggs per clutch. Both parents wrap themselves around the egg mass; only one at a time leaves to feed.

Mortality/Longevity: Predators of eggs include benthic rockfish and kelp greenlings.

Remarks: Not a true eel of the Order Anguilliformes.

Can inflict a painful bite.

An edible food fish.

SUBORDER PHOLIDICHTHYOIDEI (CONVICT BLENNIES)

Engineerfish aka Convict Blenny

Pholidichthys leucotaenia (Pholidichthyidae)
Convictfish

Distribution: Philippines and Eastern Borneo to New Guinea and Solomon Islands, south to Flores, Indonesia.

Habitat: Shallow lagoons and coastal reefs. Juveniles form schools that are often found under ledges or around coral heads. . .

Appearance: Length to 34 cm. Eel-like, confluent dorsal and anal fins, scaleless, yellowish body heavily colored with very dark blotches or vertical bars; thus the common name "convictfish." Juveniles resemble the venomous striped catfish *Plotosus lineatus* but lack that species' venomous spines and barbels.

Remarks: Often swim with conspecifics in tight formation resembling a single large body. Able to move backwards and forwards, pulling itself through the water with extra-sinuous body movements.

Adults live secretively in reefs, camouflaged by their barred or spotted color pattern. Nocturnally retreat into a sand burrow containing 1 or 2 adults

Maintain their nocturnal sand burrows by collecting and spitting the sediment out.

Have small, conical teeth, unlike the well-developed teeth of true blennies.

Only species in the family.

SUBORDER BLENNIODEI (TRUE BLENNIES)

Crevice Kelpfish

Gibbonsia montereyensis (Clinidae)
Kelpfishes and Fringeheads

Distribution: British Columbia to Baja California.

Habitat: Lives in rocky areas among algae.

Appearance: Color varies from reddish to lavender or brown, depending on surroundings. Patterning also varies: may be plain colored, striped or spotted. It has a long dorsal fin which is raised at both ends. Grows to 11 cm.

Remarks: Can change color to match surroundings; typically rests with tail curved behind, often well camouflaged among coralline algae.

Bicolor Blenny

Ecsenius bicolor (Blenniidae)
Combtooth Blennies

Distribution: Tropical Indo-Pacific, from Maldives north to southern Japan, south to Great Barrier Reef; throughout Micronesia.

Habitat: Inhabit clear lagoon and seaward reefs with mixed corals and algae-covered rocks at depths 2–25 m.

Appearance: Highly variable. In a common phase, anterior half is blue to dull brown; posterior half a dull orange—thus the common name. Males generally larger than females, and become more brightly colored during breeding periods. Length to 10 cm.

Diet: Marine algae.

Reproduction and Development: Female lays demersal, adhesive eggs.

Remarks: Bottom dwellers; sometimes hard to see as they hide in caves and rock crevices with only the head visible. Live solitary or in pairs.

Midas Blenny

Ecsenius midas (Blenniidae)
Combtooth Blennies

Distribution: Indo-Pacific: from Gulf of Aqaba and southeast coast of Africa to Marquesas Islands.

Habitat: Coral reefs in moderate current.

Appearance: Usually dark yellow in color, with streaks of blue and gold over the body. Elongate, thick body and large head with big eyes. Max. length: ~13 cm.

Diet: Zooplankton.

Reproduction and Development: Oviparous, eggs are demersal and adhesive.

Remarks: Can change colors quickly to match the colors of other fish with which it is swimming. In its orange-yellow phase, it schools with *Pseudanthias squamipinnis*, which it closely resembles in color.

Midas blennies have been compared to eels, because of their undulating swimming motions, and because they back into holes and crevices from which they observe their surroundings.

Striped Poison-fang Blenny

Meiacanthus grammistes (Blenniidae)
Combtooth Blennies

Distribution: Western Pacific, including Philippines, Indonesia, south to Great Barrier Reef.

Habitat: Sheltered lagoons and seaward reefs.

Appearance: This colorful, elongate fish with its spotted caudal fin and alternating black and white stripes blending into bright yellow on the head advertises its venomous bite. Max. length: 11 cm.

Diet: Omnivorous; small invertebrates and plant material.

Reproduction and Development: Oviparous. Details unknown, but probably like most blennies, the male entices the female to lay eggs in a hole in the reef, and both male and female may guard them until they hatch.

Remarks: About 50 blenny spp., including the 22 *Meiacanthus* spp., have evolved glands that produce venom and fangs to deliver it. The fangs are very large canines in the lower jaw that are grooved to inject venom when the fish bites, usually only in self-defense. Reports indicate that

the fang blenny will bite the inside of a predator's mouth and is quickly spit out. Humans are rarely bitten as the blenny's mouth is small. The bite is said to resemble a wasp sting.

Several non-venomous species have evolved to mimic and be protected by their semblance to the venomous model. The dandy blenny (*Petroscirtes breviceps*) is thought to be a mimic of the striped poison-fang blenny.

Unlike most blennies, which typically lack swim bladders and are bottom-dwellers, *Meiacanthus* spp. have functional swim bladders and frequently hover in mid-water. The large tail gives the fish bursts of speed, causing one observer to call them "aquatic hummingbirds."

Canary Blenny
Meiacanthus oualanensis (Blenniidae)
Combtooth Blennies

Distribution: Western Pacific; native to Fiji.

Habitat: Reefs.

Appearance: Uniformly rich, solid yellow body with a long, continuous trailing lyretail composed mostly of soft rays. Males are generally larger than females and undergo a succession of color changes during breeding.

Diet: Plankton.

Reproduction and Development: Demersal (on or near the bottom) spawner.

Remarks: Five genera with about 50 species are known as "sabre-toothed" blennies because of the distinctive canine-like tooth on each side of the lower jaw. (The rest are "comb-toothed" - see blenny species above). The genus *Meiacanthus* is notable having venom that can be injected through grooves in these fangs. Fortunately for other fish, the bite is mostly defensive, but aquarists should be cautious. The bite is painful.

The conspicuous color is believed to advertise venomous fangs to predators, an example of aposematism.

The golden mimic blenny, *Plagiotremus laudandus flavus*, gains protection from predators by being a canary blenny lookalike.

Jeweled Blenny aka **Eyelash Blenny** aka **Lawnmower Blenny**
Salarias fasciatus (Blenniidae)
Combtooth Blennies

Distribution: Tropical Indo-Pacific.

Habitat: Intertidal to a few meters in depth on reef flats and in shallow lagoons and estuaries.

Appearance: Body a mottled tan with blue dots; up to about 12 cm.

Diet: Algae eaters; tend to be territorial about feeding areas.

Reproduction and Development: Oviparous; form pairs and guard nests.

Remarks: Tends to hop from rock to rock looking for food. Its nickname "Lawnmower Blenny" comes from its prodigious and efficient algal consumption using comb-like teeth that line the jaws.

Also noted for the filamentous skin projections on the head that give it a look of having long (if not too glamorous) eyelashes.

SUBORDER CALLIONYMOIDEI (DRAGONETS)

Spotted Dragonet aka **Psychedelic Mandarinfish**
Synchiropus picturatus (Callionymidae)
Dragonets

Distribution: NW Australia, Indonesia, Philippines.

Habitat: Over rubble patches and sandy bottoms of shallow, sheltered coral reefs 2–10 m. Hides secretively in coral rubble.

Appearance: Elongate, moderately depressed, broad-headed. Pale brown to green, covered with large dark spots ringed with orange and green, turquoise band markings around eye. Length to 7 cm.

Diet: Benthic invertebrates.

Reproduction and Development: In captivity frequently fight with opposite sex conspecifics.

Remarks: Spectacularly attractive, thus potentially a popular aquarium fish. That said, it is very difficult to maintain in captivity and has one of the highest mortality rates in the aquarium trade, though Steinhart specimens have done well.

Green Mandarinfish
Synchiropus splendidus (Callionymidae)
Dragonets

Distribution: Western Pacific.

Habitat: Shallow protected lagoons and inshore reefs to 18 m. Over silty substrates with

coral and rubble.

Appearance: Length to 6 cm. Body depressed, small head. Ground color green (rare individuals red). Body covered with dark blue blotches ringed with dark outlines. Pectoral fins, face yellow.

Diet: Benthic invertebrates.

Reproduction and Development: External fertilization. Open water egg scatterers.

Conservation Status: Heavily exploited in the Philippines for the aquarium trade.

Remarks: Mandarinfish produce mucous that is highly distasteful; their bright color is a warning to would-be predators to steer clear of this noxious beauty.

SUBORDER GOBIOIDEI (GOBIES)

Yellowfin Goby

Acanthogobius flavimanus (Gobiidae)
Gobies

Distribution: Native to Asia; introduced to Australia and the west coast of North America.

Habitat: Muddy and sandy bottoms in estuarine, marine and freshwater habitats. Found at depths of 1 – 14 m.

Appearance: Large head, pale brownish body with dark saddles and spots; length to 30 cm.

Diet: Smaller fish.

Reproduction and Development: Spawn in winter to early spring in estuaries; eggs are laid on the ceilings of y-shaped burrows constructed by the males. Male guards the eggs.

Mortality/Longevity: Males mature at 1 year, females at 2. Most live only 3 years.

Remarks: Used in Chinese medicine.

This goby is an invasive species which has partially replaced the Pacific staghorn sculpins in at least one location in California and extirpated the endangered tidewater goby from some bodies of water. Probably introduced in ships' ballast or contaminated oyster shipments.

Like all gobies, the yellowfin's pelvic fins are fused into a sucking disc enabling the fish able to cling to substrates or crawl into burrows.

Shrimp Goby aka Watchman Goby

Amblyeleotris sp. (Gobiidae)
Gobies

Distribution: Indo-Pacific.

Habitat: Areas of broken rubble or coarse sand.

Appearance: Typical goby body.

Diet: Sand-dwelling invertebrates, many of which are exposed by the shrimp's digging.

Mortality/Longevity: Preyed upon by other fishes.

Remarks: *Amblyeleotris* is the largest genus of shrimp gobies, a group well known for its symbiotic relationships with certain pistol shrimps of the genus *Alpheus*. The hard-working shrimp digs and maintains the burrow that is home to both, and the shrimp goby uses its superior eyesight to detect predators.

The shrimp, nearly blind, maintains contact with its visually superior partner via its antennae touching the goby's tail. If the goby flicks its tail, the shrimp retreats.

Randall's Prawn Goby

Amblyeleotris randalli (Gobiidae)
Gobies

Distribution: Western Pacific.

Habitat: Occurs on patches of carbonate sand of clear-water reefs.

Appearance: Whitish background with seven horizontal orange stripes, the first through the eye. Male sports a white-rimmed black eyespot on prominent dorsal fin. Max. length: 12 cm.

Diet: Zooplankton and small benthic invertebrates.

Reproduction and Development: Male attracts a female with his courtship "dance," stimulating the female to lay her eggs, usually in a hole in the sand. After fertilization, the male guards the eggs from predators. Successfully bred in captivity.

Mortality/Longevity: Life span: 5 to 8 years.

Remarks: Called a "prawn-goby" because it usually lives in a symbiotic association with one or more alpheid shrimps in a shared burrow. The shrimp builds and maintains the burrow, constantly clearing it of sand and rubble. When exposed, the shrimp rests an antennae on the fish, which quivers to alert the shrimp if danger lurks. Both then quickly retreat to cover in the burrow. Presently our

goby is living without the company of a crustacean companion.

Hector's Goby
Amblygobius hectori (Gobiidae)
Gobies

Distribution: Red Sea and Aldabra atoll east to Indonesia and Palau, north to SW Japan.

Habitat: Over sandy patches near base of reef formations, 3–30 m.

Appearance: Dark brown with 4 bright yellow stripes; black spot on first dorsal fin, yellow-edged black spot on second dorsal fin and black spot on dorsal base of tail. Length to 8.5 cm.

Diet: Stomach contents of one specimen included filamentous algae, copepods, amphipods, and nematodes.

Reproduction and Development: Demersal eggs are guarded by the male.

Remarks: Solitary. Lurks near shelter

Stripes through the eyes disguise them; eye spots on the tail may confuse predators into attacking a less vulnerable area.

Banded Goby
Amblygobius phalaena (Gobiidae)
Gobies

Distribution: Indo-Pacific from the Philippines to the Society Islands, southern Australia, throughout Micronesia.

Habitat: Coastal reefs and sandy lagoons from shallows of about 2 m to depths of 20 m.

Appearance: Head is greenish-yellow with blue and orange markings. The body is yellow with brown bands. Fin edges are fringed with dark blue.

Diet: Feeds by sifting mouthfuls of sand and expelling it through its gills filtering out small invertebrates, organic matter and large quantities of algae.

Reproduction and Development: Like most gobies, they live in pairs maintaining territories with several burrows for shelter and spawning. A paired female will guard her mate to prevent him from mating with other females. Once the eggs have been deposited on the ceiling of the burrow, the male stops feeding and tends them until the embryos hatch in 3–4 days. Both the paired female and male will show aggression toward any fish approaching their burrow.

Blackeye Goby
Coryphopterus nicholsii (Gobiidae)
Gobies

Distribution: Northern British Columbia to central Baja.

Habitat: Quiet water, usually in sandy areas near rocks. Intertidal to 100 m.

Appearance: Eye and tip of first dorsal fin black. Large scales. Fleshy ridge extending from area between the eyes to dorsal fin. Pale tan overall with small blue spot below the eye. Max. length: 15 cm.

Diet: Mostly zooplankton and small bentthic invertebrates.

Reproduction and Development: A protogynous hermaphrodite; forms permanent harem groups composed of a single male that defends a territory and several females. During spawning, which takes place between May–October, male prepares spawning site; after eggs are laid, male protects the nest.

Remarks: Defensive strategy is to freeze on the bottom; if a predator comes too close, the goby dashes for safety under a rock or to another protective spot.

Blue-Banded Goby
Lythrypnus dalli (Gobiidae)
Gobies

Distribution: Eastern Pacific coast of southern California to Baja California and the Gulf of California.

Habitat: Generally found in open rocky areas, but will retreat into crevices and holes. Prefers more exposed rocky areas to 75 m, but can be found in the intertidal area.

Appearance: Bright reddish-orange body and several iridescent blue vertical bars that narrow towards the rear of the body. Males have a higher first dorsal fin than the females. Typical of gobies, the pelvic fins unite to form a ventral suction disk. Adult length: 6 cm.

Diet: Mainly small crustaceans.

Reproduction and Development: Hermaphroditic, having the reproductive organs of both sexes but displaying only one behavioral gender at any given time. If it is unsuccessful as one gender, it can switch to the other sex. The male blue-banded goby selects a cave in which to care for his brood, courts a female by rapidly darting at her several times

with his dorsal fin fully extended until she deposits the eggs. The territorial male will then guard the eggs, which are attached to the walls of the brood chamber.

Conservation Status: Prolific, not endangered.

Remarks: When threatened, often hides among the spines of sea urchins.

Barred Mudskipper

Periophthalmus argentilineatus (Gobiidae)
Gobies

Distribution: Indo-Pacific: southern Red Sea to South Africa, east to Marianas and Samoa, north to southern Japan, south to western Australia and Oceania.

Habitat: Brackish mudflats in mangrove areas. Typically found resting on mud, rocks, or mangrove roots with its tail dipped in water.

Appearance: Eyes on top of head, mouth directed downward. Silvery bars on lowers sides. Strong pectoral fins enable it to lift its body from the surface and move about. Partially fused pelvic fins create a suction disk, a feature common to gobies. Max. size: 15 cm.

Reproduction: Construct deep burrows in the mud where they sleep and breed. Females deposit eggs in the burrow and then are driven out by the male, who tends the eggs and often aerates them by bringing down mouthfuls of air that he relases inside the brooding chamber.

Diet: Worms, crustaceans, insects. Active predators that sport sharp teeth

Remarks: Actively shuttles back and forth between rock pools and air.

Amphibious air-breather, the mudskipper is able to take in oxygen through the skin and the lining of the mouth and throat, where rich networks of capillaries absorb oxygen and release carbon dioxide, rather like a lung. The animal also has large gill chambers that retain water, can be tightly closed, and so supply oxygen to the gills even when the animal is out of water.

When disturbed, it can jump away from danger by flipping itself with its muscular pectoral fins.

The genus name refers to its large and mobile eyes, *peri* meaning "all around" (think periscope, and *ophtalmos* meaning "eye."

Bluestreak Goby

Valenciennea strigata (Gobiidae)
Sleeper Gobies

Distribution: Indo-Pacific Ocean, East Africa to Australia, and north to Southern Japan.

Habitat: Shallow reef habitat, usually 1–6 m, but have been found at depths of 25 m. Commonly seen in clear lagoons over hard or sandy bottoms, usually in pairs, hovering around their burrow.

Appearance: Light gray dorsally and white ventrally with a yellow head; black-edged blue stripe from the mouth to the rear of the operculum, a short blue dash behind the eye, and several curved markings on the lower sides of the head. Max. length: ~18 cm.

Diet: Benthic invertebrates, fishes, and fish eggs.

Reproduction and Development: Males and females bond for life. (The male has an elongated second dorsal spine that distinguishes it from the female.) A female will generally lay about 2000 eggs on the roof of the nesting chamber. She will tend the eggs for three weeks, during which time she will not leave the chamber. Just before hatching occurs the male will close the entrance to the chamber, sealing in the female. After the eggs have hatched, the male will reopen the chamber, at night, freeing the 2-millimeter fry.

Remarks: Like many other goby genera, *Valenciennea*, commonly called sleeper gobies, have the habit of resting on the substrate for long periods. Sleeper gobies, however, often float motionless just above the substrate, and so are sometimes called "hover gobies."

Members of the genus are carnivorous sand-shifters, a fancy name that describes their habit of taking in mouthfuls of sand, using specialized structures in their gills to extract small invertebrates, and then expelling the sand.

Firefish Goby

Nemateleotris helfrichi (Ptereleotridae)
Dartfishes

Distribution: Central Pacific.

Habitat: Occurs on or near reefs, in relatively deep water, 25–90 m, over small patches of sand, rubble, or hard open bottoms of steep

seaward reefs.

Appearance: Yellow head and lavender body; yellowish rear dorsal, anal, and tail fins; long white and red first dorsal spine. Female tends to be smaller and thinner than the male. Max length: 6 cm.

Diet: Zooplankton.

Reproduction and Development: Egg layer. Monogamous, frequently found in pairs.

Remarks: Dartfishes are timid and require lots of cover, including a sandy substrate for burrowing and rocky rubble into which they "dart."

Zebra Goby
Ptereleotris zebra (Ptereleotridae)
Dartfishes

Distribution: Indo-Pacific: Red Sea and islands in the western Indian Ocean, north to the Ryukyu Islands, south to the southern Great Barrier Reef and parts of Micronesia.

Habitat: Exposed seaward reefs, in shallow water over hard bottoms. Usually found at depths between 2–4 meters.

Appearance: Long and slim with large slanted mouths. Yellowish to greenish gray in color. The area from the lower half of eye to the chin is enclosed by a broad blue-edged dark red to purple area. The pectoral fin base has an orange-red bar broadly bordered with bright blue. The fins are yellowish.

Diet: Zooplankton. Small schools hover several feet above the substrate capturing morsels the current carries to them.

Reproduction and Development: Very little known about reproduction. They are probably monogamous, since they are often found in pairs.

Remarks: In captivity they are jumping fish and should be kept in a covered aquarium.

The common name of the genus is "dartfish," derived from the group's habit of darting between rocks or into rubble when frightened.

Ptereleotris spp. usurp the burrows of alpheid shrimp, like the pistol shrimp in the Commensal Cluster, or *Valenciennea* gobies, like its tank mate the bluestreak goby.

SUBORDER ACANTHUROIDEI (SURGEONFISHES, RABBITFISHES, UNICORNFISHES AND MOORISH IDOL)

Blue Spotted Spinefoot
Siganus corallinus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Indo-West Pacific.

Habitat: Often among corals of lagoons and protected reefs at 3–30 m.

Appearance: Head, body, and fins orange-yellow with many small blue spots on the head and body. Max. size: 30 cm.

Diet: Benthic algae. Diurnal feeders, like all members of the genus.

Reproduction and Development: Pelagic spawner.

Remarks: Adults are often seen in pairs, as in our exhibit.

Like all rabbitfishes, have small, rabbit-like mouths, large dark eyes, and a shy temperament, thus their common name.

Rabbitfishes have fin spines with venom glands that can inflict painful, though not life-threatening wounds; aquarists should take care as the genus is easily frightened and readily takes defensive action.

Barred Spinefoot aka Scribbled Rabbitfish
Siganus doliatus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Tropical west Pacific.

Habitat: Coral rich areas of channels and lagoon slopes, reef flats and seaward reefs. Depth 1–15 m.

Appearance: Length to 25 cm. Light blue body above, silvery below with intricate patterns of thin blue and yellow lines; pair of brown bars on head and forebody; yellow tail.

Diet: Algae and other plant matter.

Reproduction and Development: Juveniles form schools. Pairs form at 7 cm; but these pairs continue to form loose schools to feed in areas being flooded by the tide.

Remarks: Usually in male/female pairs.

Fin spines are venomous.

Named rabbitfish due to their voracious appetite.

Orange Spotted Spinefoot
Siganus guttatus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: East Indo-Pacific.

Habitat: To 25 m in inner lagoons, turbid coastal reefs, mangroves and brackish waters. Typically in large groups of conspecifics.

Appearance: Length to 42 cm. Pale grey with numerous orange-gold spots; large yellow spot on caudal peduncle below base of dorsal fin.

Diet: Algae and seagrasses, though known to nip on large-polyp stony corals as well as soft corals.

Reproduction and Development: Spawners.

Mortality/Longevity: Highly esteemed as a food fish.

Remarks: The spines of rabbitfishes (Siganidae) are venomous, and can inflict painful wounds.

Common name "rabbitfish" is due to their voracious appetites for browse. The orange-spotted rabbitfish in the Steinhart coral reef tank at Howard Street left the large *Sarcophyton* soft corals with bare spots where the fish fed.

Gold Spotted Spinefoot
Siganus punctatus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Tropical Western Pacific.

Habitat: Clear lagoon and seaward reefs from 1–40 m. Adults typically paired. Juveniles in groups to 50 individuals.

Appearance: Length to 40 cm. Highly compressed body. Blue, with numerous dark edged orange spots on the head and caudal fin.

Diet: Benthic algae.

Reproduction and Development: Fertilization external. Spawn in pairs.

Remarks: Like all rabbitfishes, possess venomous spines.

Adults usually swim together as a pair.

Masked Spinefoot
Siganus puellus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Indo-West Pacific.

Habitat: Shallow, coral-rich areas of lagoons and seaward reefs to 30 m. Adults often in pairs; species forms large schools in shallows, lagoons and outer reef flats, particularly in areas dominated by luxurious growths of *Acropora* coral.

Appearance: Length to 38 cm. Highly compressed body yellow with wavy, broken blue lines. Dark band from eyes to mouth. Dark dots extend from eyes to dorsal fin.

Diet: Juveniles feed on filamentous algae; adults on algae, tunicates, and sponges.

Remarks: Venomous spines, which can be flashed at any bothersome fish or hand.

Blotched Foxface Rabbitfish
Siganus unimaculatus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Western Pacific: Ryukyu Islands of Japan, the Philippines, south to western Australia.

Habitat: Coral rich areas of lagoons and seaward reefs to depths of 30 m.

Appearance: Same as the Foxface Rabbitfish (*S. vulpinus)* except for the black spot or 'blotch" on posterior upper side of body. Max. length: 20 cm.

Diet: Seaweeds.

Reproduction and Development: Pelagic spawner.

Remarks: Some researchers believe ***S. unimaculatus*** and *S. vulpinus* are a single species.

All siganids have venomous spines on dorsal and anal fins.

Barhead Spinefoot aka **Varigate Rabbitfish**
Siganus virgatus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Indo-West Pacific.

Habitat: Usually shallow, inshore coastal reefs, often in turbid water to 12 m. Juveniles are found in mangrove lagoons and are known to enter freshwater.

Appearance: Yellow above, white below with yellow dorsal and caudal fins; blue markings on head and back. Eyes masked by a black stripe that extends from the bottom of the mouth to the top of the head, and a second black stripe behind the gill cover. Max. length: 30 cm.

Diet: Benthic algae.

Reproduction and Development: Pelagic spawner.

Mortality/Longevity: Stout venomous spines discourage would-be predators.

Foxface Rabbitfish
Siganus vulpinus (Siganidae)
Rabbitfishes and Spinefoots

Distribution: Tropical Western Pacific.

Habitat: Coral-rich areas of lagoon and seaward reefs to 30 m. Juveniles school among branching corals. Adults usually found in pairs.

Appearance: Length to 24 cm. Highly compressed yellow body, face white with two vertical, broad chocolate bands. Long snout.

Diet: Diurnal herbivore of algae and zooplankton.

Reproduction and Development: Spawns during outgoing tides.

Remarks: Highly esteemed as a food fish.

Moorish Idol
Zanclus cornutus (Zanclidae)
Moorish Idol

Distribution: Indo-Pacific. Southern Gulf of California.

Habitat: Hard substrates from turbid inner harbors and reef flats to clear seaward reefs as deep as 182 m. Usually in small groups of conspecifics, occasionally in schools of more than 100.

Appearance: Length to 23 cm. Discoid body, tubular snout, dorsal spines elongated into a very long white whip-like filament. Broad vertical white, black, white-yellow black, yellow banding. Tail black with white margin Black stripes break up the body outline and hide the eye from predators.

Diet: Primarily sponges. Also consumes tunicates, other benthic invertebrates, and algae.

Reproduction and Development: Has a long larval phase and settles at a large size (6 cm), resulting in its very wide geographic distribution.

Remarks: The moorish idol was the icon of the Golden Gate Park Steinhart Aquarium since 1923..

Gill, the leader of the tank fish in *Finding Nemo*, with the voice of Willem Dafoe, is a moorish idol.

Achilles Tang aka **Achilles Surgeonfish**
Acanthurus achilles (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Indo-Pacific.

Habitat: Clear seaward reefs, primarily in the surf zone to 4 m. Usually in small groups.

Appearance: Length to 24 cm. Ovate compressed body black with a large orange caudal spot. Caudal fin has a broad vertical orange band.

Diet: Diurnal herbivores of filamentous and small fleshy algae.

Reproduction and Development: Spawners. Juveniles lack the orange spot.

Mortality/Longevity: An important food fish on tropical islands.

Remarks: Highly territorial.

"Tang" in British dialect means dagger or knife. Thus the common name refers to the caudal peduncle spines.

Single scalpel-like peduncular spine folds into a groove on each side of the tail. Spines are used offensively or defensively, against conspecifics in struggles for dominance or against predators.

Whether a fish has a common name of "surgeonfish" or "tang" seems to be a matter of convention, not substance.

The generic name comes from the Greek *acantha* ("thorn") and *oura* ("tail")

Ringtail Surgeonfish
Acanthurus blochii (Acanthuridae)

Distribution: Indo-Pacific: East Africa to the Hawaiian Islands, south to Australia.

Habitat: Lagoon and outer reef, 2–15 m.

Appearance: Blue-gray to light brown; yellow spot behind the eye. Dark blue dorsal, anal, and caudal fins with narrow lighter blue margins. Often display a white ring around the base of the tail. Max size: 45 cm.

Diet: Graze on algae.

Blue Tang
Acanthurus coeruleus (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: New York (rare north of Florida), Bermuda, Northwest Gulf of Mexico south to Brazil, east to Ascension Island.

Habitat: May be solitary, but typically in large schools over rocky areas or coral reefs, 2–40 m. Often school with other species of surgeonfishes.

Appearance: Length to 39 cm. Juveniles yellow, subadults blue with yellow tails. Adults blue, laterally compressed, more circular than other surgeonfish.

Diet: Graze on algae.

Reproduction and Development: External fertilization. Open water/substratum egg scatterers. Adults do not guard eggs. Males mature at 11 cm, females at 13 cm.

Remarks: Adults can quickly change color from powder blue to deep purple, or become paler or darker.

Eyestripe Surgeonfish

Acanthurus dussumieri (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Indo-Pacific: from East Africa to Hawaii and the eastern Central Pacific. Also from southwest Japan to the Great Barrier Reef. Absent from most of the Central Pacific.

Habitat: Adults are found mainly on deep coastal reef slopes and outer reef walls, often on deep shipwrecks. Depth ranges from 4–130 m.

Appearance: Bluish to brownish body with horizontal line markings; yellow stripe through eye, blue tail with numerous black spots; white caudal spine with the socket edged in black. Typically seen as a solitary fish but may also occur in small groups. Max. size: 50 cm.

Diet: Grazes algae from reefs and sand.

Reproduction and Development: Reported to be a pair spawner; eggs are small and pelagic.

Remarks: Surgeonfish are able to slash other fishes with their caudal spines by a rapid side-sweep of the tail.

The eyestripe surgeonfish reputedly has a strong odor when cooked. The Hawaiian name for this fish is *palani* and a Hawaiian riddle based on this name means "odor reaching to heaven."

This species can quickly change its coloration to a much darker shade that obscures the yellow and markings.

Powder Brown Tang

Acanthurus japonicus (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Asian-Pacific: Sulawesi to Philippines, SW Japan.

Habitat: Clear lagoons and shallow (2–12 m) seaward reefs.

Appearance: Like all surgeonfish, are colorful, thin-bodied, oval shaped. Typically have long continuous dorsal and anal fins and crescent-shaped caudal fins.

Brownish body with white patch on check between eyes and mouth; pectoral, anal, and dorsal fins brown with blue highlight at tip. Orange band on last third of dorsal fin. Yellow stripes along base of dorsal and anal fins, tail blue with yellow bar. Length to 21 cm.

Diet: Algae.

Reproduction and Development: Group spawner.

Lined Surgeonfish

Acanthurus lineatus (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Indo-Pacific from East Africa north to southern Japan and south to New South Wales, Australia.

Habitat: Usually found on exposed outer reef areas at depths of 1–3 m.

Appearance: Compressed, disc-like body with a large venomous, scalpel-like spine on each side of the caudal peduncle. Body is yellowish green, with bright blue stripes edged with black most pronounced on the flank. The stripes on the belly are lavender blue to bluish. The pelvic fins are bright orange. Length to 38 cm.

Diet: Herbivorous, browses on algae. Large males patrol defined feeding areas and maintain harems of females.

Reproduction and Development: Migrates to and spawns in aggregations at specific sites, although they sometimes spawn in pairs. Spawning occurs year-round at lower latitudes but may be seasonal at higher latitudes. The eggs and larvae are pelagic.

Mortality/Longevity: Can live 30 to 45 years.

Remarks: The caudal spines are very effective defense mechanisms for surgeonfish. They are razor sharp and useful weapons against attack.

The lined surgeonfish was first described in 1758 by Carl Linnaeus.

Mata Tang

Acanthurus mata (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Red Sea and East Africa to French Polynesia; southwest to Japan, Great Barrier Reef, New Caledonia.

Habitat: Frequently inshore in turbid water, as well as outer reefs in depths 5–100 m. Usually in groups of conspecifics.

Appearance: Length to 50 cm. Compressed, pale to dark bluish body with numerous dark

to blue horizontal lines. Yellow dorsal fin, upper lip and band across eyes.

Diet: Group grazer upon plankton.

Reproduction and Development: Form resident spawning aggregations mid-water.

Conservation Status: IUCN: Not Evaluated. Reported to be moderately to highly vulnerable to extinction in the scientific press.

Remarks: Marketed as a food fish.

Whitecheek Surgeonfish aka **Goldrim Tang**

Acanthurus nigricans (Acanthuridae)
Surgeonfishes and Unicornfishes

Distribution: Eastern Indian Ocean and throughout the tropical Pacific, including Indonesia and the Philippines, eastward as far as Hawaii, Galapagos and coast of Mexico.

Habitat: Hard substrates of clear lagoon and especially exposed reefs to 67 m.

Appearance: Length to 21 cm. Body dark brown, navy-blue or black. Tail white with yellow bar; white patch below eye, white ring behind mouth; yellow line at base of anal and dorsal fins; yellow tail spine.

Diet: Filamentous algae.

Reproduction and Development: Monogamous. Following external fertilization, female scatters eggs over substrate. Hatched larvae join the plankton.

Remarks: Territorial.

Bluelined Surgeonfish

Acanthurus nigroris (Acanthuridae)

Distribution: Indo-Pacific: East Africa to Hawaiian Islands.

Habitat: Clear lagoons and outward reefs to 90 m.

Appearance: Dark brown body with numerous blue stripes in scroll patterns on face and chest, more horizontal on body. Dark peduncular spine and tail. Small but distinctive black spots on rear base of both dorsal and anal fins. A small surgeonfish; max. size: 25 cm.

Diet: Filamentous algae, diatoms, fine algal film.

Reproduction and Development: Pelagic spawner.

Remarks: Solitary or forms small groups.

Orangeband Surgeonfish aka **Orange Shoulder Tang**

Acanthurus olivaceus (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Eastern Indo-Pacific.

Habitat: Near reefs over sand, bare rock and rubble substrates, 3–45 m. Juveniles inhabit protected bays and lagoons in depths as shallow as 3 m. Adults occur singly or in schools.

Appearance: Juveniles less than 6 cm are yellow, subadults become a dirty yellowish-brown. At 12 cm have the adult coloration: light gray head and forebody, dark gray behind; blue-edged elliptical orange band behind upper gill cover. Length to 35 cm.

Diet: Diurnal feeder on surface film of detritus, diatoms and filamentous algae covering sand and rocks.

Reproduction and Development: Spawn, typically at dusk.

Mortality/Longevity: An important food fish.

Mimic Surgeonfish

Acanthurus pyroferus (Acanthuridae)
Surgeonfishes and Unicornfishes

Distribution: Indonesia, Philippines, Micronesia to French Polynesia; southwest Japan to New Caledonia and the Great Barrier Reef.

Habitat: Lagoon and seaward reefs from 4–60 m. Prefers areas of mixed coral, rock or sand near base of reefs. Often observed on silty reefs.

Appearance: Length to 25 cm. Adults have a purplish-black to brown body; curving black band from chin to upper edge of the operculum; orange patch above base of pectoral fin. Front of juvenile's body ("face") is gray; body is white anteriorly and dark posteriorly. Dark-colored caudal fin rounded in juveniles.

Diet: Algae.

Reproduction and Development: Following external fertilization female scatters eggs over open water substrate; eggs not guarded.

Remarks: The common name "mimic" is based on the juvenile coloration; juveniles exhibit three different color patterns mimicking angelfish in the *Centropyge* genus. Coloration of juveniles mimics these angelfishes until they achieve the largest size attained by the angelfishes; then their appearance transforms to the appropriate adult coloration for *A. pyroferus*. Presumably

there is an advantage to mimicking an angelfish which possesses a sharp, preopercular spine when this young surgeonfish and its peduncular spines are quite small.

Convict Tang aka **Convict Surgeonfish**
Acanthurus triostegus (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Indo-Pacific.

Habitat: Juveniles in tide pools. Adults in lagoon and seaward reefs in areas of hard substrates from sea level to 90 m; typically occur in shallows to 5 m.

Appearance: Length to 27 cm. White with 5–6 black bars on head and body.

Diet: Filamentous algae.

Reproduction and Development: Spawn at sunset within small groups that break away from a huge milling aggregation of conspecifics at a reef edge or channel entrance. Pelagic eggs. Larvae drift ~75 days. Post-larvae settle in intertidal areas of benches and reef flats.

Mortality/Longevity: Eggs and sperm are preyed upon by eagle rays, which are often present during spawning.

Remarks: Ubiquitous, one of the most widespread coral reef species. May be solitary, in small groups or in schools of 1,000 or more.

This black-barred fish's common name presumably alludes to the coloration of many prison uniforms of the previous century.

This species has a very small caudal spine and therefore is near the gutter of the "acanthurid pecking order." Thus they usually feed in large, roving aggregations which overwhelm the defenses of territorial herbivores.

Goldring Bristletooth aka **Spotted Surgeonfish**
Ctenochaetus strigosus (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Central Pacific.

Habitat: Coral-rich areas of deep lagoon and seaward reefs.

Appearance: Brown with pale yellow spots on head and pale yellow pinstripes on body. Conspicuous, broad yellow ring around the eye. Max. length: 15 cm.

Diet: Feeds on algae and detritus using its comb-like teeth.

Reproduction and Development: Pelagic spawner.

Remarks: The genus *Ctenochaetus* (bristletooths) have differently shaped mouths than *Acanthurus* species. The latter group have lips and dentition suitable for snipping off the tips and branches of algae. Bristletooths feed on detritus and unicellular algae from the surfaces of dead coral, rock, seagrasses, or other algae, using specialized bristle-like teeth to scrape off their meal and then suck it into the mouth. Both groups are favorites of aquarists for their tank-cleaning services.

Their diet may contain high concentrations of the dinoflagellates that produces ciguatera toxin, and so bristletooths and their predators are known to sometimes concentrate sufficient toxin to cause illness in humans.

Tomini Tang
Ctenochaetus tominiensis (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Western Central Pacific, including Indonesia, Philippines, to northern Great Barrier Reef.

Habitat: Steep coral drop-offs of sheltered coasts.

Appearance: Brown with pale lower head. The only species of *Ctenochaetus* (bristletooths) with angular dorsal and anal fins; outer portion of these fins is a bright orange. Caudal fin white. Max length: 15 cm.

Diet: See Goldring Bristletooth remarks above.

Reproduction and Development: Pelagic spawner.

Spotted Unicornfish
Naso brevirostris (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Indo-Pacific: East Africa to the Hawaiian Islands, north to southern Japan, south to Australia.

Habitat: Mid-waters along steep outer lagoon and seaward reef drop-offs, from 4–45 m.

Appearance: Olive-brown to blue-grey with dark spots on head and vertical rows of spots and lines on sides. Tail whitish with dark area at base. Long, tapering horn on forehead of adults is lacking in juveniles. Max length: 60 cm.

Diet: Juveniles: benthic algae; adults: mainly zooplankton.

Reproduction and Development: Pelagic spawners.

Remarks: Unicornfishes (*Naso* spp.) are characterized by 2 sharp, fixed (not moveable as in surgeonfishes), keel-like plates on the caudal peduncle. The skin is leathery with tiny non-overlapping scales, and teeth have finely serrate edges.

Males of many *Naso* species are able to display spectacular iridescent markings during courtship.

Orangespine Unicornfish
Naso lituratus (Acanthuridae)
Surgeonfishes, Tangs, and Unicornfishes

Distribution: Indo-Pacific.

Habitat: Over coral, rock or rubble of lagoon and seaward reefs from the lower surge zone to 90 m.

Appearance: Length to 46 cm. A hornless unicornfish, despite the common name. Coloration varies among populations. Ovate compressed body typically black with yellow dorsal fin and orange anal fin. Face white, prominent vertical black stripe from eyes to mouth.

Diet: Primarily leafy brown algae.

Reproduction and Development: External fertilization, open water pair spawning. Non-guarders.

Bluespine Unicornfish
Naso unicornis (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Indo-Pacific.

Habitat: Inhabits channels, moats, lagoons and seaward reefs with strong surge. Typically occurs in small groups at depths of 1–80 m.

Appearance: Body color gray to olive , tail spines blue, Short forehead horn does not project past mouth. Adult males tend be larger and have better developed horn, peduncular spines, and caudal filaments than females. Length to 70 cm.

Diet: Diurnal feeders on macro- and microalgae, including brown algae like *Sargassum*.

Reproduction and Development: External fertilization. Pair-spawning has been observed; pelagic larvae.

Mortality/Longevity: An important food fish on most tropical islands. Long-lived, up to 35 years. Preyed upon by other fishes.

Remarks: Rostral horn responsible for species' common name.

Surgeonfishes have a single scalpel-like peduncular spine which folds into a groove while unicornfishes have 1 or 2 sharp, fixed keel-like peduncular plates.

The spines are used both offensively and defensively.

Bignose Unicornfish aka **Bumphead Naso**
Naso vlamingii (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Indo-Pacific.

Habitat: Deep lagoon and seaward reefs from 4–50 m.in conspecific groups off steep slopes.

Appearance: Length to 60 cm. Adults develop a convexly rounded prominent snout and extremely tall dorsal and anal fins. Gray ovate compressed body with bright blue markings. Tips of the tail fin are unusually long.

Diet: Zooplankton.

Reproduction and Development: External fertilization. Egg scatterers, non-guarding.

Remarks: Courting males are able to instantaneously turn iridescent blue.

Flagtail Surgeonfish aka **Hepatus Tang**
Paracanthurus hepatus (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Indo-Pacific.

Habitat: Clear, current-swept terraces of seaward reefs, 2–40 m. Typically in loose groups 1–3 m above substrate. Shelters among branches of *Pocillopora* corals or in crevices of rocks.

Appearance: Ovate, compressed blue body. Tail and pectoral fins yellow. Black oval extends under dorsal fin to caudal peduncle. Length to 31 cm.

Diet: Zooplankton.

Reproduction and Development: Fertilization external. Open water egg scatterers on substrate. Nonguarders.

Remarks: Single scalpel-like peduncular spine used offensively or defensively against conspecifics in struggles for dominance or against predators.

Dory, the co-star of *Finding Nemo*, with the voice of Ellen DeGeneres' "spaced-out" fish, is a hepatus tang. Most kids now recognize this fish as Dory.

Taken for commercial and aquarium trade.

Brown Scopas Tang
Zebrasoma scopas (Acanthuridae)
Surgeonfishes, Tangs, Unicornfishes

Distribution: Widespread throughout the

Indo-Pacific from Africa to Japan.

Habitat: Lagoons and outer reefs to 50 m. Particularly well suited to large aquaria where they can roam.

Appearance: Males and females similar. Color can be variable; most often shades of gray and brown with a greenish tinge running along the dorsal spine; "scalpels," which are used against rivals, are white (Gr. *Acanthus* means "thorn" or "spine"). Length to 20 cm.

Diet: Predominantly herbivorous in the wild, but eats many different foods in captivity.

Reproduction and Development: Mate in groups, scattering eggs and sperm into the water column.

Remarks: *Zebrasoma* is a small genus of tangs characterized by round, laterally compressed bodies, large dorsal sail-like fins, and pointed snouts. Because of their snouts, they are able to eat filamentous algae that grow in spots other fishes cannot reach, a talent that also makes them popular in aquariums large and small.

Interestingly, *Zebrasoma* are known to irritate some stony corals to induce the release of zooxanthellae, evidently a sailfin delicacy.

Territorial and sometimes aggressive toward other fish, especially other sailfins.

Pacific Sailfin Tang

Zebrasoma veliferum (Acanthuridae)
Surgeonfishes, Tangs and Unicornfishes

Distribution: Western Pacific Ocean.

Habitat: Lagoon or outer reef to 45 m. Solitary or in small groups. Juveniles inhabit sheltered inshore areas.

Appearance: Length to 40 cm. White bars alternate with grey/brown bars with pale bands. Displaying its enormous fins will more than double the size of this fish. Juveniles have alternating yellow and black bars.

Diet: Small leafy algae growing around rock and coral.

Reproduction and Development: Spawn in pairs and groups. Larvae planktonic.

Mortality/Longevity: Relatively long-lived, to about 25 years; eaten by sharks and other fishes.

Remarks: Shelter on the reef at night.

The extended pelagic larval period of *Zebrasoma* spp. accounts for their broad distribution, but has also kept them from being bred in captivity as yet.

Like many other species of fish, use pheromones to communicate with conspecifics.

Like most *Zebrasoma* spp., contain ciguatoxins that can be poisonous to humans if eaten; spines can inflict deep, painful wounds.

SUBORDER ANABANTOIDEI (LABYRINTHFISHES)

Whiteseam Betta

Betta albimarginata (Osphronemidae)
Labyrinthfishes

Distribution: Known only from the Sebuku basin in Borneo, Indonesia.

Habitat: Forest streams with moderate current, especially in shallow water (5–10 cm deep) among plant roots and leaf litter of shore margins.

Appearance: Males have dark fins trimmed in white, and are more intensely colored than the relatively drab females. Max. length: c. 4 cm.

Diet: Small insects and various zooplankton.

Reproduction and Development: Paternal mouth brooder. The female stakes out a territory and initiates spawning, flaring her fins and coaxing the male into the typical betta side-by-side embrace. The female then deposits her eggs, the male fertilizes them and scoops them into his mouth for protective brooding for the 12 or so days before they hatch and he spits out the fully formed fry. At least in captivity, older fry from a previous spawn may eat their younger siblings.

Remarks: All species in the suborder Anabantoidei possess an accessory breathing organ known as the labyrinth organ, highly vascularized, folded flaps of skin that allow the fish to take in atmospheric air when water is oxygen deficient.

This betta lacks the brilliant colors and flowing, dramatic fins of the "figthing bettas" that have been selectively bred for these features over generations. In the wild, speed and agility are more important than color and beauty.

Siamese Fighting Fish

Betta splendens (Osphronemidae)
Gouramis and their Allies

Distribution: Thailand, (formerly Siam, thus their name), Indonesia, Malaysia, Vietnam, and

parts of China.

Habitat: Shallow, warm freshwater of rice paddies, ponds, and slow moving streams.

Appearance: Usually grow to about 5cm, though some varieties reach 30 cm in length.

Known for brilliant colors (red, blue, turquoise, orange, yellow, and green, as well as marbled patterns and metallic shades) and large, flowing fins.

Diet: Carnivorous surface feeder (note the upturned mouth); in the wild feeds on insects and insect larvae.

Reproduction: When ready to spawn, the male builds an elaborate bubble nest at the water's surface. He will posture with flared gills, twist his body and spread his elaborate fins if interested in a female. She will darken in color, and curve her body back and forth. The male then wraps his body around the female in a "nuptial embrace." Some 10–40 eggs are released during each embrace, until the female is exhausted of eggs. The male fertilizes them, retrieves the sinking eggs in his mouth, and deposits them in the bubble nest which he guards and tends. Incubation lasts for 24–36 hours, and the newly-hatched fry remain in the nest for 2-3 days before swimming free. Juveniles can reach sexual maturity at 3 months.

Mortality/Longevity: Life span: 2-5 years in captivity.

Conservation Status: Not at risk; bred successfully around the world for the aquarium trade. Breeders continue to develop new varieties, often crossing species to enhance colors, fin size, and combativeness.

Remarks: *Betta splendens* has been nicknamed "The Jewel of the Orient" due to its beauty and wide range of colors.

Males are highly territorial and aggressive, especially toward trespassing rivals. They are known to respond aggressively even to their own reflections in a mirror! Therefore, only one male should be kept in aquarium tanks. Several females and other compatible fishes can complete a peaceful community.

Females will flare their gills at other females, especially when setting up a pecking order.

Like their allies the gouramis, bettas possess a lung-like labyrinth organ that allows them take in oxygen directly from the air, an important adaptation for fishes that live in warm, shallow, oxygen-poor water. They can live out of water for several hours if necessary.

Striped Betta

Betta taeniata (Osphronemidae)
Gouramies

Distribution: Borneo; may also be found in other parts of South East Asia.

Habitat: The upper parts of fast flowing rivers and clear-water streams, especially in shallow areas with vegetation where it hides when threatened.

Appearance: An elongated fish with short, rounded fins. Males: brownish color; small iridescent green scales around the head and a black horizontal bar across the face close to eye level. Lower body and fins have a green or bluish iridescence. The female is smaller and less colorful. Length: c. 7 cm.

Diet: Omnivore.

Reproduction and Development: Paternal mouth brooders. During courtship, the male's body becomes an iridescent red Between 200 to 300 eggs are laid and fertilized, then the female spits them into the male's mouth. The female defends the male and the territory during incubation which lasts about 9–12 days.

Mortality/Longevity: Life span: c. 4 years.

Remarks: These fish puff out when aggravated or to intimidate other males while attracting females.

When threatened, they can lighten or darken their color in seconds creating horizontal or vertical dark bars depending on the degree of danger.

They have been kept in Thai households in aquariums since the 1200s, in Europe since the 1800s.

Pearl Gourami

Trichogaster leeri (Osphronemidae)
Gouramies

Distribution: Asia: Malay Peninsula, Thailand and Indonesia, including Borneo.

Habitat: Small flowing rivers and lakes in areas of dense vegetation.

Appearance: Has filamentous pelvic fins. Large anal fin extends from just behind the pelvic fins almost to the caudal fin. Length to 12 cm.

Diet: Omnivorous; small invertebrates and plants.

Reproduction and Development: All gouramis build nests of small air bubbles that vary in size, shape, and position depending on the species. Some may incorporate plants; others are only bubbles.

Remarks: Common name comes from the small, light spots that cover the body like iridescent "pearls.

Moonlight Gourami

Trichogaster microlepis (Osphronemidae)
Gouramies

Distribution: Thailand and Cambodia.

Habitat: Lives in ponds, lakes and swamps with shallow, sluggish or standing water and abundant vegetation.

Appearance: It has a greenish hue similar to moonlight glow, hence its name, and a distinctive concave head. Males can be identified by the orange to red color of the pelvic fins and the long, pointed dorsal fins. The female's pelvic fins are colorless to yellow, while the dorsal fins are shorter and rounder. Length: 12–15 cm.

Diet: Omnivore. Eats insects, crustaceans, and zooplankton.

Reproduction and Development: Oviparous; a bubble nest builder. The bubble nest does not contain much plant matter so the bubbles float around freely. The male performs a courtship dance beneath the nest, culminating with the male wrapping itself around the female and turning her on her back as she releases her eggs. Up to 2000 eggs may be laid during the spawning. The male fertilizes the eggs as they float up to the prepared bubble nest. Eggs incubate in the nest for 2–3 days before hatching.

Remarks: Like all gouramis, has a lung-like organ that allows it to breathe air directly by gulping at the surface, an ability that increases survival in low oxygen situations.

Blue Gourami

Trichogaster trichopterus **(Belontiidae)**
Gouramies

Distribution: Southeast Asia: Mekong River basin in Laos, Yunnan, Thailand, Cambodia, and Viet Nam

Habitat: Preference is thickly vegetated fresh water in ditches, canals, ponds, swamps, rivers or lakes.

Appearance: The three-spot gourami displays only two spots, one in the center of the body and a second on the caudal peduncle. The eye is actually the third "spot". Their scientific name refers to the long pelvic fins that seem like "hair" (Gr. *trichias*) "wings" (Gr. *pteron*). Length to 15 cm.

Diet: Omnivorous

Reproduction and Development: Typical of gouramies, male builds bubble nest, usually under a large leaf, after which he displays to female. Their courtship ends with her releasing eggs, which the male fertilizes and then collects in his mouth and "spits" into the bubble nest, where he guards them until they hatch in 2–3 days.

Remarks: Like all gouramies, have a labyrinth organ just behind the gills that enables these fish to breathe air and so inhabit water low in oxygen. You may see them regularly come to the surface, release an air bubble, or swallow air."

ORDER PLEURONECTIFORMES (FLATFISHES)

Pacific Sanddab

Citharichthys sordidus (Paralichthyidae)
Large-tooth Flounders

Distribution: Bering Sea to Cabo San Lucas, Baja California.

Appearance: Flatfish; left-eyed, bottom dwelling. Eyed side mottled brown, blind side light. To 40 cm long. Similar to speckled sanddab though are darker with yellow, orange, or reddish-brown rather than black spots.

Habitat: Sandy bottom, most commonly from 45–140 m, though reported as deep as 550 m.

Diet: Opportunistic feeders: small fishes, mollusks, marine worms, sea squirts, copepods. Often swim above the bottom to feed.

Reproduction and Development: Spawn from July through September, possibly multiple times.

Mortality/Longevity: Sharks, rays, marine mammals and a variety of seabirds are among their predators. Older specimens probably live in excess of 11 years.

Remarks: They are a popular food fish taken by both commercial and sport fishermen. Common in San Francisco Bay and the Gulf of the Farallones.

Speckled Sanddab

Citharichthys stigmaeus (Bothidae)
Lefteye Flounders

Distribution: Alaska to southern Baja California.

Habitat: Lives on sandy bottom from nearshore to 360 m; most often found at less than 90 m.

Appearance: Small, left-eyed flatfish, c. 13–17 cm. Eyed side brown or tan with black speckles and spots; blind side white.

Diet: Small benthic crustaceans (mysid shrimp, amphipods especially), worms. Eaten by other fishes, marine mammals, and sea birds.

Reproduction and Development: Spawns March–October. Eggs and larvae pelagic.

Remarks: Like many members of their family, speckled sanddabs can change color and pattern to match the substrate.

California Halibut aka California Flounder

Paralichthys californicus (Paralichthyidae)
Large-tooth Flounders

Distribution: Northern Washington to southern Baja California, though less common north of San Francisco Bay.

Habitat: Sandy bottoms to a depth of 90 m along the shore, near rocks and in bays and estuaries.

Appearance: They have small heads with large mouths, small eyes set wide apart and the lateral line appears as a high arch above the pectoral fin. Many of these fish are right eyed even though they are members of the left-eyed family. They may grow to 1.5 m in length and weigh 32 kg.

Diet: Adults: fish and squid. Juveniles: small organisms such as copepods and amphipods.

Reproduction and Development: Spawn in shallow water from February to July; some southern populations may spawn year round. The females mature at 4–5 years and grow larger than the males which are ready to spawn at 2–3 years.

Mortality/Longevity: May live as long as 30 years. Subject to predation by sea lions, sharks, rays and dolphins.

Remarks: They have very sharp teeth, and are known to bite. In the larval form flatfish are bilaterally symmetrical and swim upright, as do other fishes, but at about 13 days one eye begins to migrate to the other side of the head. By the time the juvenile is about 8 mm, it has turned on its side and begins a primarily benthic lifestyle.

Like flatfish in general, is an ambush predator, using its large, powerful caudal fin to accelerate off of the substrate when prey ventures near.

Support important commercial and recreational fisheries.

C-O Turbot

Pleuronichthys coenosus (Pleuronectidae)
Righteye Flounders

Distribution: Southeastern Alaska to northern Baja.

Habitat: On sandy or rocky bottoms. Common in shallow water, but found to depths of 350 m.

Appearance: A right-eyed flatfish. Eyed side dark brown to blackish, though able to change color to match substrate. Blind side white. Max. length: 36 cm.

Diet: Benthic crustaceans, mollusks, and worms.

Reproduction and Development: Oviparous. Females lay eggs that float in mid-water until larvae develop and sink to bottom.

Mortality/Longevity: Life span: up to 14 years.

Remarks: As in all members of the family, swim bladder is absent in adults, an adaptation for bottom-dwelling life style.

A dark spot on the caudal fin with a curved dark bar in front of it gives this fish its common name: upside down the pattern reads "CO."

Caught commercially and recreationally in small numbers. Like all flatfish, it is edible.

English Sole

Pleuronectes vetulus (Pleuronectidae)
Right-eye Flounders

Distribution: Eastern Pacific: Bering Sea to central Baja California.

Habitat: Sand and mud bottoms. Young found in intertidal areas and estuaries; migrate into deeper water as they mature.

Appearance: A right-eyed flatfish with a pointed head. Eyed side a flat brown; the blind side white or pale yellow. Max length: 49 cm; common length: 30 cm.

Diet: Small crustaceans, marine worms, brittle stars, small mollusks. Often feed by digging snouts into sand to extract food items.

Reproduction and Development: Pelagic spawner. Move to deeper water for spawning. Larvae transform into flatfish shape at 6–10 weeks.

Mortality/Longevity: **Preyed upon by large** flounders, California sea lions, and cormorants. Life span: c. 20 years.

Remarks: Pigmented side is capable of remarkable color changes to match substrate.

As in all flatfish, the swim bladder disappears in the adult.

Are an important part of the flatfish trawl fishery from California to British Columbia, where they are second only to Dover sole in total pounds landed.

ORDER TETRAODONTIFORMES

Clown Triggerfish
Balistoides conspicillum (Balistidae)
Triggerfishes

Distribution: Indo-Pacific; East Africa to Samoa, north to Hakkaido, south to Lord Howe Island. Throughout Micronesia.

Habitat: Clear seaward reefs, 3—5 m. Adults prefer coral-rich areas of outer reef terraces adjacent to steep drop offs. Juveniles usually near ledges and caves of steep drop offs below 20 m.

Appearance: Length to 50 cm. Adults have a small yellow mouth, black dorsal side with yellow venations, large white polka dots on belly, blue dorsal and anal fins.

Diet: Solitary diurnal carnivores. Dentition is very efficient for chewing food with mineral structures, such as sea urchins, mollusks, corals, crabs and other crustaceans. Also eat tunicates.

Reproduction and Development: Female lays demersal eggs in a nest which is aggressively guarded by the male.

Remarks: Large, thick dorsal spine may be locked upright by the second spine (the trigger).

Pinktail Triggerfish
Melichthys vidua (Balistidae)
Triggerfishes

Distribution: Indo-Pacific: East to South Africa, east to the Hawaiian Islands, north to southern Japan, and south to the Great Barrier Reef.

Habitat: Marine reefs, 4–60 m depth.

Appearance: Kite-shaped body so dark it looks black, but is actually a deep forest green. Pectoral fins yellow, black-edged gray or white dorsal and anal fins, white and pink tail. Max. length: 40 cm.

Diet: Algae, detritus, sponges, crustaceans, octopuses, and fishes.

Reproduction and Development: Lays eggs in nests guarded by the female.

Remarks: The first dorsal spine has a locking mechanism.

Like all triggerfishes, able to rotate eyeballs independently.

Black Triggerfish aka Redtooth Triggerfish
Odonus niger (Balistidae)
Triggerfishes

Distribution: Red Sea to Marquesas and Society Islands, north to Southern Japan, south to Great Barrier Reef and New Caledonia.

Habitat: Current-swept seaward reefs 2–35 m.

Appearance: Length to 40 cm. Head green with rows of dark blue dots and stripes. Body, fins dark blue.

Diet: Plankton and occasionally sponges, corals, and other invertebrates.

Reproduction and Development: External fertilization. Forms pairs, builds and guards nest.

Remarks: When alarmed retreats into crevasses, with only tail filaments visible.

Blackbar Triggerfish aka Picassofish aka Humuhumu nukunuku a pua'a
Rhinecanthus aculeatus (Balistidae)
Triggerfishes

Distribution: Indo-Pacific.

Habitat: Subtidal reef flats and shallow protected lagoons to 50 m. In sandy areas with rubble and shelter cavities.

Appearance: Length to 30 cm. Light brown dorsally, shading to white ventrally, with a large black area containing four blue diagonal bands.

Diet: Algae, detritus, mollusks, crustaceans, worms, sea urchins, heart urchins, fishes, coral, tunicates, foraminiferans and eggs.

Reproduction and Development: Sexes separate; fertilization external. Oviparous. Demersal eggs in nest aggressively guarded by the male.

Remarks: Complete Hawaiian name *Humuhumu nukunuku a pua'a* means "grunts like a pig," a reference to its habit of loudly grunting when disturbed.

Popular in the tee shirt trade as a poster fish for the State of Hawaii.

Highly territorial; individuals or pairs aggressively defend their turf.

Sleeps on its side.

Popular in the aquarium trade.

Gilded Triggerfish aka **Bluechin Triggerfish**
Xanthichthys auromarginatus (Balistidae)
Triggerfishes

Distribution: Indo-Pacific: East Africa to Hawaiian Islands, north to the Ryukyus, south to New Caledonia.

Habitat: Marine reefs, 8–150 m depths.

Appearance: Steel blue with white spots. Males have blue chin patch and yellow margins on dorsal, anal, and caudal fins. Females lack chin patch, and have maroon stripe on base of dorsal and anal fins, and on outer margin of tail. Max. size: 30 cm

Diet: Zooplankton, especially copepods.

Reproduction and Development: Oviparous. Lay eggs in nests.

Remarks: Form small, loose aggregations.

ORDER TETRAODONTIFORMES (PUFFERS AND FILEFISHES)

Orange-spotted Filefish
Oxymonacanthus longirostris (Monacanthidae)
Filefishes

Distribution: Indo-Pacific.

Habitat: Clear lagoons and seaward reefs in depths from 0.5–30 m.

Appearance: Color: pale blue with about eight longitudinal rows of orange-yellow patches, or green with small dark-edged yellow to orange spots. Dark spot on the caudal fin Long snout with a small upturned mouth; concave body profile above and below the snout. Max. size: 12.0 cm. Diet: Feeds almost exclusively on *Acropora* polyps throughout the day. (In aquaria, they may been weaned onto live brine shrimp, but this will not provide the complete nutrition they require.) Protruding snout and teeth that project from small mouth permit them to snip off coral polyps.

Reproduction and Development: Monogomous batch spawners and non-guarders, scattering eggs among algae on the substrate. After spawning and fertilization, the pair swims back to their territory.

Remarks: Because the orange-spotted filefish has a passive nature, it needs a species-specific tank, or one with very passive tank mates. For successful acclimation, the aquarium should also include hiding places.

Shaw's Boxfish
Aracana aurita (Aracanidae)
Deepwater Boxfishes

Distribution: Eastern Indian Ocean: southern Australia and Tasmania.

Habitat: Continental shelf to depths of 160 m. Also on deep rocky reefs.

Appearance: Sexes dichromatic: males covered with blue spots and lines, females orange/brown with white lines. Max. size: 20 cm.

Diet: Small worms and other invertebrates as well as plant material.

Remarks: Like its Australian tank mate above, this fish also releases a poisonous substance, called ostracitoxin, which will kill other fish in the tank very quickly.

Ornate Cowfish
Aracana ornate (Aracanidae)
Deepwater Boxfishes

Distribution: Eastern Indian Ocean, southern coast of Australia.

Habitat: Shallow tropical seas under 20 m.

Appearance: Brownish gold background with a handsome pattern of white stripes and spots. Max size: 15 cm.

Diet: Small benthic crustaceans, algae.

Remarks: Rare (and expensive) in the Aquarium trade.

Though the cowfish moves slowly, it requires surprisingly little thrust as water flows over its body very efficiently. The fish is so good at turning and balancing that engineers modeled a submarine after it

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Papuan Toby aka **Spotted Sharpnose Puffer**
Canthigaster papua (Tetradontidae)
Pufferfish

Distribution: Indo-Pacific: Philippines, Indonesia, New Guinea, Australia.

Habitat: Various reef habitats from fringing reefs to lagoons, patch reefs, and deeper seaward reefs to 35 m.

Appearance: Brown overall with blue lines on the back, forehead, and snout; blue spots on sides; black spot at base of dorsal fin. Max. size: 10 cm.

Diet: Mostly algae, but also take a variety of small, benthic invertebrates. Some may nip off the tips of small-polyped stony corals and soft corals with their strong, fused teeth.

Reproduction and Development: Haremic, with males establishing territories. Males posture and display to discourage conspecific competitors, a ritual that can become violent and result in serious injury.

Remarks: Tobies, both in the wild and the aquarium, need hard calcareous material to bite on to wear down their teeth, which otherwise continue to grow and may interfere with regular feeding.

Like all members of its family, tobies are able inflate themselves to a prickly ball that discourages predators.

Amazon Pufferfish
Colomesus asellus (Tetradontidae)
Pufferfish

Distribution: Peru, Colombia, Brazil. The Amazon Basin.

Habitat: Mostly warm freshwater and coastal streams.

Appearance: Max size: 7.5 cm.

Diet: An active hunter, especially of snails.

Reproduction: Pairs breed during the wet season, spawning in rivers. Small eggs are scattered on the substrate and hatched larvae are carried downstream.

Mortality/Longevity: Life span: 10+ years.

Remarks: Continuous growth of teeth keeps these fish ready for their crunchy and abrasive diet of crustaceans and snails. In captivity, these puffers should have a daily dose of snails to prevent beak overgrowth.

These active and curious little fish need a complexly decorated aquarium to explore, or like big cats in a barren cage, they will be found "pacing" back and forth along the aquarium glass.

Like other puffers, can inflate themselves when threatened, presenting a much larger and spine-laden body to suddenly disheartened predators.

Many pufferfishes are highly toxic. *C. asellus* produces saixitoxin, the same neurotoxin produced by marine dinoflagellates such as *Gymnodinium*, source of the red tides off the California coast. Ingestion of saxitoxin by humans, usually through ingestion of contaminated shellfish, can produce potentially lethal paralytic shellfish poisoning.

CLASS SARCOPTERYGII (LOBE-FINNED FISHES)

ORDER COELACANTHIFORMES (COELACANTHS)

Coelacanth (specimen)
Latimeria chalumnae (Latimeriidae)
Coelacanths

Distribution: Western Indian Ocean; off coasts of Comoros Islands, Kenya, Mozambique, Madagascar, South Africa.

Habitat: By day, along steep rocky shore, sheltered in caves with as many as 13 conspecifics in a single cave at depths 100–700 m. By night, several individuals occupy

overlapping home ranges.

Appearance: Length to 2 m. Weight to 95 k. Body dark, metallic blue-black, with numerous irregular pale blotches.

Diet: After sunset, a coelacanth singly leaves its cave and moves slowly across the substrate, presumably looking for food, within 1–3 meters of the bottom, drifting passively with the current or swimming slowly with its paired fins and its second dorsal and anal fins. Travels as much as 8 km in search of food and retreats to the nearest cave before dawn. Preys on fishes and squid (a skate, an eel and a swell shark have also been reported as eaten).

A relatively small gill area seems to limit coelacanth to a slow metabolism and movements, drift-feeding at night in cold waters and resting in slightly warmer caves for food digestion during the day. By resting in caves where there are no strong currents, the coelacanth saves energy and avoids encounters with large predators such as deep-water sharks.

Reproduction and Development: Ovoviviparous, with as many as 5–29 offspring. Gestation period estimated at 3 years, which would be the longest known in vertebrates.

Mortality/Longevity: Eaten by large sharks. Live to at least 48 years, and perhaps to 80.

Conservation Status: CITES: Appendix I: international trade banned since 1990. IUCN: Critically Endangered.

Remarks: Entire books have been written about this species!

This "living fossil," was first documented as a living species in 1938, when discovered near the Comoros Islands off the east coast of Africa. It comes from a line of fishes thought to have been extinct since the time of dinosaurs some 66 million years ago. Earliest representatives from the fossil record date to at least 360 million years ago.

Until fairly recently, coelacanths were believed to be the ancestors of tetrapods, though many researchers presently give this distinction to lungfishes. The issue has yet to be resolved.

When the animal swims, the left pectoral and right pelvic fins move forward, while the right pectoral and left pelvic fins are pulled backward. This tandem movement of alternate paired fins resembles the movement of the forelimbs and hindlimbs of a tetrapod walking on land.

ORDER CERATODONTIFORMES (AUSTRALIAN LUNGFISH)

Australian Lungfish

Neoceratodus forsteri (Ceratodontidae)
Australian Lungfish

Distribution: Four rivers in the state of Queensland, Australia.

Habitat: Rivers with low flow in the austral summer, then restricted to pools that remain.

Appearance: Flipperlike fins, large scales; stocky, compressed body. To nearly 2 m in length.

Diet: Omnivorous. Plant material is an important component of the diet.

Reproduction: Eggs hatch into small lungfish; unlike African (Protopteridae) and South American (Lepidosirenidae) lungfishes, the Australian lungfish has no larval stage

Mortality/Longevity: Live to more than 65 years in captivity. Some individuals may live to 100 years.

Conservation Status: CITES Appendix II. Loss of habitat threatens this species.

Remarks: One Australian lungfish is the oldest specimen in the Steinhart's live collection; "Methusela" arrived from the Melbourne Zoo in 1938. It was half its current size at the time.

This species most resembles lungfish fossil forms.

Unlike the African lungfish, this species cannot survive dry spells through estivation. Although the lung supplements the gills during times of oxygen stress, it cannot survive solely by breathing air.

The Australian lungfish has only a single lung; the other two lungfish species have paired lungs.

CLASS AMPHIBIA

ORDER CAUDATA (SALAMANDERS)

Chinese Giant Salamander

Andrias davidianus (Cryptobranchidae)

Distribution: Streams and rivers in Southeast China.

Habitat: Totally aquatic. Clear, cold, fast-

flowing mountain streams. Active nocturnally; rests under rocks by day.

Appearance: Length to 1. m. Body broad and flattened, tail laterally compressed. Colored whitish with black and charcoal dots and mottling.

Diet: Fishes, salamanders, worms, insects, crayfish and snails located nocturnally by smell and touch. Giant salamanders have very slow metabolism and are capable of going for weeks between meals.

Reproduction and Development: Male builds a nest and entices a female to his site. External fertilization on strings of ~ 600 eggs laid in nest in streambed. Male drives away his mate and guards the eggs until they hatch.

Mortality/Longevity: Can live to more than 50 years.

Conservation Status: Endangered due to pollution and damming of rivers.

Remarks: It's the world's largest salamander.

Its heavily wrinkled skin aids in respiration (oxygen uptake).

Species first described by Pere David, a Jesuit scientist who made an early biological survey of China. A prized gourmet food item in some regions of China.

Lesser Siren aka **Mud Siren**

Siren intermedia (Sirenidae)

Distribution: Southeast USA.

Habitat: Totally aquatic. Inhabit shallow, heavily vegetated freshwater lakes, marshes and swamps, often buried in mud or sand.

Appearance: Adults: length to 25 cm. Eel-like appearance, external gills, minute front legs, rear legs lacking. Tiny eyes. Larvae black with red markings.

Diet: Benthic nocturnal feeders upon insect larvae, crayfish, worms, snails and small fish. Mouth lacks teeth; prey is crunched by siren's horny beak and swallowed whole.

Reproduction and Development: Mating has never been observed; likely external fertilization. Females lay up to 1500 eggs singly, dispersing them widely onto aquatic vegetation. A parent guards until the larvae hatch 45–75 days later.

Conservation Status: Threatened in Texas due to drainage of wetlands. Due to degradation of habitat, likely threatened elsewhere.

Remarks: Able to estivate when their ponds dry up. The mucous coat covering their skin hardens into a parchment-like cocoon over the body, excepting the mouth.

When grasped by humans, siren vocalization sounds like yelps.

ORDER ANURA (TOADS AND FROGS)

Dwarf African Frog

Hymenochirus boettgeri (Pipidae)

Distribution: Central Africa: Niger, Cameroon through Zaire.

Habitat: Freshwater; shallow rivers, creeks, and ponds.

Appearance: Like all pipids, are dorsoventrally flattened, though females are typically rounder and larger than males. Max. size: 3.5 cm.

Diet: Insects and small fish fry. Unlike terrestrial frogs usually noted for their sticky tongues used to capture prey, pipids lack tongues entirely, and as aquatic feeders, seem to depend on the creation of negative pressure by the rapid opening of the mouth that sucks in prey that is then swallowed whole. Eyesight is poor; prey detection depends more on sense of smell and vibration.

Reproduction and Development: Male captures the female in the embrace of amplexus and holds on for hours. If receptive, the female releases eggs near the surface where the male fertilizes them. Eggs attach to the water's surface tension layer and hatch in about 24 hours. Larvae are free-swimming for about 27 days, and tadpoles metamorphose into small frogs in t six weeks.

Mortality/Longevity: Life span: about 5 years.

Remarks: The dwarf African frog has been introduced to southeastern Florida.

Pipid males lack vocal cords but are able to communicate underwater via clicking sounds generated by the larynx.

Surinam Toad

Pipa pipa (Pipidae)

Distribution: South America: Amazon region.

Habitat: Freshwater; can live in oxygen deficient, muddy, turbid or even polluted water. Benthic, rises to surface to breathe.

Appearance: Length to 20 cm. Stout body, huge, webbed rear feet for propulsion. Body dark, gray to brown. Head triangular with flaps of skin on the jaw. Fingers are not webbed and terminate in star-like tipped extremities equipped with tactile sensory organs.

Diet: Juveniles are cannibals and predators. Adults locate food with long fingers with tactile receptors in murky water. Adults eat fish, worms, insects, and crustaceans.

Reproduction and Development: Males utilize a rapidly repeated clicking sound to attract mates. Fertilization external. Eggs are extruded while the pair somersaults in the water column. Female's epidermis becomes soft at mating; 290+ (60–100 eggs according to another reference) eggs laid on her back sink into her skin; within 24 hours the female's skin begins to swell around her eggs forming pockets that cover over with skin. Larvae mature through the tadpole stage within these pockets for 12–20 weeks. Eventually emerging as fully formed toads, though they are less than 2 cm long.

Mortality/Longevity: Eaten by some indigenous Amazonian people.

Remarks: Like all Pipidae, it lacks a tongue. The clicking sound they make is produced by snapping the hyroid bone in their throats.

Asian Horned Frog

Megophrys nasuta (Megophryidae)

Distribution: Borneo, Malay Peninsula, Sumatra.

Habitat: Lives in relatively cool damp environs. Optimal temperature is between 22–24° C. Found on the rainforest floors, usually near small streams.

Appearance: Have projections above each eye and nasal area, hence the name Horned Frog. Designed for camouflage; back is gray, tan, russet, or brown and darkens toward the side making the frog almost invisible among the forest leaf litter. The smooth skin resembles dead leaves. Females are about 12.5 cm and males about half that size.

Diet: Mainly crabs and scorpions; also arachnids, nestling rodents, lizards and other frogs that live on the forest floor.

Reproduction and Development: Oviparous. Little is known about natural breeding. Captive reproduction is fairly common. Females attach the egg clusters to the underside of water-washed rocks and logs. The eggs are large and few in number. Tadpoles have very large, funnel–shaped mouths. They cling with their mouths at the surface while their body hangs vertically. This helps them feed on microorganisms at the water's surface.

Remarks: Call is unmistakable: a loud, resonating, metallic honk or henk, somewhat reminiscent of an air horn. The Jahai, an aboriginal group from northern Peninsular Malaysia, call this frog "Kengkang," onomatopoeic after its call.

Oak Toad

Bufo quercicus (Bufonidae)

Distribution: Southeastern U.S. form southern tip of Florida to southern Virginia, west to eastern Louisiana.

Habitat: Coastal plains in moist grassy areas near pine or oak savannahs with sandy soil. Also in vernal pools and freshwater wetlands.

Appearance: Length from snout to vent: 1.9 to 3.3 cm. Short head with pointed nose. Flat body is black to brown with a long dorsal stripe of white, cream, yellow, or orange. Back has fine bumps of red to orangish-brown. Relatively long teardrop-shaped parotid (poison) glands extend down the sides of the head.

Diet: Primarily terrestrial insects and other small arthropods. Active during the day unlike most toads of the genus *Bufo*.

Reproduction and Development: Sexes separate. Males make high-pitched calls to attract females. Breeding takes place in shallow pools, ditches, and ponds. Eggs hatch and tadpoles develop into adult toads in about 2 months. No parental care. A notable evolutionary advantage: if males are unable to produce sperm, they have an ovary that becomes functional, allowing them to breed as females!

Mortality/Longevity: Predators include snakes and larger frogs.

Conservation Status: Not listed, but numbers are declining due to habitat loss.

Remarks: *B. quercicus* is the smallest toad species in the Western Hemisphere.

Though small, it plays a significant role in insect population control.

Like most toads, its poison glands secrete a toxic fluid used to deter predators.

Borneo River Toad

Phrynoidis juxtaspera (Bufonidae)

Distribution: This species is widely distributed in Borneo and Sumatra. It probably occurs more widely than current records suggest, especially in areas between known sites. It occurs up to elevations of 1,600 meters.

Habitat: Found along rocky creeks and riverbanks. Breed in rocky-bottomed, strong flowing streams where the larvae also develop.

Appearance: *Phrynoidis juxtaspera* is one of the two river toads. It can get as big as a small rabbit. The toad has extensive webbing between toes and is a good swimmer; strong legs make it a good jumper as well.

Diet: Ants, other insects, spiders.

Reproduction and Development: No specific information found. Most species of toads lay eggs in water. The eggs develop into tadpoles, which metamorphose into adult toads.

Remarks: The toads secrete large amounts of highly toxic, milky poison from their warts when molested. Not only skin secretions of adults but also eggs and tadpoles are poisonous. However, large specimens are hunted for food in some areas: the toad is skinned, washed, and cooked. The heat denatures the toxins.

Green and Black Poison Dart Frog

Dendrobates auratus (Dendrobatidae)

Distribution: Central America to Northwest Colombia.

Habitat: Lowland primary tropical rainforests. Active diurnally.

Appearance: Length to 4.2 cm female, 4.0 cm male. Calligraphic green marking on dark background. Color and pattern varies widely among populations of this species.

Diet: Ants and mites, also tiny beetles, flies and springtails. Often captures insects feeding on rotting fruit.

Reproduction and Development: Males territorial at high population densities. Females do not defend territories, but some females guard protecting males and attack other females. Lay eggs in leaf litter during rainy season. Male visits the eggs periodically during the two weeks of development and sheds water on them, removes fungi and rotates eggs. Males can tend offspring of several different females simultaneously. The male of this species transports tadpoles on its back, typically one at a time, to pools of water, commonly in tree cavities. The male excretes a thick mucus on its back, soluble only in water so the tadpoles are securely attached until arrival in their new home.

Mortality/Longevity: Life span: known to live 8 years in captivity, probably a much shorter period in the wild.

Conservation status: Still reported to be locally common. Popular in the pet trade; most sold are captive-born.

Remarks: Common in cocoa (not coca) plantations.

Introduced to Hawaii to control non-native insect populations. The "success" of this experiment has yet to be proven.

Aposematic ("warning") coloration shies diurnal predators away from this bold frog.

Blue Poison Dart Frog

Dendrobates azureus (Dendrobatidae)

Distribution: Panama and Guyanas.

Habitat: Adults entirely terrestrial. Active diurnally.

Appearance: Length to 5 cm. Electric-blue coloration, flecked with black.

Diet: Carnivorous.

Reproduction and Development: Several clutches of 5-13 eggs per female. Eggs laid in leaf litter. Male apparently selectively guard eggs; often protects one clutch more than another. When the eggs hatch, the tadpoles wriggle to the male's dorsum. The male transports them, one or two at a tme to quiet pools within leaves of bromeliads or into tree cavities.

Mortality/Longevity: Life span: to 10 years

Conservation Status: Endangered due to rain forest destruction.

Remarks: Aposematic "warning coloration" shies diurnal predators away from this tiny but bold frog.

Strawberry Poison Dart Frog

Oophaga (formerly Dendrobates) pumilio (Dendrobatidae)

Distribution: Nicaragua, Costa Rica, Panama.

Habitat: Tropical rain forest leaf litter and

decaying vegetation.

Appearance: Length to 2.5 cm. Despite the common name, coloration is reportedly highly variable among locations. Individuals may be ripe-strawberry red, brilliant blue, deep green or brown. The limbs are marbled dark blue and black. Body is slim, snout is rounded, the eyes large. The long, slender forelimbs end in finger and toe tips expanded into adhesive discs.

Diet: Hunts diurnally, primarily upon ants and termites.

Reproduction and Development: Males vocalize loudly in order to attract mates. Amplexus absent; fertilization external. Females lay clutches of 4–6 eggs in leaf litter during the rainy season. Males protect the clutch of eggs, keeping them moist by periodically emptying their bladders on the eggs. Once the eggs hatch, the female of this species, transports them on her back, often high into the canopy, to rosettes of bromeliads or to water-filled tree crevices and deposits one tadpole into each pool. She returns on a regular basis to feed her offspring unfertilized eggs. Tadpoles metamorphose after ~ six weeks.

Conservation Status: Reported locally common, though tourism and cultivation of forests are problems for some populations.

Remarks: Indigenous hunters heat this frog over a fire to extract the toxin exuded from the frog's skin glands. The hunters use the poison to tip their hunting darts.

Their bright coloration is a "stay away" warning to potential predators. Such coloration is called warning coloration, or aposematic, if you are a biologist.

Striped Poison Dart Frog

Phyllobates sp. (Dendrobatidae)

Distribution: Central and South America: Nicaragua to Colombia.

Habitat: Humid lowlands to premontane zones.

Appearance: Most species are brightly colored.

Diet: Various insects. Diurnal feeder.

Reproduction and Development: Eggs are deposited in dry leaf-litter; males transport hatching tadpoles to forest streams to complete metamorphosis.

Remarks: The genus *Phyllobates* contains the most poisonous frog species, *Pyllobates terribilis*, the Golden Poison Dart Frog.

Phyllobates species are the frogs most commonly sought by South American tribes for the poison used on their hunting darts.

Red-eyed Treefrog

Agalychnis callidryas (Hylidae)

Distribution: Southeastern Mexico, through Central America, to northwestern Colombia.

Habitat: Live near ponds or rivers in neotropical rainforests from sea level up to 960 m. These nocturnal frogs are completely arboreal. During the day they remain motionless, blending in among the foliage. They live in warm (75-85° F, day; 66-77° F, night), humid (80-100%) climates.

Appearance: Males are smaller (about 5 cm) than females (almost 1.75 cm). Both have neon green backs. With its bright orange-red suction toe pads it easily clings, climbs, and jumps among arboreal surfaces. Their distinctive bright red, bulging eyes provide highly developed parabolic vision. A reticulated pale nictitating membrane shields the frog's sensitive eyes.

Diet: These carnivorous frogs ambush insects (crickets, moths, beetles, flies, grasshoppers) and even smaller frogs.

Reproduction and Development: The red-eyed treefrog's reproduction is remarkable in all three phases: courting, mating, and development. Males call from branches and leaves of trees above ponds in the rainy season; they vocalize in unison and threaten one another competing for females. Females approach calling males; once in amplexus, with one or even several males attached, the female descends to the pond, where she absorbs water for each clutch of eggs and then climbs to a leaf above the water. with all suitors attached! Sometimes a single male will become superior, at other times another male will displace the original one and inseminate subsequent clutches. Clutches of 11–78 eggs are deposited on the leaf, which usually is folded around the egg clutch. After hatching, tadpoles drop into the water. Tadpoles are mid-water filter feeders and orient themselves in a head-up position.

Mortality/Longevity: Life span: 3–5 yrs. Adults preyed upon by birds, turtles, lizards, snakes,

bats and other mammals. Tadpoles taken by aquatic predators such as giant water bugs or fishing spiders such as those on display in the Water Planet.

Conservation Status: CITES Appendix II. *A. callidryas* has become the familiar icon for conservation of the world's rainforests. However, as deforestation continues to destroy its habitat, its numbers are shrinking.

These frogs are also threatened by being captured by zoos or for the pet trade. Global warming, deforestation, climatic and atmospheric changes, wetland drainage and pollution have caused dramatic declines and deformities in all amphibian populations including those of the neotropical rainforests.

Green Treefrog

Hyla cinerea (Hylidae)

Distribution: Central to Southeastern United States. North to Virginia's eastern shore, south to the southern tip of Florida, west to central Texas.

Habitat: Forest habitats in small ponds, large lakes, marshes, and streams, especially in richly vegetated areas.

Appearance: Bright yellow-green above, though some are reddish-brown to green, often with small golden spots. White to cream below with a prominent white lateral stripe on each side. Length to 62 cm. Females larger than males.

Diet: Insectivores: flies, mosquitoes, and other small insects.

Reproduction and Development: Breeding cycle is influenced by day length, temperature, and rainfall. To attract females, males produce a distinct advertisement call. Males mate with as many females as they can attract.

Mortality/Longevity: Predators include snakes, birds, large fish, and other frogs. Predatory aquatic insects such as giant water bugs may take tadpoles. Green frogs in captivity are known to live as long as 6 years.

Remarks: Active at night. During the day, adults are well camouflaged among grasses and other vegetation, especially when legs are tucked below the body and eyes are closed.

Grey Treefrog

Hyla versicolor (Hylidae)

Distribution: Southern Ontario/Maine, westward to central Texas, northwest to Manitoba, and south to northern Florida. An isolated colony is also noted in New Brunswick.

Habitat: All elevations of wooded areas near temporary and permanent waters.

Appearance: Dorsal surface is rough and sprinkled with warts, but less than those of an average toad. Colors range with background and environment (including season and humidity), but shades of gray are common with a black star on the back and white mark beneath the eye. Bottom of hind legs and groin are orange/yellow with black speckles; belly is white. Sexes alike. Average size: length ~ 3–5 cm; weight ~ 7 g.

Diet: Tadpoles: algae and detritus. Adults: opportunistic cannibals, eating smaller frogs if they can catch and swallow them as well as most insects and their larvae.

Reproduction and Development: Males start breeding choruses in April/May and go on for several weeks. Females choose males with the most prolonged and frequent calls. Eggs are externally fertilized by the male. Tadpoles hatch in 3–7 days and become froglets in 6-8 weeks.

Mortality/Longevity: Suffer a high mortality in the wild; in captivity can live up to 7 yrs.

Remarks: Two species, *Hyla versicolor* and *Hyla chrysoscelis*, look identical and are distinguishable only by chromosome number (*H. chrysoscelis* is diploid, *H. versicolor* is tetraploid) and mating call (trill rate is faster in *H. chrysoscelis)*. The different pulse rate and pitch of the mating call is a barrier to cross breeding.

Hylid treefrogs produce a mucus on their toepads which adheres to smooth bark or man-made structures. Also, extra cartilage segments between the last two bones of each toe allow the toes to swivel and remain flat against surfaces.

These frogs are known to seek out light sources, which attract insects.

Waxy Monkey Tree Frog

Phyllomedusa sauvagii (Hylidae)

Distribution: Chacoan (dry prairie) regions of Bolivia, Paraguay, Brazil, and Argentina.

Habitat: Arboreal, near ponds, lagoons, & other bodies of fresh water.

Appearance: Green with prominent white stripes. Hind legs are relatively short. Length: 5–7.5 cm.

Diet: Small insects such as flies and ants.

Reproduction and Development: Breeding takes place during the rainy months, and the frogs do not return to the ground. They deposit eggs in leaf nests attached to branches overhanging water. The leaves are rolled up and secured by a waxy substance, and upon hatching, tadpoles fall into the water where they mature.

Remarks: The waxy monkey tree frog is adapted to a warm, dry environment by diurnal torpor, uric acid excretion, and the ability to secrete a waxy substance on the skin that limits water loss. The lipid secretions are distributed over the skin by the legs in a wiping movement.

Though visitors rarely see this nocturnal species move about; the frog, rather than hopping, grabs branches and moves like tiny monkeys swinging through the trees.

Golden Mantella

Mantella aurantiaca (Mantellidae)

Distribution: Very limited in west central Madagascar.

Habitat: Sunny patches in the high montane rainforest. Entirely terrestrial. Diurnally active.

Appearance: Length to 3 cm. Adult body color may be yellow, orange or gold. Black eye, horizontal pupils. Juveniles are black and green.

Diet: Very young tadpoles rasp algae and plant matter. 6-8 week old froglets begin to hunt for flea-sized food. ~10 weeks begin to hunt fruitflies and other insects.

Reproduction and Development: Males call to females from their territories on the ground. Females roam among competing male territories. Fertilization internal (unusual for a frog). Lays eggs on leaf litter during the rainy season. Egg mass requires high humidity, warmth and no direct sunlight, but not immersion. At ~ 10 days larvae have absorbed much of their yolksac, the jelly surrounding the eggs liquifies and forms a communal pool for the clutch. A few days later tadpoles are washed into small pools by rain. Rear legs start developing at 3-4 weeks, front legs a week later. At this point the larval gills regress and the larvae can drown without access to air. They reach adult breeding size in 9–12 months.

Conservation Status: Listed as endangered (IUCN) due to destruction of their habitat and introduced predators. Pet trade also decimating this species.

Remarks: The animal's bright color advertises the toxicity of skin secretions that protect it from most predators.

Painted Mantella

Mantella baroni (Mantellidae)

Distribution: Endemic to the forests of east-central Madagascar.

Habitat: Includes swamp forests, semi-arid streambeds, bamboo groves, and streamside forests, including rainforests. Also lives in degraded and second-growth forests.

Appearance: Females generally larger than males. Length from snout to vent: 3 cm.

Diet: Diurnal; feed on insects, especially ants.

Reproduction and Development: Like all mantellas, lack amplexus (the nuptial embrace of most frog species). Instead, females lay eggs on land, but always close to water. When tadpoles develop, they are washed by rain into nearby stream or pool. Are successfully bred in captivity, though captive bred individuals are not widely available.

Conservation Status: IUCN: Least concern. A fairly common frog within its area of distribution, parts of which are within borders of protected areas, though its increasing popularity in the pet trade may be reducing its numbers.

Remarks: Research over the past several decades has shown that the poison dart frogs (*Dendrobates* spp.) acquire their alkaloids by eating ants, but the poison source for Madagascar frogs remained unknown until recently. Now, Academy entomologist Brian Fisher and Cornell chemist Valerie Clark, together with colleagues from the United States and Madagascar, have found that Madagascar's *Mantella* frogs also acquire their toxins from ants. Both groups have evolved ways to ingest the poisonous ants without harming themselves. Their bright colors are aposematic signals of toxicity.

Even though the frogs in Madagascar and

Panama live nearly half a world apart from one another, they share 13 identical poisonous compounds. This, Fisher notes, is a beautiful example of convergent evolution—similar evolutionary pressures in two different parts of the world have led unrelated frogs to find and sequester the same poisonous alkaloids in the same way (from Headline Science – CAS)

Green Mantella

Mantella viridis (Mantellidae)

Distribution: Endemic to Madagascar.

Habitat: Inhabits deciduous forests. Usually found around temporary streams. Also lives in degraded mango plantations.

Appearance: *Mantella viridis* is one of the biggest of the Madagascar mantella frogs; max length: 3.5 cm. The back and sides are yellow-green; ventral parts are black with blue spots. The toes are not webbed. A light stripe runs along the upper lip.

Diet: Diurnal predators, eating mainly insects, ants, and termites. May also eat fruit that has fallen to the ground.

Reproduction and Development: Adults mate on land and the eggs are laid in depressions in moss or damp vegetation. Eggs hatch into tadpoles during heavy rainfall, which washes them into small pools of water. The tadpoles grow to a size of about 2.5 cm. In 45–65 days they undergo metamorphosis and take the adult form.

Mortality/Longevity: No specific information found. Snakes, small carnivorous mammals, and birds prey upon the frogs. Coloring and toxins may protect against predators.

Conservation Status: IUCN Red list: Endangered.

Remarks: Many species of tropical frogs sequester toxins in their skins. In most cases these toxins come from eating toxic arthropods such as ants. During the past 30 years, over 400 alkaloids of over 20 structural classes have been detected. The skin of *Mantella viridis* has been shown to contain such toxins.

It has been suggested that South American toxic frogs and Malagasy toxic frogs arose in Gondwanaland before continental separation began, from a common stock. This hypothesis still needs to be confirmed by DNA analysis.

Madagascar Reed Frog

Heterixalus madagascariensis (Hyperoliidae)
African Tree Frogs

Distribution: Endemic to Madagascar. Found along the northeast coast.

Habitat: Common near rainforest edges, in dry forested areas, and coastal forests as well as deforested areas, croplands, and even urban areas.

Appearance: Though color can change depending on environmental conditions, the back is usually uniformly white, gray, or sometimes yellow. Thighs and the undersides of legs and feet are orange. A dark band extends between the nostril and eye. Males to 3.5 cm snout to vent; females to 4 cm.

Diet: A nocturnal and semi-arboreal hunter of insects, it readily eats insects as big as its own head.

Reproduction and Development: Breed in temporary or permanent still water year round. Like most members of the family, males compete over sites by calling during the evenings. Our Steinhart reed frogs bred during the late summer (2010); the minute tadpoles grew out in the leaf-nosed snake (MA14) and tiny frogs can be seen in the Klemmer's yellow-headed day gecko tank (MA12).

Mortality/Longevity: Life span: c. 5 years.

Conservation Status: IUCN: Species of Least Concern; *H. madagascariensis* seems a survivor, able to live and breed in a wide variety of human-impacted habitats, including heavily degraded forest areas and seasonably flooded agricultural land.

Remarks: All of the 11 known species of the genus *Heterixalus* are endemic to Madagascar.

Reed frogs spend days resting or sleeping in the sun, frequently perched on emergent vegetation of swamps and ponds, thus the common name "reed frogs."

Borneo File-eared Frog

Polypedates otilophus (Rhacophoridae)

Distribution: Endemic to islands of Borneo and Sumatra.

Habitat: Secondary forest growth, edges of primary growth; also villages, plantations, and other disturbed habitats. Lowland: sea level to 500 m. Generally arboreal on vegetation near pools of standing water.

Appearance: Dorsal color light brown to gray to yellowish brown or bright yellow. Head triangular and longer than broad; serrated bony ridge behind the eye. Thin black stripes run from the head down the back; thighs marked by black bars. Finger and toe tips expanded into large discs; toes webbed. Length from snout to vent: 6–8 cm.

Diet: Adults feed on insects and spiders.

Reproduction and Development: Males call at night. When clasped by males, females produce foam nest, made by whipping mucus with the hind limbs. Nest is attached to leaves overhanging water. Tadpoles, upon hatching, drop into the water.

Conservation Status: Though populations are declining somewhat, this frog's wide distribution and ability to thrive under conditions modified by humans suggest a strong survivability quotient

Harlequin Tree Frog

Rhacophorus pardalis (Rhacophoridae)

Distribution: Known from pennisular Malaysia, Sumatra, Borneo, and the Philippines.

Habitat: Subtropical primary forest, secondary forest and freshwater marshes from sea level to 1,000 m.

Appearance: Fingers webbed and bear expanded discs, outer edge of hand and forearm have wide flap of skin - all adaptations for gliding. Bright red hand and foot webbing make this frog easy to identify. Dorsal side tan to reddish brown, often with spots. Flanks yellowish with black spots. Size: Snout to vent - 5.0 cm males, 6.0–7.0 females.

Diet: Forages in canopy.

Reproduction and Development: Probably lives in the canopy, and descends in breeding aggregations to swampy forests, marshes, ponds. Eggs laid in foam nests and tadpoles develop in standing water.

Remarks: Heavily webbed hands and feet used for gliding. Spreads digits to break its fall.

Vietnamese Mossy Frog

Theloderma corticale (Rhacophoridae)

Distribution: Vietnam, and possibly China.

Habitat: Known from karst (limestone rock) zones of montane evergreen forests, where they occupy flooded caves and deep niches in mountain streams. Less well-documented reports of habitation in lowland forests.

Appearance: These frogs are a marvel of camouflage coloration and texture. Tubercles and spines on the skin and mottled colors of green, black, and purple make the animals blend perfectly into their mossy, wooded background.

Diet: Feed nocturnally on insects.

Reproduction and Development: Eggs are deposited above the water for protection from aquatic predators. Larvae develop in rock cavities or tree holes containing water. Tadpole larvae hatch in 7–14 days and drop into the water below. Are being bred in captivity, so threat from pet trade has been reduced.

Conservation Status: Threatened by forest loss. IUCN lists it as "Data Deficient." As a highly cryptic species and one that may have sizable but localized populations, the verdict is still out on its conservation status. Some biologists think it should be listed as threatened or endangered. Protected by the Vietnamese government.

Remarks: A semi-aquatic species that spends much time in the water, hiding under rocks and floating plants. Also spends time above the water, attached to crevice or rock where it blends perfectly with its background.

Curls into a ball and "plays dead" when frightened.

Like all tree frogs, has adhesive toe pads that allow it to grip the undersides of slick leaves or rocks. Recent studies have shown these pads to be a sophisticated combination of mucous-covered areas that provide wet adhesion and raised dry areas that provide a grip on dry surfaces. These findings have stimulated exploration into improved tire design.

Madagascar Tomato Frog

Dyscophus antongilli (Microhylidae)

Distribution: Northeast Madagascar.

Habitat: Primarily terrestrial in lowland habitats. Buries itself in soil during the day; feeds nocturnally.

Appearance: Length to 12 cm. Female is larger with vivid red body (looking not unlike a rather oddly shaped ripe tomato); male less brightly colored. Flat head.

Diet: Insects.

Reproduction and Development: Breeds

in pools and ditches after heavy rainfall. Lays eggs in water during the rainy season. Fertilized eggs hatch into free-swimming tadpoles.

Mortality/Longevity: Estimated to live ~10 years in the wild.

Conservation Status: CITES: Appendix I. Endangered due to habitat destruction and over-collecting for the pet trade. For the past 20 years, the tomato frog has been considered a flagship species for the Madagascar Fauna Group, a consortium of mostly U.S. zoos dedicated to the preservation of threatened animals and natural habitats of Madagascar. Today, institutions in the U.S., Europe, and beyond have determined exact lineages of tomato frogs bred in captivity and are exchanging animals appropriate for breeding with maximum genetic diversity.

Remarks: Captive-bred individuals are rarely as bright red as wild tomato frogs.

When alarmed, the frog secretes a very sticky goo onto its skin, a defense against predators; this substance may produce allergic reactions in humans.

CLASS REPTILIA

ORDER TESTUDINES AKA CHELONIA (TURTLES AND TORTOISES)

Pig-nosed Turtle aka **Fly River Turtle**
Carettochelys insculpta (Carettochelyidae)
Pignose Turtles

Distribution: Southern New Guinea and Kimberly Plateau of Australia.

Habitat: Shallow, slow-moving rivers, lagoons, lakes and swamps with sandy or silty bottoms. Also in estuaries. Active nocturnally. Emerge from water only in order to nest.

Appearance: Length to 75 cm. Pitted, leathery, gray-green carapace and a white plastron. Limbs are clawed and paddlelike. Short head terminates in a broad, tubular, "piglike" snout. Carapaces of juveniles have serrated perimeters and a central keel.

Diet: Opportunistic omnivores. Principal food is the fruits of shoreline trees. Eat other plant material: leaves, flowers that fall into river from banks, and aquatic algae. Also take insect larvae, mollusks and crustaceans. Scavenge fishes and mammals as carrion.

Reproduction and Development: Female excavates nest with hind limbs, lays multiple clutches of 7–9 eggs, number probably correlated with the mother's size. Sex of offspring is determined by temperature during the middle third of incubation (females produced at high temperatures, males during low temperatures). At 30° C embryos develop to full term in 64–74 days. Embryos capable of estivating in their egg until the rainy season's flooding stimulates hatching. Thus total incubation period is to 102 days.

Mortality/Longevity: Eggs and adults taken for food by Papua New Guineans. Australian aborigines eat adults of this species.

Conservation Status: Listed as Vulnerable by the IUCN. Trampling of nests by water buffalo, fishing, logging, grazing, agriculture and hunting are among negative effects.

Remarks: Australian populations were not discovered by biologists until 1969.

Species first described from the Fly River of New Guinea in the 1800s.

Secretive animals. Use forelimbs to burrow by scooping sand substrate over their carapace.

Adults may thermoregulate underwater by lying over small thermal springs.

Only extant species in its family.

Matamata
Chelus fimbriatus (Latin = "fringed turtle")
(Chelidae)
Australo-American Snakenecked Turtles

Distribution: Amazon Basin, South America.

Habitat: Active nocturnally in lakes, ponds and sluggish creeks. This sideneck lives near the bottom of turbid waterways and rarely leaves the water.

Appearance: Length to 40 cm. Broad, three-keeled brown carapace. Long thick neck, triangular head with tiny eyes. Large mouth, weak jaws. Snout is "snorkel-like: proboscis with nostrils at the top. Well camouflaged; algae grows on its carapace.

Diet: A "lay-in-wait" predator. Fishes captured with the "gape and suck" technique: open mouth creates a vacuum to draw in prey, mouth snaps shut, water expelled, and the fish

is swallowed whole.

Reproduction: Male attracts a mate by repeatedly extending the head toward the female and opening and closing its mouth. Fertilization internal. Female lays 12–28 ping-pong ball sized brittle-shelled eggs terrestrially. The eggs hatch about 200 days after being laid.

Mortality/Longevity: Life span: up to 15 yrs. in captivity.

Conservation Status: Reported to be locally common.

Remarks: South American Indian name "matamata" translates as "*I kill*."

A poor swimmer; its legs are adapted for walking over bottom of habitat.

Has been described as most resembling a pile of debris. Slow movement, mottled colors, and algal coating all combine to create the illusion.

Alligator Snapping Turtle

Macrochelys temmincki (Chelydridae)
Snapping Turtles

Distribution: Southeastern United States and Central America.

Habitat: Primarily quiet, muddy freshwater, rivers, streams, lakes and ponds; leaves water only to deposit eggs. Juveniles occasionally near bottom of small mud and gravel streams, to 9–29 cm deep.

Appearance: Big head, long tail. Three ridge keels on the broad carapace rise to knobby keels. Length to 80 cm, weight to 113 kg. Males have been known to exceed 100 kg; females are much smaller. The largest individual turtle in the exhibit is over 55 kgs. The rest are likely ~45 kg.

Diet: Lie-in-wait predator. Rests on substrate with its mouth open and lures fish to its mouth with a movable, pink wormlike tongue appendage. Also takes crayfish, crabs, snails, freshwater mussels, salamanders, snakes, very small alligators, small mammals, water birds, briar roots, wild grapes, acorns, and scavenges as well. At the Steinhart, are fed fish, including herring and tilapia. Because they are accustomed to being feed regularly, they are rarely tempted by their tankmate fish.

Reproduction and Development: Male climbs onto the female's carapace from behind. As in all reptiles, fertilization is internal. Female's terrestrial nest is typically within 72 m. of water. A single clutch of 9–61 eggs (35 average) is laid per year. Larger females produce larger clutches. Incubation lasts 79–113 days, depending on temperature. Warm and low incubation temperatures result in all female neonates. Intermediate incubation temperatures produce mostly males.

Mortality/Longevity: Life span: to 100 yrs. (A second source suggests 150 yrs) Eggs preyed upon by raccoons, river otters and wading birds. Humans collect adults for food.

Conservation Status: Listed as Threatened on the IUCN Red List. CITES Appendix III. Still harvested as the key ingredient of turtle soup. Habitat degradation also threatens them. Hatchlings produced for the pet trade.

Remarks: This is the largest freshwater turtle in North America.

Can swim, but most locomotion is by bottom-walking.

Can remain submerged for about an hour.

Despite its reputation, the species does not readily bite; however, its powerful jaws and sharp beak can easily sever a finger, bone and all.

Some living Steinhart specimens were "rescued" in 1972 from a "turtle soup" fate from a restaurant in San Bruno. A few months earlier than the arrival of their shipment by air, the California Fish and Game Commission had adopted regulations restricting snapping turtle importation, a law that remains on the books, and so they were confiscated and ultimately released to the Steinhart. Our middle-aged, lucky survivors are thought to be at least ~40–50 years old.

Arrau River Turtle aka South American River Turtle

P*odocnemis expansa* (Pelomedusidae)
Afro-American Side-necked Turtles

Distribution: Northern South America: Amazon, Negro and Orinoco River basins.

Habitat: Freshwater; large rivers and their tributaries, lagoons and forest ponds. Restricted to calm waters of large rivers during the dry season, but move into the flooded forest where food is plentiful during the high-water season.

Appearance: Max. size: 100 cm. Carapace broad, flat; wider in the back than the front. Males smaller than females, which can weigh up to 90 kg.

Diet: Aquatic vegetation and fruit, also insects and sponges. Eats during the rainy season when the forest is flooded; fasts during dry season. In captivity, feeds on a vegetarian/fruit diet with a bit of fish added.

Reproduction: During the dry season, migrate to nesting sites on beaches. Females dig a nest in which they lay 50–150 spherical eggs, and then cover them with sand. After about 45 days, hatchlings emerge, usually at night or early morning to avoid midday heat and predators, and head directly to water. Colonial nesting and simultaneous hatching helps maximize survival numbers of this perilous journey. Hatchlings' carapace is quite small, about 5 cm long.

Mortality/Longevity: Recent studies on the growth patterns of bones and carapace suggest these turtles can live up to 50 years. Though young are vulnerable to predation, the massive size of adults protects them from most predators except man.

Conservation Status: U.S. Fish and Wildlife Service: Endangered; IUCN: Endangered; Lower risk, conservation dependent. Eggs and adults have been overcollected for food. These turtles are considered rare throughout the Amazon.

Remarks: A fossil Pelomdusid is thought to be the largest freshwater turtle to have ever lived (carapace length: 230 cm). Even today, the Arrau is one of the largest freshwater turtles in the world.

Sidenecked turtles have a long neck which can be withdrawn horizontally within the shell, leaving it partly exposed, rather than retracting it in a vertical 'S' bend as in most other turtles.

Our handsome "fellow" (sex unknown) is on loan from the San Francisco Zoo during the renovation of their Tropical Building.

Weight: 20 kg. Age: unknown.

"Art," as we call our turtle, was confiscated in Miami and came to the SF Zoo via the Miami Metro Zoo in 1997.

Radiated Tortoise

Astrochelys radiata (Testudinidae)

Distribution: Occur naturally only in the extreme southern and southwestern part of Madagascar.

Habitat: They prefer dry regions of brush, thorn and woodlands.

Appearance: The basic "tortoise" body shape: high-domed carapace, a blunt head, and elephantine feet. Legs, feet and head are yellow except for a black patch on top of the head. Carapace is brilliantly marked with yellow lines radiating from the center of each dark plate of the shell, creating a star pattern.

Diet: Grazing herbivores, they also eat fruits and succulent plants. A favorite food in the wild is the *Opuntia* cactus.

Reproduction and Development: The male begins this fairly noisy procedure by bobbing his head and smelling the female's hind legs and cloaca. He mounts her from the rear, hissing and grunting, while striking the anal region of his plastron against the female's carapace. Females lay from 3–12 eggs in a pre-excavated hole about 15 cm deep and then depart. Incubation is between 5–8 months; juveniles are between 3–4 cm upon hatching and soon after attain the high-domed carapace. They can grow to a carapace length of up to 40 cm and weigh up to 16 kg.

Mortality/Longevity: Radiated tortoises may live as long as 40–50 years.

Conservation Status: Critically endangered in the wild due to loss of habitat, being poached for food, and being over exploited in the pet trade.

A team of biologists from the Turtle Survival Alliance predicts that unless drastic conservation measures take place, the species will be driven to extinction within the next 20 years. Conservation efforts: habitat preservation, environmental education programs, and captive breeding. *A. radiata* is included in the Species Survival Plan of the worldwide Association of Zoos and Aquariums.

Remarks: These cold-blooded reptiles move from place to place to moderate their body heat and are active after rain. Traditional cultures revere the tortoise (it brings rain; when there are no more animals, there will be no more rain).

Like other tortoises their shell is supplied with blood vessels and nerves, which enables it to sense when being touched.

In some areas of China, a radiated tortoise

can sell for over $50, as it is believed to have aphrodisiac properties.

When caught, this tortoise emits high-pitched cries, sometimes lasting an hour after capture. This noise would startle a predator in the wild, an effective defense.

Pancake Tortoise

Malacochersus tornieri (Testudinidae)

Distribution*:* Confined to Kenya and Tanzania and a small population recently reported in Zambia.

Habitat*:* Lives among rocky outcroppings in dry areas of scrub brush.

Appearance*:* Unlike most tortoises, the pancake tortoise sports a soft, flexible shell rather than a rigid, thick one. Its common name reflects its flat-as-a-pancake profile. Length: 6–7 inches (15–18 cm); height: 2 inches (5 cm).

Diet*:* Grasses and other vegetation, including red oat grass and aloe. Also eats seeds and nuts. During the dry season, the diet provides sufficient moisture.

Reproduction and Development: Mating occurs in January, egg laying and nesting in July and August. The female generally lays a single egg per clutch and several clutches may be laid per year.

Mortality/Longevity: Because of the soft shell, this tortoise is easy to tear apart though not so easy to catch, an evolutionary tradeoff that seems in the natural predator-prey cycle to favor the tortoise. Mongooses and predatory birds are among its predators

Remarks: Its flat and flexible shell allows it to shelter in narrow crevices. Once tightly lodged in its cranny, the tortoise then braces its legs against the rock. These maneuvers usually thwart even the most determined predator's efforts to dislodge it. They live communally, with several tortoises peaceably sharing a crevice.

Because of its light shell, the animal is the fastest tortoise known and depends on escaping danger by dashing for the nearest crevice hideout rather than by withdrawing into its shell. Its relative lightness and agility also enable it to flip over quickly if turned on its back, an advantage for an animal that spends most of its day climbing over and perhaps falling from steep. rock-strewn hills.

Spider Tortoise aka Madagascar Spider Tortoise

Pyxis arachnoides (Testudinidae)

Tortoises

Distribution: Southwestern Madagascar.

Habitat: Dry deciduous forest.

Appearance: Highly variable among subspecies.

Diet: Opportunistic browsers.

Reproduction and Development: Sexual maturity at ~12 years; clutch size 1 egg.

Conservation Status: IUCN: Critically Endangered because of habitat loss and its popularity in the pet trade due to its small size and the handsome design on its carapace. Low reproductive rate exacerbates these pressures. Will likely be extinct in the wild in less than 30 years; global climatic change not included in that dire conclusion.

ORDER CROCODYLIA

American Alligator

Alligator mississippiensis (Crocodylidae)

Distribution: Southeastern United States, from North Carolina to the Rio Grande in Texas. The wetlands it inhabits frequently overlap with human-populated areas.

Habitat: Usually found in freshwater, especially in slow-moving rivers. They are also found in swamps, marshes, and lakes. They can tolerate salt water only briefly.

Appearance: Average female length is 2.6 m; average male length is 3.4 m. The largest recorded male was 5.8 m long. Exceptionally large males can weigh over 450 kg. Alligators have between 74 and 80 teeth, which are replaced as they wear down; an alligator can go through 2,000 to 3,000 teeth in a lifetime. The tail, which accounts for half of the alligator's total length, is primarily used for aquatic propulsion, but is also an effective defensive weapon.

Diet: Alligators eat almost anything, but primarily consume fish, birds, turtles, mammals and amphibians. Hatchlings mostly eat invertebrates. Once an alligator reaches adulthood, it will prey on any animal that lives in the water or comes there to drink. Adult alligators will eat domestic animals including cattle, and will also kill and eat smaller alligators. Larger males have been known to tackle Florida panthers and bears, making the alligator the apex predator throughout its distribution.

Small prey is swallowed whole. Large prey is crushed by the sharp teeth, then slapped against water or shore to break off manageable pieces. Very large prey will be rolled underwater until the victim drowns, then guarded until the meat rots enough to be ripped apart and swallowed.

The stomachs of alligators often contain gastroliths, which grind up food in the stomach and help with digestion.

All crocs store fat in their tails, so they can go for long periods without eating if necessary—as long as two years for some big adults!

Reproduction and Development: Both males and females reach sexual maturity at about 10–12 years of age. Breeding takes place during the night, in shallow waters. Males roar to attract females and to ward off other males. Courtship starts in April, with mating occurring in early May.

After mating, the female builds a nest of vegetation. The nest measures about 2 m–3 m in diameter and about 0.5 m to 1 m in height. In late June or early July, the female lays 35–50 eggs. The eggs are then buried within the nest for a 65-day incubation period. The sex of the juveniles is determined by the temperature of the nest: above 34° C all are male, below 30° C all are female, and temperatures in between result in both sexes.

Toward the end of August, the young alligators make high-pitched noises from inside the egg. The mother then removes the nesting material. Upon hatching the alligator measures about 15 cm–20 cm. Newly hatched alligators live in small groups. Birds and raccoons eat 80%. Other predators include bobcats, otters, snakes, large bass, and larger alligators. Females aggressively defend their young during the first year (occasionally for 2 or even 3 years). This maternal care is unusual among reptiles.

Mortality/Longevity: After it is 1.25 m long, an alligator is safe from predators except humans and occasionally other, larger alligators. American alligators may live about 50 years in the wild.

Conservation Status: Although once on the verge of extinction, it is no longer endangered except in scattered parts of its range. A combined effort by the U.S. Fish and Wildlife Service, state wildlife agencies, and commercial alligator farms saved these unique animals. However, the American alligator is still listed as threatened on the U.S. Endangered Species List because it looks like the American crocodile, which *is* endangered, and hunters are likely to confuse the two species. Hunting is allowed in some states, but it is strictly controlled. The greatest current threat is habitat destruction; this includes water management systems and pollution.

Remarks: Spanish sailors thought this animal was a huge lizard. In Spanish, "el lagarto" means "the lizard." English sailors took the name as "allagarter" and in time it became '"alligator."

Despite shared habitats, alligator attacks on humans are fairly rare. There were only nine fatal attacks throughout the 70s, 80s and 90s, although alligators killed 11 people from 2001 to 2006. Most alligators fear humans; attacks often result from feeding. Once an alligator is fed by a human, it expects food whenever it sees someone.

Differences between alligators and crocodiles:

- Alligators tend to have wide, U-shaped, rounded snouts, while crocodiles tend to have longer, more pointed, V-shaped snouts.
- The large lower fourth tooth of an alligator fits into a socket in the upper jaw and is not seen when the mouth is closed, whereas in crocodiles this tooth is visible.
- Alligators live in freshwater; crocodiles tend to inhabit salt water.
- On average alligators are smaller than crocodiles.

Claude is a male, 15 years old, 2.5 m (8.5 ft) long, and weighs ~82 kg, (181 lbs); born in captivity in Florida. (2010)

Claude is a true albino, meaning that he is unable to produce melanin in his skin or eyes. In fact, the pinkness/redness of his eyes is due our ability to see the blood/blood vessels through his irises.

Albinism is a naturally occurring (recessive) genetic condition and is found in many kinds of animals, ncluding rats, birds, humans, tigers, etc.

Like all albino animals, Claude has reduced vision and is vulnerable to UV rays from the sun. Because of these issues, and the fact that albinos are easily seen and eaten by predators, they rarely survive in the wild.

Gars and snapping turtles would be an alligator menu item in the wild. Fortunately, Claude is satifsfied with "gator chow." large pellets comprised of "meat," fish meal and vitamins.

Alligators remain on average about 10–15 minutes underwater before going to the surface for air. Dives may occasionally last longer, but alligators have also been known to drown within 20–30 minutes if held struggling underwater.

ORDER SQUAMATA (LIZARDS AND SNAKES)

Saharan Spiny-tailed Lizard

Uromastyx geyri (Agamidae)

Distribution: North Africa, including parts of Algeria, Mali, and Niger.

Habitat: Rocky, semi-arid areas.

Appearance: Beige or orange with lighter spots. A red phase is bright red to a near-neon orange. Females paler with less vivid patterns. Length: c. 35 cm.

Diet: Primarily herbivorous. Acquire most of their water from vegetation. Have powerful jaws capable of eating cacti, especially if they need water.

Reproduction and Development: Eggs incubated 70–80 days before hatching.

Conservations Status: An uncommon species, but total numbers seem to be holding steady in spite of increased import for the pet trade.

Remarks: Hide in underground chambers during the heat of the day or to escape predators. In the wild, *Uromastyx* burrows may be as deep as 3 m.

The thick spiked tail is characteristic of all *Uromastyx* species, thus the common name.

Green Iguana

Iguana iguana (Iguanidae)

Distribution: Widely distributed from Mexico to southern Brazil and Paraguay, as well as on Caribbean Islands.

Habitat: Tropical rainforests at low altitudes. Is arboreal and spends most ofi its time in the canopy, 12–15 m above ground, coming down only to mate, lay eggs, and change trees.

Appearance: Green iguanas are among the largest lizards in the Americas: 2 m in length, 5 kg weight. They can be various shades of green, ranging from bright green to a dull gray-green. The skin is rough with a set of pointy scales along the back. They have long fingers and claws to help them climb and grasp branches. Males have a flap of skin, called a dewlap, on the ventral side of the neck. It can be inflated to make them seem larger, to attract females, and to adjust their body temperature. The tail is almost half their length, and can be used as a whip to drive off predators. They can detach their tail if caught, and it will grow back.

Diet: Primarily herbivores, eating plants, especially leaves and fruit.

Reproduction and Development: Iguanas reach sexual maturity in 2–3 years. Green iguanas breed at the onset of the dry season. A month or two later, the females lay a clutch of 14–76 eggs in burrows excavated in communal nesting sites. At the end of a three-month incubation period, the newly hatched iguanas emerge. Because hatching takes place during the rainy season, food is plentiful.

Mortality/Longevity: Reptiles, birds and mammals prey upon the hatchlings. Less than 3% live to adulthood. Adults are highly prized for their meat, and are hunted by humans. They are also captured for the pet trade.

Conservation Status: The green iguana has become extinct in some countries and is endangered in others because of excessive hunting and habitat loss. In Costa Rica a program is being developed to breed and raise green iguanas in semi-captivity. After successful breeding, the hatchlings are maintained for 6–10 months, then released into the surrounding area with supplemental food and protection. When they are adults, some are harvested for food and to generate income by supplying leather for handicrafts. Such programs have decreased forest destruction and helped to protected wild iguanas.

Remarks: In parts of Central America where iguanas are eaten for food, they are called "bamboo chickens" or "chicken of the trees."

Green Basilisk Lizard

Basiliscus plumifrons (Corytophanidae)

Helmeted Lizards

Distribution: Central and South America.

Habitat: Arboreal and semi-aquatic; inhabit the trees and bushes of the rainforest, often along riverbanks.

Appearance: Length, including tail, can be up to 85 cm. Adult color is bright green, or slightly blue-green. Males have distinctive, high crests on their heads and backs, which they use to impress females. The females have only one small crest. During the first months of their lives, young ones are a brownish/olive green color, with bright green heads.

Diet: Omnivores: plant material, insects, fruit, and small vertebrates.

Reproduction and Development: In Costa Rica breeding occurs during the wet season, May to September. Pregnant females prepare a shallow trench where they lay up to 20 eggs. Female then leaves the eggs to hatch on their own. Incubation period is about 2 months. Hatchlings are born with the ability to run (on land and water), climb, and swim.

Mortality/Longevity: Life span is up to 10 years in captivity. In the wild raptors, opossums, and snakes prey upon the lizards.

Remarks: The green basilisk lizard has been called the "Jesus Christ" lizard, because of its ability to walk on water. The rear feet have long toes with fringes of skin that unfurl in the water, increasing surface area. The lizard rapidly moves its legs as it slaps its splayed feet hard against the water. This creates tiny air pockets that keep it from sinking, provided it keeps running fast enough. It can move along the surface for 4.5 meters or more. When gravity eventually takes over, the basilisk is an excellent swimmer.

Jackson's Chameleon

Chamaeleo jacksonii (Chamaeleonidae)
Chameleons

Distribution: In the wild, live only in the woodlands of East Africa.

Habitat: Arboreal; spends most of its time off the ground in bushes and shrubs, but sometimes in taller trees.

Description: Length to 30 cm including tail. Bright green coloration as adults. Male has three rostral horns that begin to develop at about 4 months. Female lacks or has reduced horns. Male also tends to be more brightly colored, with blue or yellow markings. Well camouflaged by its color in the lush woodlands it prefers, it can, like most chameleons, change color quickly depending on mood and temperature, or as a mode of communication.

Diet: Opportunistic: primarily insects.

Mortality/Longevity: Preyed upon by snakes and large birds.

Reproduction: Most chameleons are egg layers, but the Jackson's gives birth to live young, 10–50 at a time. Gestation period: 6–9 months. Young brownish at birth, taking on brighter green coloration at about 5 months. Strongly territorial animals, they live singly, with both males and females maintaining individual territories except during mating season.

Remarks: The Jackson's tongue, which extends 1½ times the length of its body, can extend to capture prey more quickly than the human eye can see—in 30–50 milliseconds! The tongue's sticky, suction-cup tip sticks to prey, which is drawn into the large mouth and crushed.

All chameleons have specialized feet that allow them to grip branches securely; each toe also has a sharp claw that increases traction.

The long tail is often curled, but can be used for balance and sometimes as a weapon.

The eyes rotate independently, a feature that increases depth focusing as well as wide-range vision.

This species was accidentally introduced into the wild in Hawaii. The large breeding population there now supplies the pet trade.

Panther Chameleon

Furcifer pardalis (Chamaeleondae)
Chameleons

Distribution: Coastal Northern third of Madagascar.

Habitat: Humid disturbed scrub and forest. Arboreal.

Appearance: Length to 56 cm. Laterally compressed body, prehensile tail, zygodactylous feet. Protruding eyes covered with muffler-like lids. Independent eye rotation. Extensile tongue. Color variable; can change due to alterations in light, heat and emotional state. Sexes dichromatic rather than dimorphic.

Diet: Forages diurnally for insects, small vertebrates and vegetation.

Reproduction and Development: Lays 10–46 eggs after about 45 days following copulation.

Can produce four clutches per year. Young hatch 4–9 months later, depending on climatic conditions. Growth is rapid. Sexual maturity at 6–9 months.

Conservation Status: CITES Appendix II . In 1998, 34,000 wild-taken of this species were exported from Madagascar for the pet trade. CITES established an export quota of 2000 in 1999.

Sakalava Velvet Gecko

Blaesodactylus sakalava (Gekkonidae)
Geckos

Distribution: Southwest Madagascar.

Habitat: Found in semi-humid forest areas under bark, in crevices of rock or on trees.

Appearance: Bodies broad with wide transverse bands across the back. Color ranges from brownish to gray, and changes depending on mood. Eyes are orange/brown or steel gray. The skin is velvet to the touch.

Diet: In captivity eats all kinds on insects and their larvae, as well as fruits.

Reproduction and Development: After mating a female will lay 6 to 12 eggs per season. It takes 45 to 50 days for the eggs to hatch.

Mortality/Longevity: Can live 10 to 25 years in captivity.

Remarks: One of three species of the genus *Blaesodactylus*, all found in Madagascar. Formerly classified in the genus *Homopholis*.

Sakalava velvet geckos have not been studied in detail in the wild, and they are not commonly held in captivity, so there is still a lot to learn about them.

Electric Blue Day Gecko

Lygodactylus williamsi (Gekkonidae)
Geckos

Distribution: Found only in the Kimboza Forest in eastern Tanzania.

Habitat: Tropical forest.

Appearance: A dwarf gecko. Male: bright blue with black throat. Female greenish, little or no black on throat. Max. length: 10 cm; usually closer to 6 cm.

Diet: Insects, nectar. Unlike most geckos, is active during the day.

Mortality/Longevity: Life history not well known; perhaps up to 10 years.

Conservations Status: IUCN: not evaluated, but deforestation within their limited range threatens survival in the wild for this species. They breed well in captivity, which presents hope for their future.

Remarks: Geckos, like lizards, have fracture planes in the tail so it breaks off easily, a handy adaptation to escape predators, but with a downside: the tail stores fat, which can be a lifesaver in hard times.

Madagascar Giant Day Gecko

Phelsuma grandis (Gekkonidae)
Geckos

Distribution: Found in northern Madagascar, Seychelles, and smaller islands close to Madagascar.

Habitat: Canopy of tropical rain forests.

Appearance: Largest species of the genus *Phelsuma*, 23–27 cm. They are bright green, with granular red spots on the body and a red line running from the eye to the tip of the nose. The eyes, surrounded by blue rings, have round pupils, indicative of a diurnal life style.

Diet: Mostly insects and other invertebrates; also soft sweet fruit, nectar, and pollen.

Reproduction and Development: Breeding season is between November and the first weeks of May. During this period, the females lay up to 6 pairs of eggs. Young hatch after approximately 60–65 days. Juveniles measure about 7 cm and reach sexual maturity after one year.

Mortality/Longevity: Life span: up to 10 years in captivity.

Conservation Status: Listed in Appendix II of CITES.

Remarks: Many geckos can make sounds to attract mates, to advertise their territories, to warn off unwanted intruders or to frighten predators. Herpetologist Ulrich Gruber described the sound produced by the Madagascar day gecko as resembling "the croaking of a tormented frog."

Like many species of geckos, the giant day gecko does not have eyelids. Instead the lids have fused, and the eye is covered with a large transparent scale. Geckos keep their eyes clean by licking them with their broad flat tongues.

The eye color of many diurnal species is much like the skin color. Their eyes blend into their heads, which in turn blend into the surrounding foliage of the geckos' habitat.

Klemmer's Yellow-headed Day Gecko

Phelsuma klemmeri (Gekkonidae)
Geckos

Distribution: Found only in northwest Madagascar.

Habitat: Medium-sized bamboo in fragmented "bamboo islands." When disturbed they hide in the cracks in older dead bamboo.

Appearance: Dorsal color is brown to turquoise with turquoise bands. A black lateral line runs from the eyes to the hind legs. The head and neck are yellow. The ventral surface is whitish; scales are small and smooth. Adults are about 9 cm long.

Diet: In captivity, eat a variety of insects, including crickets and fruit flies, but will also eat fruit baby foods. They also eat fruits such as guava, papaya, and peaches. In the wild, they avoid the hotter part of the day and usually hunt and forage in the early morning, late afternoon, or right after a shower.

Reproduction and Development: Males reach sexual maturity at about 6 months and females will start producing eggs at around 8 months. Sexual maturity depends on size more than age. Breeding can occur at anytime of year, and females will lay eggs every 3–5 weeks. The developing eggs become visible through the underside of the female before the eggs are laid. By this time her once flattened body is so large it looks as though she'll explode! Like most geckos, usually lay 2 eggs at a time, often inside a hollow piece of bamboo. The babies are iridescent and look like tiny copies of the adults. Newborn *klemmeri* weigh a mere 0.1 g at birth.

Mortality/Longevity: No specific information found. Many geckos live between 5 and 10 years.

Conservation Status: Species is widespread on the Ampasindava peninsula; they may not be as threatened as once feared. Their habitat was confined to fragmented "bamboo islands," but the slash and burn techniques to clear land actually increased habitat, since bamboo forests have replaced previously cleared lands.

Remarks: This species of *Phelsuma* was first described in 1990.

Geckos have very special feet that contain millions of hairs capable of producing electrical forces, probably van der Waals forces. These forces, which are molecular and not caused by a sticky substance, allow the gecko to attract any surface, even polished glass.

Standing's Day Gecko

Phelsuma standingi (Gekkonidae)
Geckos

Distribution: Limited range within southwest Madagascar.

Habitat: Dry thorn forests. Arid to semi-arid regions where vegetation consists of thorny succulent plants and baobab trees.

Appearance: Large for a gecko, mostly stocky 25 cm. total length. Individuals can occasionally reach 30 cm. Base color is usually light gray or brown with darker fine reticulations. Hatchlings have much brighter coloration with strong green and blue banding on a dark background. The pattern and colors gradually fade as the animals grow.

Diet: Insects, fruit, nectar and possibly other lizards.

Reproduction and Development: Established adult pairs will tolerate juveniles until they reach sexual maturity. Eggs most often laid in pairs that are "glued" to each other. As in many reptile species, sex of newborns is temperature dependent.

Remarks: If inactive, the coloration of this day gecko is often duller, giving it an overall grey appearance. When cool it takes on darker colors to help absorb light and heat and when hot it turns pale.

Kuhl's Flying Gecko

Ptychozoon kuhlii (Gekkonidae)
Geckos

Distribution: Southeast Asia, including southern Thailand, Malaysia, Borneo, Indonesia, and Singapore.

Habitat: Nocturnal arboreal animals, found in lowland and mid-level rainforests.

Appearance: Weird looking with big heads, bulging lidless eyes, and elaborate webbed feet. Gliding apparatus is composed of a large flap of skin along the flank. These flaps remain rolled across the belly until the lizard jumps off a tree. Then the flaps open passively in the air, acting as a parachute during descent. Additional flaps lie along the sides of the head, neck, and tail. These geckos are nocturnal and

cryptic, and often go unnoticed in their natural habitat.

Diet: Insects and arthropods.

Reproduction and Development: In captivity, breeding occurs when the animals are exposed to about 12 hours of daylight. The female will lay two eggs about once a month. She can lay five or six clutches per season. Eggs will hatch in 2–3 months.

Mortality/Longevity: Can live up to 7–9 years.

Remarks: Some unusual characteristics of geckos:

- Can vocalize, unlike most lizards, using their voice to threaten, or for sexual attraction.
- Most have specialized toe pads that contain thousands of microscopic hooks. These hooks catch microscopic irregularities of surfaces and enable geckos to seem to defy gravity as they walk.
- Geckos have remarkable eyes. Their irises resemble their skin color, so that their open eyes do not give them away to predators. Their lower lid is fused over the eye to form a transparent spectacle for protection; they can use their long tongue to clean them!
- Scientists at UC Berkeley have developed an adhesive that has qualities of gecko feet—easy attachment and release while having great holding strength. It won't slip or slide, but will release if lifted. Such an adhesive may be useful when movement and attachment are both desired, such as for climbing, or for robots.

Henkel's Leaf-tailed Gecko

Uroplatus henkeli (Gekkonidae)
Geckos

Distribution: Limited range in northwestern Madagascar and on Nosy Be, an island off the northwest coast of Madagascar.

Habitat: Malagasy rainforest. Arboreal, inhabits mid-section of trees; not usually found on the ground.

Appearance: A master of camouflage: its grey-brown skin blends in with the colors of tree bark. The fringes of skin along its head and body mask shadows by breaking up the outlines of its body. The charcoal/light grey patterns on some individuals' bodies look like lichen. The short flat tail, for which the genus was named (*uro* – "flat," *platus* – "tail"), looks like a dead leaf. The bulging eyes on its flat triangular head have pupils with vertical slits, an indication of a nocturnal life style.

Diet: Nocturnal predator, eats mainly insects.

Reproduction and Development: Lays clutches of just two spherical eggs. Eggs are deposited on the forest floor hidden under fallen leaves, beneath pieces of wood, or among dead leaves still attached to a plant. Following a 3-month incubation period, the eggs hatch to reveal juveniles that are about 6 cm long.

Mortality/Longevity: Life span in the wild believed to be 3–5 years. Species has lived up to 15 years in captivity.

Conservation Status: Listed in Appendix II of CITES.

Remarks: Use several tricks to help escape predators. Like most lizard species, geckos can shed their tails. A new, shorter tail will grow back.

In addition this gecko can frighten enemies by opening its mouth wide to reveal the bright red interior.

Also some geckos, including this one, have vocal cords, the only lizards that do. Its defensive behavior is often accompanied by loud distress calls.

Great Plated Lizard

Gerrhosaurus major (Gerrhosauridae)
Plated Lizards

Distribution*:* Widely distributed in eastern and southeastern Africa. Found in the Somali Arid Zone.

Habitat*:* Favors rocky terrain in semi-arid steppe or grassland. May also use burrows of other animals or termite mounds for shelter.

Appearance*:* Length: snout to vent, c. 9 inches (23 cm); tail of equal length. Their heavy armor of large, bony, keeled scales, especially on the dorsal surface, gives them their common name. Moderately long tail is covered by rings of scales. Scaleless area along the sides functions as expansion joints for gravid females or distention after feeding. Color grayish brown; males are larger and sport bright-colored throat. Stout cylindrical body. Non-venomous.

Diet: Young eat fruit, leaves, and other vegetation; also spiders, insects, and other small invertebrates. Adults will also eat small mice and other rodents, as well as smaller lizards. They are sit-and-wait predators, disguised from prey by their coloration and stillness. In captivity, their diet may consist of live crickets, chopped fruits and vegetables, and small pinkie mice.

Reproduction and Care of Young: Females lay 4–6 eggs in a shallow depression, which is then covered. Eggs hatch in three–four months; hatchlings are about 4–6 inches (10–15 cm) long. Life span: to 24 years.

Mortality/Longevity: Primarily snakes.

Remarks: Males are territorial. When threatened often run to hiding places among rocks where they wedge themselves into crevices. May also run a short distance, then stop abruptly with tail raised, perhaps confusing would-be attackers.

A favorite in the pet trade, this lizard has a generally calm temperament.

Madagascar Plated Lizard

Zonosaurus sp. (Gerrhosauridae)
Plated Lizards

Distribution: *Zonosaurus* lizards comprise a genus of 17 species of plated lizards, all found in Magagascar and all but one (*Z. madagascarensis*) endemic to that country. Found in all ecoregions, they are common in eastern Madagascar, but also known in the west and south and on some offshore islands.

Habitat: A wide range of habitats in Madagascar, depending on the species, from montane rainforests to rocky crevices, to sand dunes of the spiny desert. Normally found in dry, open landscapes, they also adapt well to field edges and secondary thickets. Even found in the zsingy, the fantastic limestone formations that create a "forest" of rocky spires that harbor many rare animals.

Appearance: Plated lizards are medium-sized (up to 36 cm) with an elongate, slightly flattened body. A prominent lateral fold running the length of the flank allows considerable expansion of the body. The tail is almost twice as long as the body. Ground color is brown, with two yellow lateral stripes that run from the eye to the base of the tail. The color of the flanks is variable, but is usually mottled with white and dark scales. Belly is grayish white, but may be reddish on the throat.

Diet: Active diurnal foragers. Most species eat a variety of insects, though some species also seek fruits and berries.

Reproduction and Development: Internal fertilization. The female lays a small clutch (up to 5) of large, elongate eggs in moist soil or within a rock crack.

Conservation Status: Some species and subspecies are listed by IUCN: Vulnerable.

Remarks: One of the most unusual behaviors of the plated lizards is that they sunbathe, or bask, in an odd position. They lie on the belly with their arms and legs held up in the air.

When frightened, which happens quite often for this shy species, they quickly run for cover under a bush or in some other hiding place or bury themselves in loose soil by moving their arms and legs as if they were swimming. Sometimes they will stay underground for 24 hours before coming above ground again.

Relatively peaceable lizards, they rarely bite, preferring instead to flail the spiked tail like a whip, an effective defense.

Mexican Beaded Lizard

Heloderma horridum (Helodermatidae)
Gila Monsters

Distribution: Western coast of Sonora, Mexico south to Western Guatemala.

Habitat: Tropical, deciduous woodland and thornscrub. Frequently climbs trees. Often diurnal, on very hot days remains in burrows and emerges to hunt at night.

Appearance: Length to 1 m. Stout body covered with dark brown and yellow beadlike scales. Powerful limbs, long fat tail.

Diet: Young rodents, fledgling birds, eggs, reptiles, arthropods. Chemosensorily locates food with its forked tongue.

Reproduction and Development: Mating takes place in spring. Copulation can last for nearly 1 hour. Female lays 8-10 leathery eggs and buries them in shallow nests in sunny locations.

Conservation Status: Listed as Vulnerable by IUCN. CITES Appendix II. Dry forest and desert habitat loss is the greatest threat, followed by collection by unscrupulous dealers and hobbyists. Fully protected on paper: cannot be

killed, molested or collected.

Remarks: Venom is used more for defense than for stunning prey. Venom is in lower jaw (vs. in upper jaw in venomous snakes).

The two members of this family, which also includes the Gila Monster (*Heloderma suspectum*), are the only known venomous lizards.

Their tenacious, chewing bite is potentially, though rarely fatal to humans.

Redtail Boa aka **Boa Constrictor**
Boa constrictor (Boidae)
Boas

Distribution: Northern Mexico south to Central and Northeast South America to 35° south latitude, Lesser Antilles, Dominica, St. Lucia and other small Caribbean islands.

Habitat: Deserts, grasslands, arid woodlands, rainforests, also near human habitation. Primarily terrestrial but can climb and swim well. Active crepuscularly or nocturnally. Spends much time arboreally. Also shelters in burrows of agoutis, pacas and armadillos.

Appearance: Varies by subspecies. Many are gigantic, camouflaged brown with saddle markings. Length to 5.6 m. for mainland boas; most are much smaller.

Diet: Primarily ambush hunters. Rodents killed by constriction. Also consume bats, monkeys, squirrels, agoutis, pacas, birds and reptiles including ameivas, tegus and iguanas.

Reproduction and Development: Reproductive in their second to fourth year. Fertilization internal. Viviparous. 15-60 offspring per clutch born 120-145 days after ovulation. Neonates average 45 cm.

Mortality/Longevity: Can live to more than 25 years.

Conservation status: Not on IUCN Red List. Seems to be holding its own.

Remarks: Capable of delivering painful bites to humans.

Important predator of rodents.

The two currently on display were born at the old Steinhart Aquarium.

Emerald Tree Boa
Corallus caninus (Boidae)
Boas

Distribution: South America's Amazon basin.

Habitat: Lowland rainforest. Adults arboreal, typically in high canopy. Juveniles live in leaf litter.

Appearance: Length to 2 m. Adults: leaf-green scales with white transverse markings. Thin-bodied. Head and body heavily laterally flattened. Neonotates in a single litter may be green, red, yellow or a combination of these colors. Juveniles typically have brown bodies.

Diet: Adults seize prey with long fang-like teeth, subsequently constrict with its coils. Eat rodents (e.g., the arboreal rice rat), monkeys, squirrels, birds (passerines and parrots) and bats. Juveniles may prey on lizards.

Reproduction and Development: Fertilization internal. Live-bearing (ovoviparous). Seven-18 neonates per clutch. Offspring colored red, orange or green; change to adult green at sexual maturity.

Mortality/Longevity: In captivity the estimated life span is 25 years.

Conservation Status: Locally common.

Strong prehensile tail.

The scales of the long, slender snout contain heat-sensitive labial pits used in locating prey.

Anaconda aka **Water Anaconda**
Eunectes murinus (Boidae)
Boas

Distribution: South America: Amazon and Orinoco drainages from Colombia and Venezuela to East Bolivia and Central Brazil. Also on Trinidad Island.

Habitat: Associated strongly with watercourses, swamps and other freshwater locations.

Appearance: Length to 12 m. (another reference: to 5 m.) Gigantic, heavy-bodied, dark green boa with dark spots.

Diet: Monkeys, deer, peccaries, pacas, agoutis, birds, fish, caiman and turtles. Prey usually killed by constriction; prey suffocates but is not crushed. Usually feed in water. Primarily a lie-in-wait predator.

Reproduction and Development: Typically during the spring a group of males will court a receptive female, competing peacefully to copulate. Male vibrates his vestigial hindlimbs rapidly, rubs on the back and flanks of the female before mating. Copulatory behavior may last 2 hours. A receptive female orients her cloaca toward his hemipenis. Ovoviviparous.

Female coils around her eggs providing extra heat. She gives birth to 4-39 young, each about 80 cm in length.

Mortality/Longevity: Lives to over 29 years.

Conservation status: Not yet strongly threatened. Rarely harvested for meat. Skin trade light in most of its range. Not a popular pet due to its size and "nasty" disposition.

Remarks: Can remained submerged for a very long time lying in wait for its next meal.

Our specimen is a female. She is now (2008) 3 m long and weighs 90 lbs. In 3 0r 4 years, she's expected to be about 6 m long!

Madagascar Tree Boa

Sanzinia madagascariensis (Boidae)
Boas

Distribution: Endemic to Nosy Be, (an island on the northwest coast of Madagascar) and throughout the island of Madagascar, excluding the very southwest corner.

Habitat: Live in a variety of forest habitats, ranging from lowland tropical forests, to humid upland forests, to dry forests.

Appearance: Occurs in 2 color variations; those in the eastern part of the range are green to grayish-green, while in some parts of the western range they are yellow, orange, and brown. The green variety is somewhat smaller than the western form. Max length: about 2 m. Females are larger than males.

Diet: Hunt at night, feeding on small mammals and birds. They use heat sensitive pits around their mouths to hunt for warm-blooded animals in darkness. Once captured, they use powerful muscles to constrict the prey, decreasing blood return to the heart or oxygen intake. Prey die from cardiovascular or respiratory collapse. Boas are not venomous.

Reproduction and Development: Viviparous (like all boas), usually bearing less than a dozen bright red young. Gestation lasts 6 months and the offspring are about 25cm long. During the first year of life, they attain adult coloration.

Conservation Status: Vulnerable on IUCN Red List (2003), Listed on Appendix 1 of CITES. Although the Madagascar tree boa is part of a captive breeding program, it is threatened by loss of habitat. Only 10% to 20% of the original primary forest of Madagascar still exists.

Remarks: Although called a "tree boa" it is less arboreal than most other tree snakes, primarily using trees for hunting. They are probably best described as part-time arboreals.

The bright red color of the newborn may be aposematic mimicry, warning predators to stay away, even though boas are not venomous.

Black-headed Python

Aspidites melanocephalus (Pythonidae)
Pythons

Distribution: Northern Territory, Queensland, Western Australia.

Habitat: Open woodlands, shrublands, outcrops, humid coastal forests, and seasonally-dry tropical woodlands. Not found in very arid regions. Found among rocks and loose debris.

Appearance: A large snake with maximum length of 2.5 m, though 1.5 to 2 m more common. Head covered with shiny black scales; body a striped or brindled pattern in shades of black and gray brown, gold and cream. Juveniles more vividly marked. Females larger than males.

Diet: Other reptiles; small mammals, especially rodents. Active at night.

Reproduction and Development: Oviparous, with 5–10 eggs per clutch, incubated by female, who coils around the eggs and aggressively protects them for 2–3 months until they hatch. Reproductively mature at 4–5 years.

Mortality/Longevity: Adults have no natural predators besides dingos and humans; juveniles are subject to predation, including cannibalism.

Conservation Status: Though the species is unlisted, little is known about its numbers.

Remarks: Like all pythons, a non-venomous species that kills by constriction.

Because of its docility and handsome markings, the black-headed python is prized by collectors.

To save energy during the dry season when food and water are scarce, pythons reduce their body temperature.

Can dig and live in burrows to escape daytime heat. Small, streamlined head and non-protrusive eyes may be adaptations to entering burrows and hollows.

Valued by Aborigines as a Dream Time animal.

Woma
Aspidites ramsayi (Pythonidae)
Pythons

Distribution: Central and southwest Australia.

Habitat: Arid zones on sandplains and dune fields. Shelters in hollow logs, animals burrows, or vegetation during the day.

Appearance: Like the black-headed python, the Woma's head is unusually narrow for a python. Gray, olive, brown, or red-brown above with darker olive brown to black cross-bands on the body. Sides and undersides pale.

Diet: A nocturnal hunter of small mammals, ground birds, and lizards. Because it hunts its prey in narrow tunnels, it cannot throw coils around its target. Instead the snake pushes a loop of its body against the prey, crushing it to death against the side of the burrow.

Reproduction and Development: Oviparous, like all pythons. The female coils around the 5–20 eggs, protecting and warming them with heat generated by muscular "shivering" for the 2–3 month incubation period.

Conservation Status: Listed as endangered by IUCN in 1996. Clearing of land for agriculture and grazing and perhaps high predation by foxes and feral cats are causes for decline.

Adelaide Zoo in South Australia is coordinating a captive breeding program with offspring being released to the wild. Active research is aimed at returning the woma to its former range.

Remarks: The woma, like its relative the black-headed python, lacks the heat-sensing pits that border the mouth of most other pythons.

The woma is a prized food item for desert Aboriginal people. Hunters follow the track of a woma to its burrow and then dig it out.

Centralian Python
Morelia bredli (Pythonidae)
Pythons

Distribution: Northern Territory of Central Australia.

Habitat: Arid desert areas; most often on rocky outcrops and river banks in or around trees and shrubs.

Appearance: A large, heavily built species, unlike its two more slender Aspidites exhibit companions, who are built for burrowing. Distinct, but variable colors and pattern; often brown-to-reddish background color with cream patterning surrounded by black. Undersides lighter. Length: up to 2 m, known to reach 3 m in captivity.

Diet: Small mammals, lizards, other snakes, and birds.

Reproduction and Development: Female lays and incubates12–45 eggs, which hatch within 2–3 months.

Mortality/Longevity: Life span in captivity: 20–30 years.

Remarks: Known to be a "well-mannered" species, easy to keep in captivity and thought by many collectors to be a particularly handsome snake.

This species may be an unexpected visitor on rafters and ceilings of buildings in more populated areas.

Ball Python
Python regius (Pythonidae)
Pythons

Distribution: West and Central Africa.

Habitat: Grassland, savannah, open woodlands and agricultural areas. Nocturnally active; often shelter in rodent burrows.

Appearance: Length to 2 m. Heavy-bodied with small, slender head. Camouflage-colored: black background with brown saddles, some interspersed with black dots. Female larger than male. Young very similar to adults in color and pattern.

Diet: Nocturnally prey on rodents.

Reproduction and Development: Fertilization internal. Female mature at 3 years; some males mature at 1 year. Lay 6-8 eggs, clutch to 16 eggs. Hatchlings are ~ 41 cm in length.

Mortality/Longevity: Live to at least 49 years in captivity.

Conservation Status: Pet trade possibly threatening? Anecdotal evidence suggests that ball python populations may have benefited from deforestation.

Remarks: Rolls into a tight ball with its head at the center when frightened.

Most common python in captivity (~ 1,000,000 exported into captivity in the 1990s).

Eastern Diamondback Rattlesnake
Crotalus adamanteus (Viperidae)

Distribution: Coastal lowlands, south from the Carolinas, and west to Lousiana; range includes Florida and the Florida Keys.

Habitat: Dry forests and sandy beaches. Known to occasionally swim in salt water.

Appearance: May grow to be 2.5 m long, but 1–2 m is more common. This is the largest rattlesnake species. Notable for large pit between the nostril and eye.

Diet: Small mammals, from mice to rabbits; it will also eat birds. Diamondback locates prey by odor, as well as by sensing infrared (heat) using its pit organ. Its venom disables and predigests its prey.

Reproduction and Development: 6-21 young are born ovoviviparously. Maternal care is minimal, from a few hours to at most a few days

Mortality/Longevity: Can live 20 years or more. Adults have no natural enemies. The young are prey to carnivorous mammals, raptors, and other snakes (especially king snakes).

Conservation Status: Not listed as endangered, but populations are in decline due to habitat destruction and hunting. The rabbit population in Florida may be on the rise due to reduced numbers of these natural predators.

Remarks: The world's largest rattlesnake, it is considered the most dangerous snake in North America. A study in the late 1950s reported a human mortality rate of 30%. It has a high venom yield, up to 1,000 mg; the estimated human lethal dose is 100–150 mg. Typically, the rattler does not strike humans except when startled or provoked.

Though feared and so often persecuted by people, this snake plays an important role in rodent control.

Wagler's Pit Viper

Tropidolaemus wagleri (Viperidae)

Distribution: Southeast Asia, including southern Thailand, Malaysia, Singapore, Borneo, Sumatra, Sulawesi and southern Philippines.

Habitat: Lives in lowland tropical rainforests. Arboreal, living in low trees, and active at night.

Appearance: Juveniles and adult males are usually green or bluish green with white markings. Females change colors and markings as they mature. The adult female coloration is dependent on the geographic region of origin. They can become quite colorful with yellow, red, blue, and green transverse markings. Females are larger than males, and can be up to 1 m long.

Diet: Nocturnal hunters. Juveniles and adult males prefer lizards, especially geckos. Females eat a more varied diet, including rats, birds, frogs and lizards.

Reproduction and Development: Mating may be seasonal, occurring during the rainy season. Pit vipers are viviparous, bearing live young. Litter size from 6 –50.

Remarks: Wagler's, like all pit vipers, have heat-sensing organs on their head below and in front of their eyes (called loreal pits.) They can use these organs to sense prey, even when they can't see it.

Their venom hemotoxic, making it hard for blood to clot. Bites can cause local pain, swelling, bruising, and bleeding. They are rarely fatal to humans.

They, along with the Swamp's Eastern Rattlesnake (also a pit viper), are the only venomous snakes maintained at the Academy.

The Temple of the Azure Cloud in Penang Island, Malaysia is known as Snake Temple. It was once filled with hundreds of Wagler's pit vipers. Tourists would be photographed with the snakes. Locals collected the snakes, and the ones used for photography had had their fangs removed.

Mangrove Snake

Boiga dendrophila (Colubridae)

Colubrids

Distribution: India to Southeast Asia, including Borneo.

Habitat: Common in lowland forests, especially in riverine habitats and mangrove swamps.

Appearance: Strikingly colored, black and yellow-banded. A large snake; may grow to almost 2.5 m.

Diet: Mainly birds, but also takes fishes, frogs, small mammals, and other reptiles. A nocturnal hunter that basks on tree branches during the day.

Reproduction and Development: Lays clutches of 4–15 eggs; young hatch in 3–4 mos.

Remarks: The species, because it is isolated

on various islands in Indonesia and the Philippines, has evolved into at least 9 known subspecies. Most differ from each other by the number, length, and width of their bands. *B.d. annectens* is confined to Borneo.

Boiga spp. are known as "cat snakes" because their elliptical pupils resemble those of cats. Unlike most "cats," this animal is an adept swimmer.

A venomous species: though no human fatalities are known, its bite can be extremely painful. Researchers recently (2006) isolated a novel toxin from the venom, and determined it to be a bird-specific neurotoxin.

Paradise Flying Snake

Chrysopelea paradisi (Colubridae)
Colubrids

Distribution: Southern Thailand, Malaysia, Singapore, Indonesia and the Philippines.

Habitat: Arboreal. Lives in a fairly diverse habitat, ranging from tropical evergreen rainforests with relatively sparse undergrowth to deciduous forests with undergrowth of shrubs and grasses.

Appearance: Long slender body, reaching over a meter long. It can reach well over 1 m. Its black body is covered with a yellow spotted pattern, which may form stripes with red and orange splotches. The head has 5 yellow or orange bars that extend the width of the head.

Diet: Carnivorous and, like all snakes, swallows its food whole. Prefers lizard species but will eat frogs, bats, small birds and small rodents.

Reproduction and Development: Oviparous, with internal fertilization. Lay clutches of 5 to 11 eggs. Gestation period is not known. Offspring hatch when they are about 15 cm long and are brightly colored like adults.

Mortality/Longevity: Preyed upon by predatory birds and large mammals. The biggest threat is increased human habitation. No information on life span.

Remarks: When prey is identified, paradise snakes will strike and snare the prey with 6 rows of teeth. Once it has hold, it uses a combination of constriction and mild venom to subdue the prey.

Snakes classified in the genus *Chrysopelea* usually posses the ability to "fly." They slither out to the end of a branch, and dangle in a "J" shape. Using the lower half of their body they form into an S. They then stretch out their ribs, flattening their bodies to double the original width. The belly region of the snake becomes concave, a shape that acts as a parachute as the snake glides on air drafts from a higher branch to a lower one. They can undulate their bodies to change directions and can glide up to 300 feet.

Everglades Rat Snake

Elaphe obsoleta rosalleni (Colubridae)
Colubrids

Distribution: Native to the Kissimmee Prairie and the Everglades regions of South Florida.

Habitat: Found in the seas of sawgrass, in the open grasslands and agricultural fields, in trees or shrubs, and along waterways. Also found in the Australian pine trees planted along roads.

Appearance: Adult rat snakes range from yellow to red to black, with 4 grey longitudinal stripes; have orange eyes and a red tongue. Relatively large, reaching lengths of up to five feet. These rat snakes are skilled swimmers and are also able to climb trees as well as burrow underground. Harmless, non-venomous.

Diet: Rodents, lizards, frogs and birds in the wild; nocturnal hunters.

Reproduction and Development: Female rat snakes generally lay clutches of 6–30 smooth-shelled, oblong eggs between May and July. Hatchlings emerge in 8–15 weeks, August to October. Hatchlings are 30–40 cm long.

Mortality/Longevity: In captivity, live up to 20 years.

Remarks: Record length of a rat snake is 2.3 m.

Pure Everglades rat snakes are becoming rare in the wild due to the expansion of the yellow rat snake (*Elaphe obsoleta quadrivittata*) into Southern Florida. The yellow rat has been interbreeding with the Glades rat to produce much darker individuals than those typical of the pure Glades form.

Red-tailed Green Rat Snake

Gonyosoma oxycephala (Colubridae)
Colubrids

Distribution: Southeast Asia including Burma, Cambodia, Indonesia, Laos, Malaysia/ Singapore, Philippines Thailand, and Vietnam.

Habitat: Arboreal, living in lowland tropical forests, mangroves, or bamboos.

Appearance: Bright iridescent green with tails of red, orange or gray. Long and slender, averaging 1.5 m but can exceed 2 m. Females are slightly larger than males. They have predominately smooth scales, with the head covered by plate-like scales, and the ventral side with ridged scales.

Diet: In the wild eat birds, eggs, and nestlings. Will also eat frogs, lizards, bats, and other small mammals. In captivity they are usually fed mice. They are fast hunters, and can capture bats in flight. Prey is killed by constriction, rather than venom.

Reproduction and Development: Breed year round, 3 to 4 clutches per year. Unlike most reptiles they will incubate their eggs for 3 to 4 months. Hatchlings are about 24 cm.

Mortality/Longevity: May live about 6 years in the wild and up to 15 years in captivity.

Conservation Status: Once commonly sold for purported medicinal value in some Asian countries, the snake is now restricted from export, at least by the Thai government, and local people value it for rodent control.

Remarks: Red-tailed rat snakes spend most of their time high in trees. The ridged scales on the ventral side help them hold tightly to tree branches.

Red-tailed green ratsnakes look and behave like a species of venomous pit viper that lives in the same area, an example of mimicry. When threatened, they can compress laterally and inflate the first 1/3 of their bodies. They coil this region into an "S" that reaches above the rest of the body. This posture exposes black and white diagonal bands of tissue and presents an ominous threat to enemies.

Madagascar Leaf-nosed Snake

Langaha madagascariensis (Colubridae)
Colubrids

Distribution: Endemic to Madagascar.

Habitat: Arboreal, lives in and on vines and branches.

Appearance: Displays striking sexual dimorphism: male has a pointed snout and body with contrasting coloration; female has leaf-shaped snout and is uniformly dark brown.

Remarks: Venomous; bites can produce severe local pain and swelling that may last for several days. Colubrids tend to chew when they bite, further envenomating and infecting the site.

None of Madagascar's more than 80 species of snakes is overly dangerous to humans. No adders, cobras, mambas, pythons, or vipers—just boas and colubrids.

Burmese Vine Snake

Ahaetulla fronticincta (Colubridae)
Colubrids

Distribution: Myanmar (formerly Burma).

Habitat: Mostly arboreal in brackish mangrove swamps.

Appearance: Length to perhaps 60 cm. Pencil thin, delicate; green and brown scales. Bulbous wide-set raised eyes.

Diet: Diurnal hunter of small fish: gobies, and rice fish. Prey immobilized with mild venom from enlarged rear fangs. Visually-oriented hunter.

Reproduction and Development: Fertilization internal. Viviparous. Newborn snakes are a subtle shade of brown. Polymorphic: some adults turn green, brown, or more rarely two-toned.

Remarks: The Steinhart Aquarium was the first to display this species. Academy field research on this little-known species continues.

An arboreally-adapted species that consumes fishes is an oddity. In the Steinhart, feed on guppies and goldfish.

Steinhart's vine shakes have bred and reproduced in captivity, a first for this species.

CLASS AVES (BIRDS)

African Penguin aka Jackass Penguin

Spheniscus demersus (Spheniscidae)

Distribution: Coasts of South Africa and Namibia.

Habitat: Nests in colonies mainly on offshore islands. Rarely encountered more than 8 km from islands or mainland.

Appearance: To 70 cm tall. Like most birds with shared parental duties, sexes are similar in appearance. Adults: upperparts blackish-grey, underparts mostly white with inverted

black horseshoe extending down flank to thigh. Feet and legs black. Chicks arrive with secondary down feathers. Juveniles and immatures gradually come to resemble adults.

Diet: Piscivorous.

Reproduction and Development: Colonial nesters. Dig nesting burrows.

Mortality/Longevity: May live to at least 25 years.

Conservation status: IUCN: vulnerable.

Historically, egg-collecting by humans reduced populations. For example in 1897 more than 700,000 eggs were collected from colonies near the Cape of Good Hope. African penguin populations have plummeted from 2 million in 1900 to less than 200,000, a 90% decimation. Egg-collecting started that trend, and the downward spiral continues due to heavy shipping traffic. Oil spills and the careless discharge of oil kill penguins by reducing their ability to insulate themselves. The fishing industry continues to remove nutrition from the food web which would otherwise be available to penguins. Global warming, blamed in part on the increasing severity and number of fish population collapses, is also impacting penguins

In July, 2007 the U.S. Fish and Wildlife Service announced that the African penguin, along with 9 other penguin species, is under review for inclusion on the Federal List of Endangered Species.

Remarks: The alternate common name "jackass" is a reference to its donkey-like vocalization.

Members of the Academy's colony are all captive-born. Hand-fed from birth. (CAS penguins will not eat live fish!) Twice daily fed thawed herring and capelin occasionally laced with medications for ailing birds.

CAS is a participant of the AAZPA (American Association of Zoological Parks and Aquaria) SSP (Species Survival Program) for this species.

CAS penguin pairs share the same colored wing band. Males wear their bands on their right wing, females on the left.

Blue Ground Dove

Claravis pretiosa (Columbidae)

Distribution: Found in most of the New World tropical zone from Mexico to northwestern Peru, Bolivia, and northern Argentina; also Trinidad.

Habitat: Semi-open rainforests. Also deciduous forest up to 1000 m. Common along forest edges. Though they feed on the ground, these doves are shy, mostly arboreal birds.

Appearance: Relatively small pigeons. The male sports blue-grey upperparts and paler grey underparts, with gray-white face and wings marked with black. Female is grey-brown on head, neck, and breast, with pale blue-grey belly, ruddy brown back, and chestnut rump and tail. Young resemble the female. Immature males similar to adult male, though some greyish brown feathers remain.

Diet: Forages on the ground, feeding on seeds and small insects.

Reproduction: Builds a flimsy nest of twigs high in a tree; lays two white eggs.

Remarks: Found alone, in pairs, or in family groups.

Call: a single, soft, repeated "coooo-oo."

Blue and Gold Macaw

Ara ararauna (Psittacidae)

True Parrots

Distribution: Mexico, Central America, and northern South America.

Habitat: Rainforests, where they live high in trees especially along swamps and rivers.

Appearance: A striking bird with emerald crown topped with azure blue across the back and wings. Primary feathers meld to a deep cobalt blue with green tips. Chest a solid, eye-catching gold. Facial skin patch etched by lines of black feathers around the eyes. A large bird with a 1.2 meter wing span; weight up to 1.2 kg.

Diet: Fruits, vegetable matter, seeds, nuts, leaves and bark. Also small animals. Beaks used for crushing seeds. In the course of daily feeding, macaws allow plenty of seeds (while eating, as well as in their droppings) to fall to the forest floor, thus generating forest growth.

Reproduction: Breed readily in captivity and are popular in the pet trade. Sexual maturity reached at 3–6 years. Like other macaws, they form monogamous pairs. Nest is usually in hole of a tall dead tree. Female lays 1–3 eggs, incubating them for 24–26 days during which time the male feeds her. Young are precocial, born blind and almost naked. Female feeds them initially with regurgitated vegetable

matter; within a week, the male joins the effort. Young fledge after 4 months, may remain with parents for up to a year.

Mortality/Longevity: Life span: about 50 years (some sources say 80 years).

Conservation Status: Listed on CITES Appendix 2, indicating they may become rare or endangered if trade is not regulated.

Remarks: A relatively calm bird which one source refers to as the golden retriever of the parrot family.

Blue-golds are extremely intelligent, speak well, and can learn tricks.

Powerful beaks exert great pressure, sufficient to crush seeds or even bite through a human finger, bone and all. Fortunately, these birds don't bite handlers hard, preferring a reprimanding pinch instead. Beaks are also used as a "third foot" when climbing.

In the wild, pairs are the principal grouping, though the birds often congregate in flocks of up to 30 birds.

According to one source, blue and gold macaws are extremely intelligent, and will show their emotions or intentions by cocking their heads, vocalizing, flashing their eyes and blushing. They also use fluffing of the feathers, raising the wings, prancing, bowing, shaking their tail feathers, and head bobbing as forms of communication.

This species is the most popular macaw among hobbyists. However, people should know blue-golds, like all parrots, are a long-term commitment given their life spans and require an extraordinary amount of positive interaction with their owners.

Scarlet Macaw

Ara macao (Psittacidae)

True Parrots

Distribution: From southeast Mexico through Central and South America to northern Argentina; especially in Amazon Basin.

Habitat: In the rainforest canopy, mostly at altitudes below 1000 m.

Description: Male and female are mostly scarlet on head, front, back, and main tail feathers. Scarlet is accented by brilliant blue and yellow on parts of flight and tail feathers and plumage on back. Face is contrasting white; large eyes are yellow. Beak is large and deep "parrot bill" shape, ivory on upper bill, black on lower. Legs and feet are black. Young birds are similar in plumage, but eye is brown.

Diet: Ripe fruit and nuts. The strong, powerful bill allows them to crack very hard nuts and pierce large unripe fruits, which are not available to the many other fruit-eating species. As with other parrot family members, the upper bill is highly hinged and can be raised and lowered with great force. They periodically eat clay to neutralize the acid of the unripe fruits. Also like other parrot family members, they bring food to their bill with one foot (usually the left one) while grasping branch with the other.

Reproduction and Development: Macaws mate for life and reinforce the pair bond with frequent preening and rubbing each other. They nest in a found hole high in canopy tree, shaping it somewhat to their needs. Chipping inside the cavity, they create a chip and fiber cushion inside the nest to absorb chick waste. The body position for copulation is side-to-side, rather than male on top of female, the male placing one wing and foot over the female as both turn towards each other to give cloacal contact. Mates may stay together on the nest, but the female incubates the 2–4 eggs for 24–27 days. She is fed by the male. Young are fed regurgitated food by both parents. They are camouflaged in foliage, and sensing danger when nesting or feeding young, will freeze until threat is assessed.

Mortality/Longevity: Adults are rarely preyed upon since size, aggressiveness, flight agility, habitat cover and camouflage offer protection. Young in nest may be taken by snakes, toucans, monkeys and African bees which may have a hive in cavity nest; fledglings are additionally prey for eagles, hawks. Life span: up to 50 years.

Remarks: Like other psittacids, macaws have a vocabulary of body language. Theirs includes "blushing" to indicate mood. They also hiss, ruffle feathers, raise and lower body, and threaten with one foot. Most aggressive posture is body and bill forward, hissing and up-and-down "push-ups."

They are strong fliers, with powerful, shallow wingbeats and very adept moving in trees, using their strong beaks as well as zygodactyl

feet to maneuver in branches.

They can be aggressive and territorial.

Red-legged Honeycreeper
Cyanerpes cyaneus (Thraupidae)
Tanagers, Honeycreepers, Euphonias and their Allies

Distribution: Widespread from southern Mexico to Peru, Bolivia, Brazil and some Caribbean Islands.

Habitat: Prefer crown of deciduous forests but are also common in semi-open, second growth and gardens in shrub and understory.

Description: Male red-legged honeycreeper is a striking dark violet-blue on its face, undersides and neck, set off by black eye patches, wings, tail and upper back. The crown is bright turquoise, the underwings yellow. The black bill is fairly long and decurved. Its legs are brilliant red. The male molts to the female plumage colors: greenish paler below with slight streaks and rufous legs. Size: c. 12 cm; weight: 14 grams.

Diet: Primarily fruit eaters, honeycreepers also depend on nectar sipped from blossoms while perching. Trees with arillate seeds (small fleshy-covered seeds often within a pod) are also a frequent food. They often come to feeders for fruit and nectar, joining small mixed flocks of birds with similar food preferences. Active and restless, they move through foliage often in groups of 15 – 20 seeking food trees. Keep in contact with constant 'tsip' notes.

Reproduction and Development: Pair jointly build a thin, somewhat flimsy cup of fiber and grasses, small twigs and moss, and fasten it to the fork of a slender branch with cobwebs, usually 10–15 feet above ground. Two brown-spotted white eggs are incubated by the female for 12–13 days; both parents feed the young for 14 days.

Mortality/Longevity: Preyed upon by hawks and snakes.

Remarks: The male's striking brilliant blue, turquoise and yellow plumage colors, and the startling red legs impress human visitors, who often have a chance to see birds which are drawn to fruit and nectar feeders. Out of breeding season, they join in fairly large mixed flocks.

Silver-beaked Tanager
Ramphocelus carbo (Thraupidae)
Tanagers, Honeycreepers, Euphonias and their Allies

Distribution: Resident breeder in South America from Colombia and Venezuela south to Paraguay and central Brazil as well as on Trinidad.

Habitat: Light woodland and cultivated areas.

Appearance: Adult male: velvety crimson back with deep crimson throat and breast; upper mandible black, lower mandible bright silver. Female: duller; brownish upperparts and reddish brown underparts, throat, and breast.

Diet: Mainly fruit as well as insects.

Reproduction: Clutch of 2 green-blue eggs blotched with black-brown are laid in bulky cup nest usually built at lower forest level. Female incubates eggs for 11–12 days before they hatch. Chicks fledge 11–12 days later.

Remarks: These social birds tend to be noisy, traveling in groups of 4–8 in the wild.

Our rainforest birds have already nested, hatched, and fledged!

Red-shouldered Tanager
Tachyphonus phoenicius (Thraupidae)

Distribution: Tropical to sub-tropical South America: Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela.

Habitat: Dry shrubland or seasonally wet or flooded lowland grassland. Also open rainforest, to 2000 m.

Appearance: Male: glossy black, point of shoulder red. Female: top and sides of head dark brownish grey as are back, wings, and tail. Underparts a dull white, sides of throat a brighter white.

Diet: Usually forage in pairs.

Rufous-crowned Tanager
Tangara cayana (Thraupidae)

Distribution: Tropical to sub-tropical areas of South America.

Habitat: Favors tropical moist lowland forests, but also found in open terrain with scattered trees and in cultivated areas.

Appearance: Male: crown a bright coppery rufous; sides of the head black; throat and breast dark greenish blue; back a shining

opalescent straw color; underparts light orange-yellow. Female: much duller; lacks the male's distinctive dark throat patch.

Diet: Fruit and insects; forages in flocks from low levels to treetops.

Reproduction: 2 eggs laid in open cup nest.

Paradise Tanager

Tangara chilensis (Thraupidae)

Distribution: South America: common in Venezuela, Peru, Colombia, Ecuador, Brazil.

Habitat: Canopy and edges of subtropical to tropical lowland humid forests, including parts of the Amazon basin and upwards to 1400 m. Often moves in mixed flocks.

Appearance: Striking colors: top and sides of head bright apple-green, black upper body plumage, lower back scarlet, underparts a bright turqoise. Beak and legs black. Sexes similar.

Diet: Mainly fruit, buds, leaves. Forage from middle heights to treetops. Also, like other *Tangara* tanagers, picks insects from leaves or sometimes takes them in flight. Often moves and feeds in mixed flocks.

Reproduction: Female builds a cup nest where she lays two or three brown- or lilac-speckled white eggs. Eggs hatch in 13–14 days; chicks fledge in additional 15–16 days. Nestlings are feed insects and fruit by both male and female.

Remarks: In Spanish, called "sieite colores" for its seven-colored appearance: green, yellow, scarlet, black, and three colors of blue feathers adorn this handsome bird.

Turquoise Tanager

Tangara mexicana (Thraupidae)

Distribution: Trinidad, Colombia, and Venezuela, much of Brazil, and south to Bolivia.

Habitat: Rainforest, mangroves, open woodland and cultivated areas.

Appearance: Head, throat, breast, lower back and rump a cornflower blue; bright turquoise shoulder patches and pale yellow lower underparts. Bill and legs black. Lower neck spotted with white; body with patches of black. Sexes similar.

Diet: Variety of fruits as well as insects, often gleaned from twigs. Forages from ground to treetops.

Reproduction: Builds bulky cup nest in tree or shrub. Female incubates three brown-blotched grey-green eggs for about 12–14 days.

Remarks: Call: sharp, twittering chirps.

Opal-rumped Tanager

Tangara velia (Thraupidae)

Distribution: Bolivia, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela.

Habitat: Tropical forests, from emergent to shrub layer, especially lowland rainforests and the forest edge, though found in some areas up to 1200 m.

Appearance: Upperparts mostly black; underparts a deep-violet blue. Rump an opalescent silvery green. Beak, feet, and legs are black. Female differs from male by having glistening blue green rather than purplish blue on sides of head.

Diet: Usually forages in the canopy or emergent layer mostly for fruits and berries.

Occasionally pick insects from leaves or takes them in flight.

Reproduction: Female constructs well-concealed cup nest and typically lays clutch of 2 grayish-white eggs dotted with darker gray. Incubation: 13–14 days; chicks fledge 15–16 days after hatching. Both male and female feed hatchlings a diet of insects and fruit, and are often assisted by same-species helpers.

Remarks: Generally seen in pairs and / or small groups of mixed species.

Emit a high-pitched twitter in flight.

Blue-gray Tanager

Thraupis episcopus (Thraupidae)

Distribution: Found mainly from central Mexico to northern parts of Boliva and Brazil. Common throughout much of Costa Rica.

Habitat: Semi-open habitats; often found near cultivated areas, especially fruit orchards.

Appearance: Male: pale blue-gray color with a darker blue-gray back, bright sky blue wings and tail, a blackish bill, and large, black eyes. Female and young are grayer.

Diet: Insects, spiders, and fruit. Also occasionally eat flowers, leaves, and nectar.

Reproduction: Female incubates 2 eggs laid in open cup nest for 12–14 days; once eggs hatch, both parents feed young, which fledge in about 17 days.

Remarks: The species is quite vocal and social. Pairs or groups participate in noisy singing and chattering, though the song is not particularly musical.

As fruit-eaters, these birds play an important role in seed dispersal for trees and shrubs in the tropics.

Like many small tropical birds, they are preyed upon by cats, both wild and domestic, snakes, and birds of prey.

Saffron Finch

Sicalis flaveola (Thraupidae)

Distribution: Common in the South American tropics of Colombia, Venezuela, Ecuador, Peru, Brazil, and Argentina.

Habitat: Open and semi-open forests and fields from lowland areas to 1850 m. Prefer drier areas; generally reside outside the Amazon basin.

Appearance: Forehead and crown bright orange. Yellow head, greenish-yellow mantle and back, bright yellow underparts. Female duller above and lighter below. Bill brownish-grey, legs pink.

Diet: Forage in pairs or larger groups for seeds, insects, and plant matter.

Reproduction: Nest in tree hollows, though use nesting boxes in captivity. Female lays 3–4 white eggs; incubation, 12–14 days. Female incubates the eggs, male guards the nest. After eggs hatch, both parents feed the young, and fledging takes place in about 2 weeks.

Remarks: Saffron finches are a favorite caged bird because of their handsome colors and pleasant song.

Violaceous Euphonia

Euphonia violacea (Fringillidae)

Distribution: Trinidad and eastern Venezuela south to Argentina.

Habitat: Forests, including second growth and plantations.

Appearance: A very small, tit-sized bird. Males are glossy blue-black on head and back, with contrasting yellow forehead, breast and belly. Females are green above, yellow-green below.

Diet: Specialized small fruit and berry eaters, and particularly feed on mistletoe berries which their digestive tracks can manage without activating the toxins. They often move and eat in mixed flocks with other small fruit eaters.

Reproduction: The female incubates 3–4 white eggs blotched with red in a ball nest formed in a cavity of a stump, bank or tree.

Remarks: These are highly social birds, moving in mixed flocks of other birds. The mixed flocks provide some defensive safety with different levels of alertness to predators.

As specialists on mistletoe and some other toxic berries, Euphonias have weak, digestive systems adapted to removing the flesh of the mistletoe berries without disturbing the toxic viscin layer surrounding each seed. Within ten minutes they can excrete the sticky strings of seeds by vigorous rear end movements, scraping them onto twigs and branches where the seeds have a chance to fall and germinate—good for the bird and good for the seeds!

Yellow-green Grosbeak

Caryothraustes canadensis (Cardinalidae)

Distribution: Brazil, Colombia, French Guiana, Panama, Suriname, and Venezuela.

Habitat: Tropical to subtropical moist lowland forest; also found on heavily degraded forest lands as well as suburban and cultivated areas up to 1000 m.

Appearance: Male: olive yellow with black face, with the back less bright than crown and nape. Female: similar to male, except slightly duller; crown and nape are similar in color to the back.

Diet: Mostly seed eaters, well equipped for this diet by their heavy bills. Also eat insects and occasional vegetable matter. Forage from medium heights to treetops, often in flocks.

Remarks: Some birds commonly called "grosbeaks" and "tanagers," such as the Yellow-green Grosbeak and the local Black-headed Grosbeak (*Pheucticus melanocephalus*) and Western Tanager (*Piranga ludoviciana*) are now classified as members of the Cardinal family.

Banaquit

Coereba flaveola (Coerebidae)

Bananaquits

Distribution: Widespread in Central and South America, from southeast Mexico to northern Argentina, and in the West Indies.

Habitat: Flourishes in different habitats that provide vegetation and flowers for food: canopy, forest edges, open second growth and

human inhabited areas.

Description: Small, short-tailed and -legged bird, length about 10 cm, weight 4 grams. Both male and female plumage on chest, belly and upper rump are bright yellow, back and head are dark gray accenting a striking wide, white eyebrow stripe and throat. Bill is black, short and slender, and slightly decurved.

Diet: Primarily nectar feeders, bananaquits seek small flowers for nectar and use sharp bill to pierce larger ones when its bill cannot otherwise reach the nectar. They also suck juices of berries and ripe fruits and nibble on bananas. Feeds in pairs or solo, short strong legs and feet allow acrobatic postures to probe or pierce flowers for nectar, even feeding upside down. They also pick bark for small insects. They readily join mixed flocks of tanagers, honeycreepers and warblers at feeders.

Reproduction and Development: Both parents, but often primarily the male, build a brooding nest and also several roosting nests. Nest is a compact globe of leaves and plant fibre, lined with seed down, moss, and feathers. The round entry doorway faces down (to discourage snakes). Nest is usually 10 -50 feet up. Two eggs are brown-spotted white, which the female incubates 12–13 days. Both parents feed young regurgitated food for 17–19 days. Their period of incubation and feeding young are unique, as is the shape of their nest and the building of adjacent "dormitory" nests, where they roost or sleep when not actively incubating. They also have an exceptionally long breeding season, lasting all year except from March to May, and often raise three broods.

Mortallity/Longevity: Like other small passerines, vulnerable to hawks, snakes.

Remarks: Banaquits have adapted well to human impact on the environment. They are highly sociable and common in inhabited areas, mixing with other species at feeders and in gardens and farm areas. People enjoy their acrobatic stances to get nectar. Unlike suspended hummingbirds, bananaquits must get nectar as they grasp twigs. Like some other small, sharp-billed birds such as honeycreepers, they pierce the base of large flowers to get nectar their short bills cannot reach, thus thwarting the pollination strategy of the flowers.

They communicate with sharp, piercing 'tsip,' and have no melodious song.

Their period of incubation and feeding young are unique, as is the shape of their nest and the building of adjacent "dormitory" nests, where they roost or sleep when not actively incubating. They also have an exceptionally long breeding season, lasting all year except from March to May, and often raise three broods.

Taxonomically, they have recently become the only remaining genus in their family, now considered unique, but that may change again, as som experts place them in the Thraupidae, the tanager family.

CLASS MAMMALIA (MAMMALS)

ORDER CHIROPTERA (BATS)

Dog-faced Fruit Bat

Cynopterus brachyotis (Pteropodidae)
Fruit Bats

Distribution: Southeast Asia including Sri Lanka, Andaman and Nicobar Islands, southern Myanmar, Thailand, southern China, Indonesia, Malaysia, Philippines and Borneo.

Habitat: Tropical forests and open country. Roost in caves, deserted mines, under the eaves of buildings, occasionally in hollow trees.

Appearance: Wingspan to ~45 cm; weight to ~100 g. Pelage is dense and variable in color, but typically olive-brown. Prominent, almost tubular nostrils. The upper lip is divided by a vertical groove.

Diet: Fruits of many plants, including palms, figs, guavas, plantains, mangoes, chinaberries and, occasionally, flowers. Subsist primarily on fruit juice, little pulp ingested. May travel more than 100 km in one night to feed.

Reproduction and Development: Gestation ~120 days. Mothers carry their single offspring during the early part of its life.

Mortality/Longevity: Sold in markets in northern Thailand as "medicine." Eaten in

some Asian cutltures "for strength."

Remarks: This is the only old world fruit bat known to build shelters; individuals occasionally bite off the center seed string in palm fruit clusters, resulting in a hollow from which to hang.

Fruit-eating bats are important in seed dispersal and the pollination of many plant species.

Like all Old World fruit bats, does not echolocate, depending instead on vision for orientation–note large eyes–and acute sense of smell to find food.

CALIFORNIA ROCKY COAST - MAIN TANK

Bull kelp
Nereocystis luetkeana

Club-tipped anemone
Corynactis californica

Giant plumose anemone
Metridium giganteum

Cloned plumose anemone
Medtridium senile

Aggregating anemone
Anthopleura elegantissima

Giant green sea anemone
Anthopleura xanthogrammica

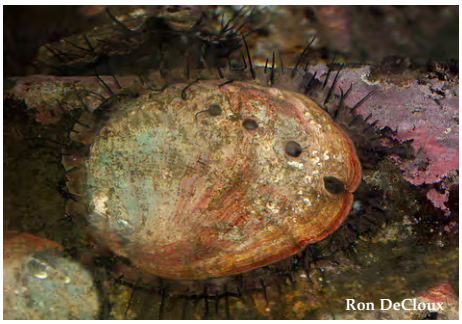
Painted Urticina
Urticina crassicornis

Rose anemone
Urticina lofotensis

Fish-eating anemone
Urticina piscivora

Mossy chiton
Mopalia muscosa

Gumboot chiton
Cryptochiton stelleri



Red abalone
Haliotis rufescens

Rough keyhole limpet
Diodora aspera

California mussel
Mytilus californianus

Giant rock scallop
Crassedoma giganteum

Red rock crab
Cancer productus

Red sea urchin
Strongylocentrotus franciscanus

Purple sea urchin
Strongylocentrotus purpuratus

Giant acorn barnacle
Balanus nubilus

Gooseneck barnacle
Pollicipes polymerus

Bat star
Asterina miniata

Pink star
Pisaster brevispinus

Giant sea star
Pisaster giganteum

Ochre star
Pisaster ochraceus

Leather star
Dermasterias imbricata

Blood star
Henricia leviuscula

Leopard shark
Triakis semifasciata

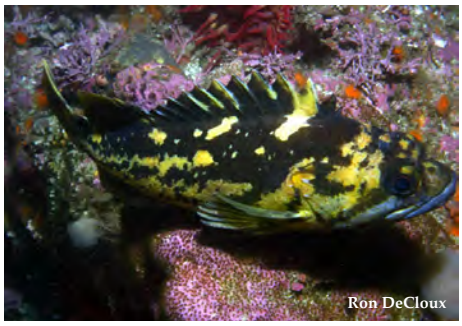
Jacksmelt
Atherinopsis californiensis

Red Irish lord
Hemilepidotus hemilepidotus

Brown rockfish
Sebastes auriculatus

Gopher rockfish
Sebastes carnatus

Copper rockfish
Sebastes caurinus



Black & yellow rockfish
Sebastes chrysomelas

Starry rockfish
Sebastes constellatus

Quillback rockfish
Sebastes maliger

Black rockfish
Sebastes melanops

Vermillion rockfish
Sebastes miniatus

Blue rockfish
Sebastes mystinus

China rockfish
Sebastes nebulosus

Tiger rockfish
Sebastes nigrocinctus

Bococcio rockfish
Sebastes paucispinis

Canary rockfish
Sebastes pinniger

Rosy rockfish
Sebastes rosaceus

Flag rockfish
Sebastes rubrivinctus

Olive rockfish
Sebastes serranoides

Treefish
Sebastes serriceps

California scorpionfish
Scorpaena guttata

Cabezon
Scorpaenichthys marmoratus

Kelp greenling (male)
Hexagrammos decagrammus

Kelp greenling (female)
Hexagrammos decagrammus

Painted greenling
Oxylebius pictus

Ocean whitefish
Caulolatilus princeps

Redtail surfperch
Amphistichus rhodoterus

Pile perch
Damalichthys vacca

Black surfperch
Embiotoca jacksoni

Striped surfperch
Embiotoca lateralis

Walleye surfperch
Hyperprosopon argenteum

Rainbow surfperch
Hypsurus caryi

Rubberlip surfperch
Rhacochilus toxotes

Wolf eel
Anarrhichthys ocellatus

C-O turbot
Pleuronichthys coenosus

SOUTHERN CALIFORNIA TANK - CALIFORNIA COAST EXHIBIT

Giant kelp (synthetic)
Macrocystis pyrifera

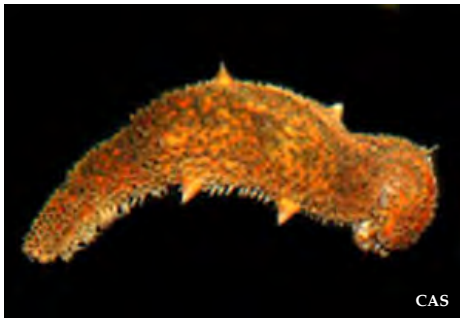
Laminaria (synthetic)
Laminaria sp.

Red gorgonian
Lophogorgia chilensis

Golden and brown gorgonians
Muricea spp.

Wavy turban snail
Lithopoma undosum

Blood star
Henricia leviuscula



Warty sea cucumber
Parastichopus parvimensis

Swell shark
Cephaloscyllium ventriosum

California scorpionfish (juvenile)
Scorpaena guttata

Gopher rockfish
Sebastes carnatus

Treefish (juvenile)
Sebastes serriceps

Kelp bass
Paralabrax clathratus

Opaleye
Paralabrax clathratus

Halfmoon
Medialuna californiensis

Blacksmith
Chromis punctipinnis

Garibaldi
Hypsypops rubicundus

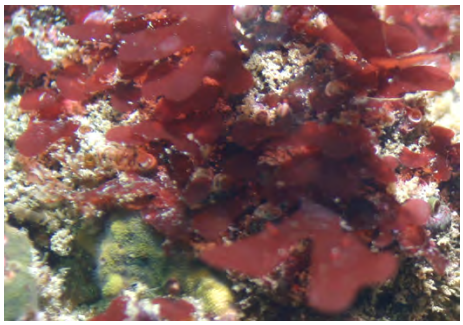
Rock wrasse (initial stage)
Halichoeres semicinctus

Rock wrasse (terminal male)
Halichoeres semicinctus

Senorita wrasse
Oxyjulis californica

California Sheephead
Semicossyphus pulcher

DISCOVERY TIDEPOOL - CALIFORNIA COAST EXHIBIT

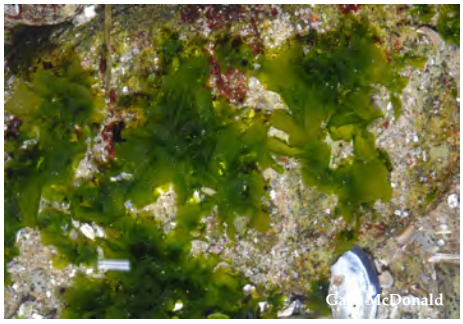


Red algae

Encrusting and articulating coralline algae
Coralllina sp.

Iridescent seaweed
Iridea sp.

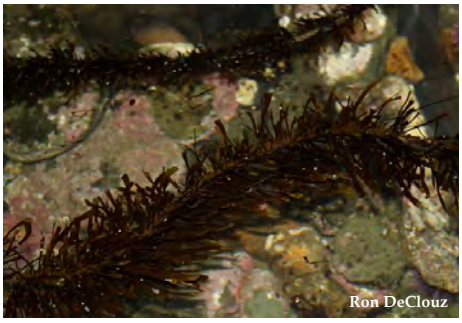
Turkish towel
Mastocarpus papillatus



Sea lettuce
Ulva sp.

Rockweed
Fucus sp.

Sea sacs
Halosaccion glandiforme



Feather boa kelp
Egregia menziesii

Giant kelp
Macrocystis pyrifera

Oar weed
Laminaria sp.

Orange cup coral
Balanophyllia elegans

Aggregating anemone
Anthopleura elegantissima

Cloned plumose anemone
Medtridium senile

Giant green anemone
Anthopleura xanthogrammica

Gumboot chiton
Cryptochiton stelleri

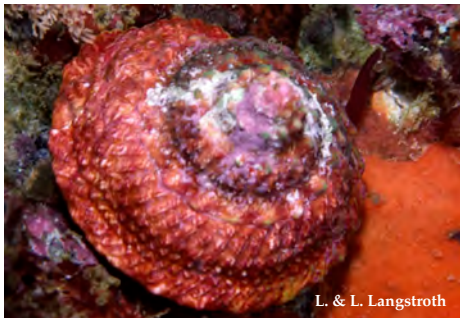
Red abalone
Haliotis rufescens

Owl limpet
Lottia gigantea

Rough keyhole limpet
Megathura crenulata

Blue ring top snail
Calliostoma annulatum

Blue top snail
Calliostoma ligatum



Red top snail
Lithopoma gibberosum

Black turban snails
Tegula spp.

California sea hare
Aplysia california

Opalescent nudibranch
Hermissenda crassicornis

California mussel
Mytilus californianus

Red octopus
Octopus rubescens

Red rock crab
Cancer productus

Green shore crab
Hemigrapsus oregonensis

Purple shore crab
Hemigraspus nudus

Decorator (or masking) crab
Loxorhynchus crispatus

Northern kelp crab
Pugettia producta

Hermit crab
Pagurus spp.

Striped shore crab
Pachygraspus crassipes

Acorn barnacle
Balanus glandula

Gooseneck barnacle
Pollicipes polymerus

Bat star
Asterina miniata

Pink sea star
Pisaster brevispinus

Leather star
Dermasterias imbricata

Giant sea star
Pisaster giganteus

Ochre star
Pisaster ochraceus

Blood star
Henricia leviuscula

Brittle star
Family Ophiodermatidae

Red sea urchin
Strongylocentrotus franciscanus

Purple sea urchin
Strongylocentrotus purpuratus

California sea cucumber
Parastichopus californicus

Warty sea cucumber
Parastichopus parvimensis

Skate egg case
Raja sp.

Swell shark egg case
Cephaloscyllium ventriosum

Horn shark egg case
Heterodontus francisci

Tidepool sculpin
Oligocottus spp.

Dwarf surfperch
Micrometrus minimus

Shiner surfperch
Cymatogaster aggregata

Penpoint gunnel
Apodichthys flavidus

GIANTS TANK - CALIFORNIA COAST EXHIBIT

Giant kelp (synthetic)
Macrocystis pyrifera

Gorgonian
Muricea sp.

White-spotted rose anemone
Urticina lofotensis

Sunflower sea star
Pycnopodia helianthoides

California horn shark
Heterodontus francisci

California moray eel
Gymnothorax mordax

Garibaldi
Hypsypops rubicundus

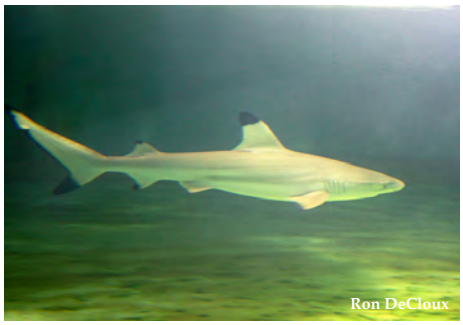
Giant sea bass
Stereolepis gigas

Kelp bass
Paralabrax clathratus

California halibut
Paralichthys californicus

Lingcod
Ophiodon elongatus

PHILIPPINE CORAL REEF LAGOON AND MANGROVE POP-UP



Blacktip reef shark
Carcharhinus melanopterus

Bowmouth guitarfish
Rhina ancylostoma

Javanese cownose ray
Rhinoptera javanica

Bluespotted stingray
Dasyatis kuhlii

Pacific tarpon
Megalops cyprinoids

Mono
Monodactylus argenteus

Neon damselfish
Neoglyphidodon oxyodon

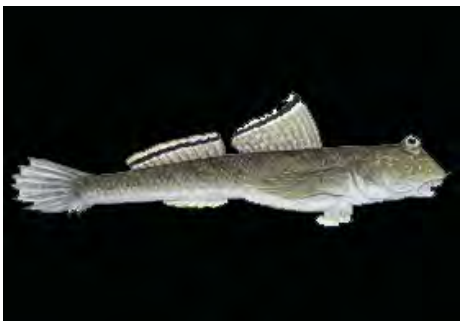
Moon wrasse
Thalassoma lunare

Canary wrasse
Halichoeres chrysus

Maori wrasse
Cheilinus undulatus

Naso
Naso sp.

Red mangrove
Rhizophora mangle



Barred mudskipper
Periophthalmus argentilineatus

SEAGRASS SHALLOWS - PHILIPPINE CORAL REEF

Bryopsis algae
Bryopsis sp.

Striped mushrooms
Discosoma sp.

Zooanthids
Zoanthus spp.

Sarcophyton
Sarcophyton sp.

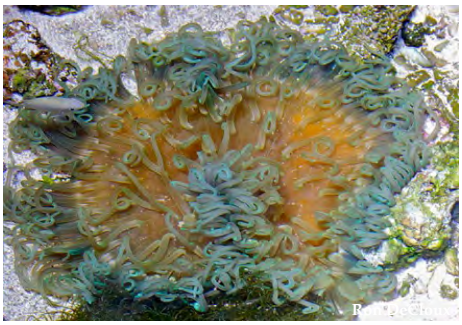
Cauliflower coral
Pocillopora damicornis

Acanthastrea
Acamtastrea sp.

Meat coral
Acanthophyllia deshayesiana

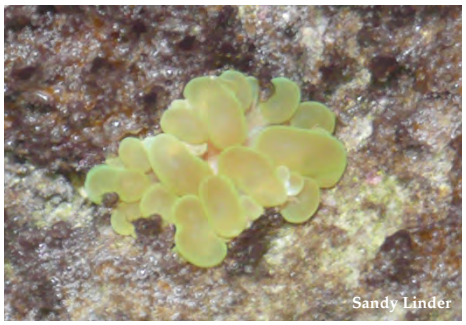
Lobophyllia
Lobophyllia sp.

Open brain coral
Trachyphyllia geoffroyi



Corkscrew tentacle sea anemone
Macrodactyla doreensis

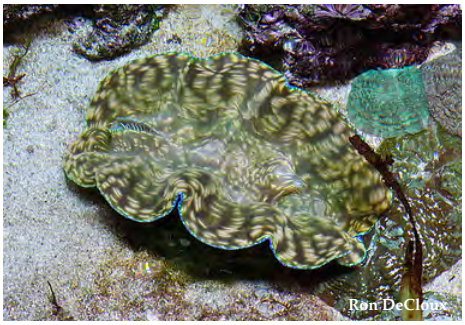
Euphyllia coral
Euphyllia sp.



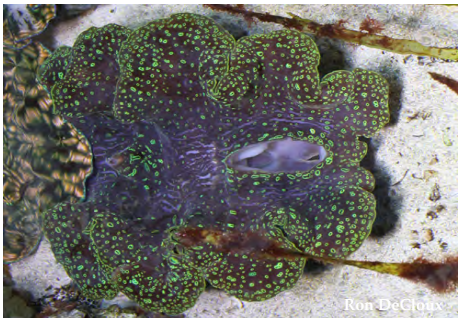
Bubble coral
Plerogyra sp.

Magnificent sea anemone
Heteractis magnifica

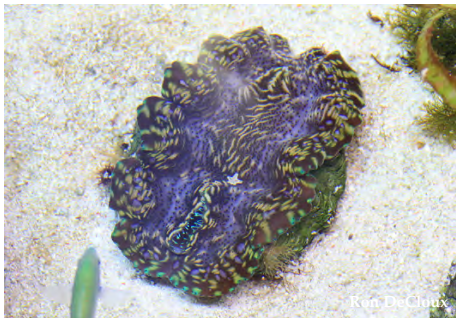
Bubbletip sea anemone
Entacmea quadricolor



Tridacna clam
Tridacna derasa



Tridacna clam
Tridacna gigas



Tridacna clam
Tridacna squamosa

Tridacna clam
Tridacna maxima

Long-spined sea urchin
Diadema setosum

Jewel fairy basslet
Pseudanthias squamapinnis

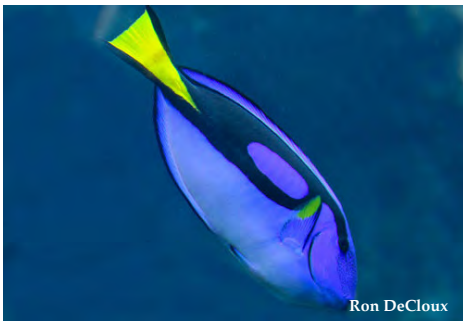
False clown anemonefish
Amphiprion ocellaris

Green chromis
Chromis viridis

Yellowtail blue damselfish
Chrysiptera parasema

Banded goby
Amblygobius phalaena

Orangebanded surgeonfish
Acanthurus olivaceous



Palette tang
Paracanthurus hepatus

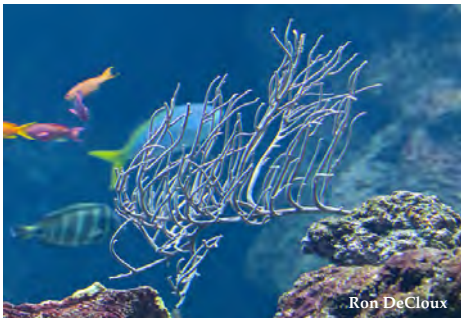
PHILIPPINE CORAL REEF MAIN TANK

Sarcophyton
Sarcophyton sp.

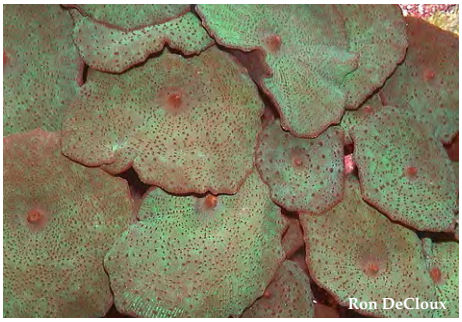
Sinularia
Sinularia sp.

Lobophytum
Lobophytum sp.

Pacific gorgonian
Rhumphella sp.



Pacific gorgonian
Rhumphella sp.



Beaded mushroom
Discosoma sp.

Hairy mushroom
Rhodactis sp.

Bullseye mushroom
Rhodactis inchoata

Blue coral
Heliopora coerulea

Cauliflower coral
Pocillopora damicornis

Cat's paw coral
Stylophora sp.

Montipora capricornis

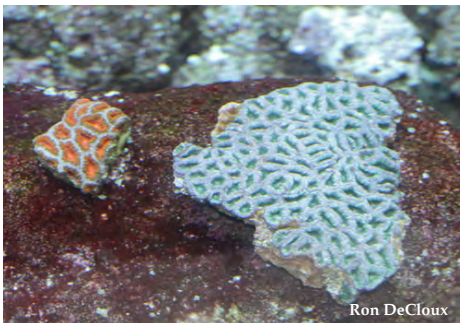
Elkhorn coral
Acropora sp.

Staghorn coral
Acropora sp.

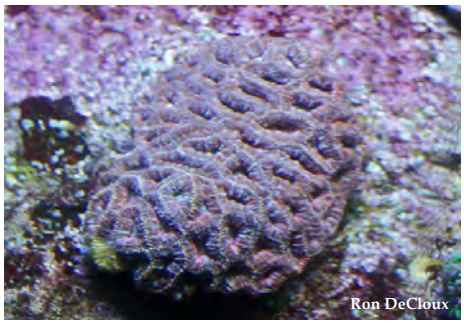
Cactus coral
Pavona sp.

Disk coral
Cycloseris or *Fungia* sp.

Galaxy coral
Galaxea fascicularis



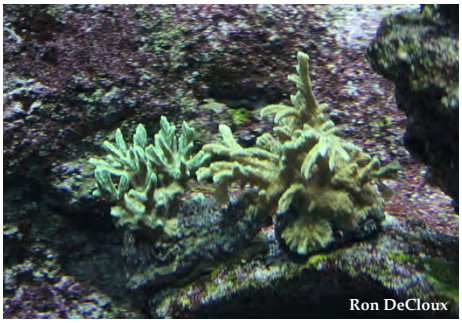
Acanthastrea
Acanthastrea sp.



Acanthastrea
Acanthastrea sp.

Symphyllia
Syphyllia sp.

Horn coral
Hydnophora grandis



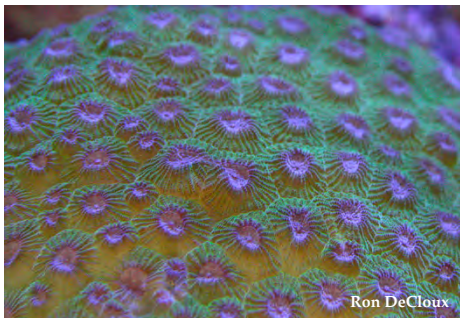
Horn coral
Hydnophora rigida

Plating hydnophora
Hydnophora sp.

Maze coral
Platygra sp.

Maze coral
Platygra sp.

Trumpet coral
Caulastrea sp.



Moon coral
Diploastrea helipora

Moon coral
Favia sp.

Closed brain coral
Favites sp.

Euphyllia coral
Euphyllia sp.

Bubble coral
Plerogyra sp.

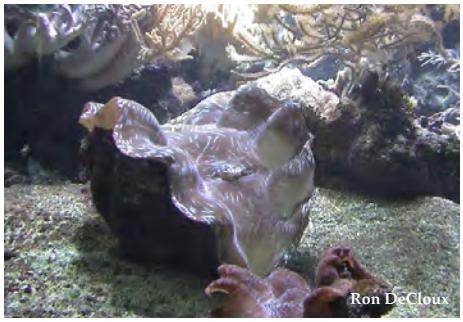
Turbinaria cup coral
Turbinaria reniformes

Bubbletip sea anemone
Entacmea quadricolor

Leathery sea anemone
Heteractis crispa

Magnificent anemone
Heteractis magnifica

Giant carpet anemone
Stichodactyla gigantea



Giant clam
Tridacna sp.

Blue linckia sea star
Linckia laevigata

Spotted garden eel
Heteroconger hassi

Soldierfish
Myripristis sp.

Red-cheeked fairy basslet
Pseudanthias huchti

Squarespot anthias
Pseudanthias pleurotaenia

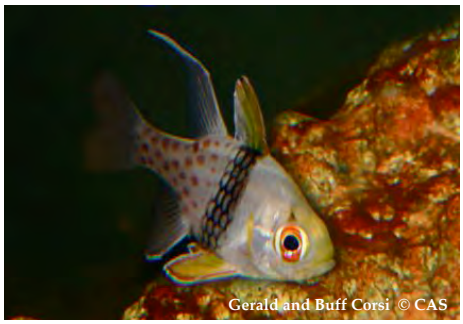
Jewel fairy basslet (male)
Pseudanthias squamipinnis

Jewel fairy basslet (male)
Pseudanthias squamipinnis

Jewel fairy basslet (female)
Pseudanthias squamipinnis

Spotted cardinalfish
Apogon maculatus

Seale's cardinalfish
Apogon sealei



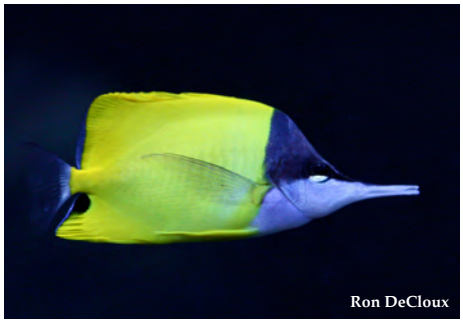
Pajama cardinalfish
Sphaeramia nematoptera

Yellow and blueback fusilier
Caesio teres

Bluestreak fusilier
Pterocaesio tile

Striped large-eye bream
Gnathodentex aurolineatus

Copperband butterflyfish
Chelmon rostratus



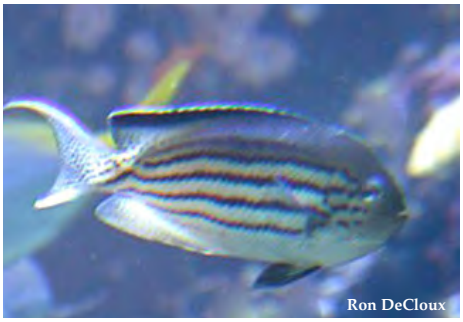
Longnose butterflyfish
Forcipiger longirostris

Pyramid butterflyfish
Hemitaurichthys polylepis

Bannerfish
Heniochus diphreutes

Lemonpeel angelfish
Centropyge flavissimus

Flame angelfish
Centropyge loricula



Lamarck's angelfish (male)
Genicanthus lamarck

Lamarck's angelfish (female)
Genicanthus lamarck

Blackspot angelfish (male)
Genicanthus melanospilos

Emperor angelfish
Pomacanthus imperator

Blue-girdled angelfish
Pomacanthus navarchus

Clark's anemonefish
Amphiprion clarkii

False clown anemonefish
Amphiprion ocellaris

Ternate chromis
Chromis ternatensis

Green chromis
Chromis viridis

Yellowtail blue damselfish
Chrysiptera parasema

Southseas devil (female)
Chrysiptera taupou

Blacktail damselfish
Dascyllus melanurus

Goldbelly damselfish
Pomacentrus auriventris

Spinecheek anemonefish
Premnas biaculeatus

Harlequin tuskfish
Choerodon fasciatus

Longnose hawkfish
Oxycirrhites typus

Flame hawkfish
Neocirrhites armatus

Exquisite fairy wrasse
Cirrhilabrus exquisitus

Yellowfin fairy wrasse
Cirrhilabrus flavidorsalis

Lubbock's fairy wrasse
Cirrhilabrus lubbocki

Redeye fairy wrasse
Cirrhilabrus solorensis

Bird wrasse
Gomphosus varius

Canary wrasse
Halichoeres chrysus

Pastel green wrasse
Halichoeres chloropterus

Two-tone wrasse
Halichoeres prosopeion

Striped cleaner wrasse
Labroides dimidiatus

Leopard wrasse
Macropharyngodon meleagris

Sixline wrasse
Pseudocheilinus hexataenia

Sixbar wrasse
Thalassoma hardwicke

Moon wrasse
Thalassoma lunare

Bicolor blenny
Ecsenius bicolor

Midas blenny
Ecsenius midas

Convict blenny (engineerfish)
Pholidichthys leucotaenia

Jeweled blenny
Salarias fasciatus

Zebra goby
Ptereleotris zebra

Bluestreak goby
Valenciennea strigata

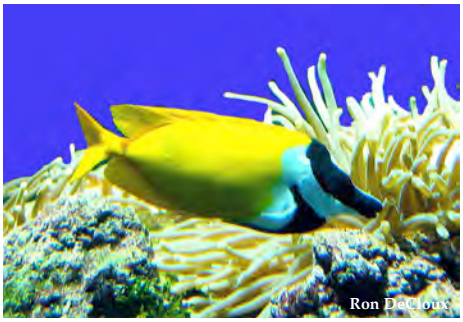
Blue spotted spinefoot
Siganus corallinus

Orange spotted spinefoot
Siganus guttatus

Masked spinefoot
Siganus puellus

Gold spotted spinefoot
Siganus punctatus

Barhead spinefoot
Siganus virgatus



Foxface rabbitfish
Siganus vulpinis

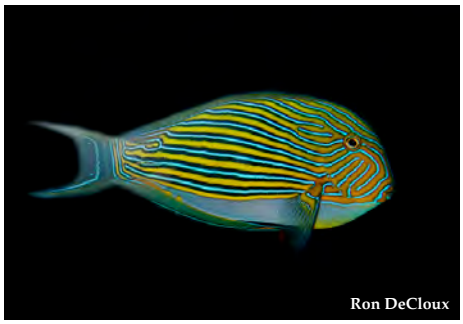
Blotched foxface rabbitfish
Siganus unimaculatus

Achilles surgeonfish
Acanthurus achilles

Ringtail surgeonfish
Acanthurus blochii

Eyestripe surgeonfish
Acanthurus dussumieri

Powder brown tang
Acanthurus japonicus



Lined surgeonfish
Acanthurus lineatus

Mata tang
Acanthurus mata

Bluelined surgeonfish
Acanthurus nigroris

Goldrim tang
Acanthurus nigricans

Orangeband surgeonfish
Acanthurus olivaceous

Mimic surgeonfish
Acanthurus pyroferus

Convict tang
Acanthurus triostegus

Goldring bristletooth
Ctenochaetus strigosus

Tomini tang
Ctenochaetus tominiensis

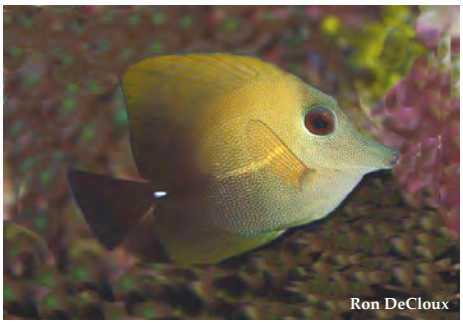
Palette tang
Paracanthurus hepatus

Spotted unicornfish
Naso brevinostris

Orangespine unicornfish
Naso lituratus

Bluespine unicornfish
Naso unicornis

Bignose unicornfish
Naso vlamingii

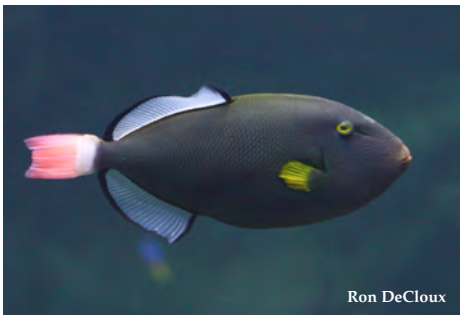


Brown scopas tang
Zebrasoma scopas

Pacific sailfin tang
Zebrasoma veliferum

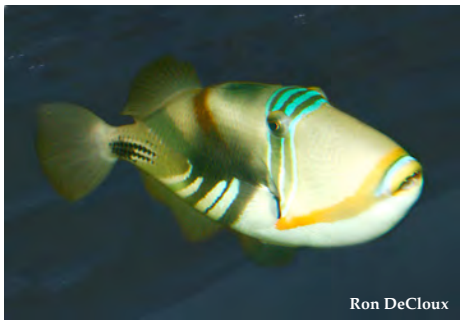
Clown triggerfish
Balistoides conspicillum

Black triggerfish
Melichthys niger



Pinktail triggerfish
Melichthys vidua

Redtooth triggerfish
Odonus niger



Blackbar triggerfish
Rhinecanthus aculeatus

Gilded triggerfish (male)
Xanthichthys auromarginatus

Gilded triggerfish (female)
Xanthichthys auromarginatus

CARIBBEAN REEF TANK

Encrusting gorgonian
Erythropodium caribaeorum

Sea plume
Muriceopsis flavida

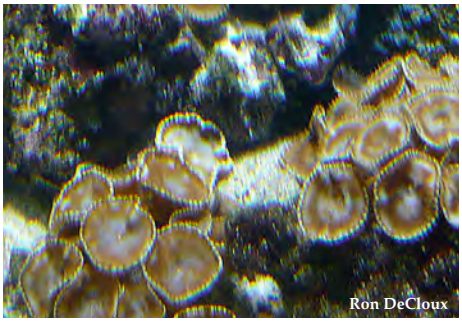
Sea rod
Plexaura sp.

Slit-pore sea rod
Plexaurella sp.

Sea rod
Pseudoplexaura sp.

Sea plume
Pseudopterogorgia sp.

Purple frilly sea plume
Pseudopterogorgia elizabethae



Zoanthid colony polyps
Protopalythoa grandis

Warty Corallimorpharian
Discosoma sp.

Condylactis anemone
Condylactis sp.

Ricordea mushroom
Ricordea florida

Sun anemone
Stichodactyla helianthus

Pencil sea urchin
Eucidaris tribuloides

Cherubfish
Centropyge argi

Queen angelfish (adolescent)
Holacanthus ciliaris

Flame cardinalfish
Apogon maculatus

Reef butterflyfish
Chaetodon sedentarius

Harlequin bass
Serranus tigrinus

Chalk bass
Serranus tortugarum

Blue chromis
Chromis cyanea

Beaugregory
Stegastes leucostictus

Spanish hogfish
Bodianus rufus

Yellowhead wrasse
Halichoeres garnoti

Royal gramma
Gramma loreto

Redspotted hawkfish
Amblycirrhitus pinos

Blue tang
Acanthurus coeruleus

THE NEOTROPICAL FOREST

Black olive tree
Bucida buceras

Brazilian beauty leaf
Calophyllum brasiliense

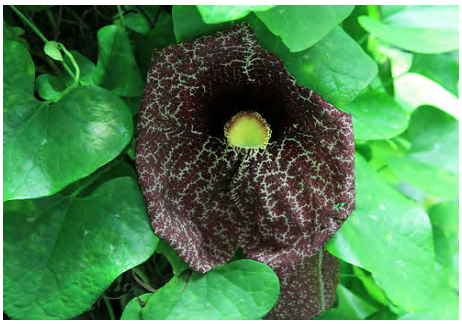
Water chestnut
Pachira aquatica

West Indies mahogany
Swietenia mahagoni

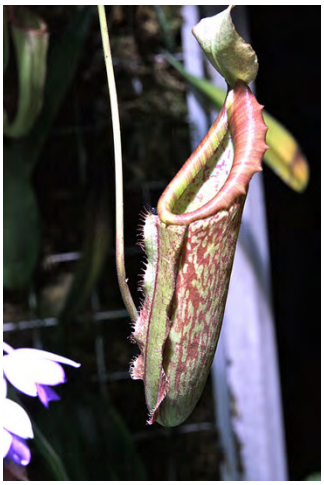
Peach Palm
Bactris gasipaes

Peach Palm Fruit
Bactris gasipaes

Water chestnut *Pachira aquatica* (left)
Peach palm (upper right)



Dutchman's pipe
Aristolochia labiata



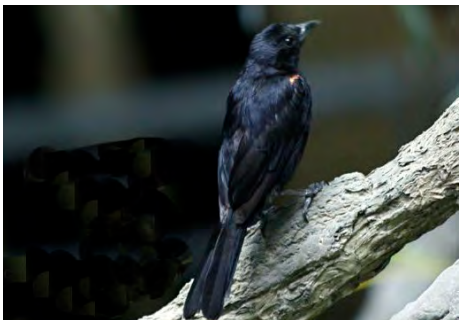
Pitcher plant
Nepehthes sp.

(l. to rt.) Brazilian beauty leaf
Black olive
West Indies mahogany

All photographs of tress, flowers, birds and butterflies by Ron DeCloux

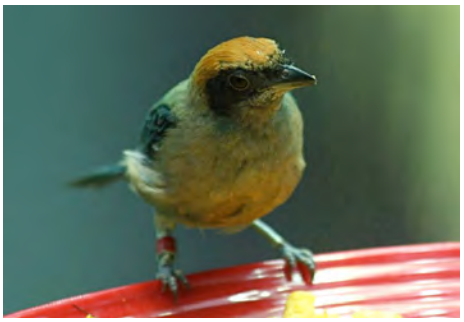
NEOTROPICAL RAINFOREST - BIRDS AND BUTTERFLIES

Silver-beaked tanager
Ramphocelus carbo



Red-shouldered tanager (male)
Tangara phoenicius

Red-shouldered tanager (female)
Tangara phoenicius



Rufous-crowned tanager
Tangara cayana

Paradise tanager
Tangara chilensis paradisea

Turquoise tanager
Tangara mexicana

Opal-rumped tanager
Tangara velia

Blue-gray tanager
Thraupis episcopus

Bananaquit
Coereba flaveola

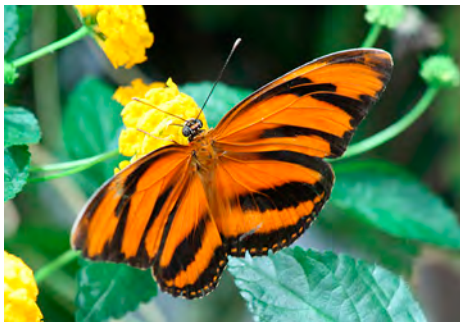
Red-legged honeycreeper (male)
Cyanerpes cyaneus

Red-legged honeycreeper (female)
Cyanerpes cyaneus

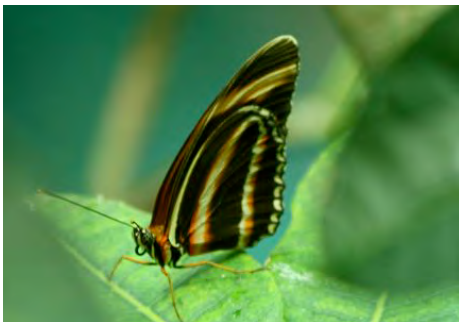
Saffron finch
Sicalis flaveola

Violaceous euphonia (male)
Euphonia violacea

Violaceous euphonia (female)
Euphonia violacea



Banded orange
Dryadula phaetusa



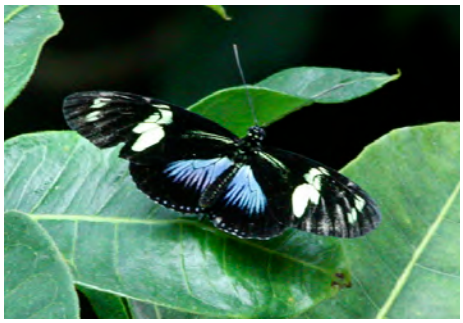
Banded orange (underwing)
Dryadula phaetusa

Giant owl
Caligo memnon

Isabella's longwing
Eueides isabella

Zebra longwing
Heliconius charithonia

Zebra longwing (underwing)
Heliconius charithonia

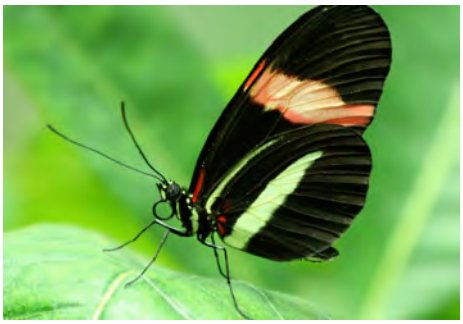


Doris longwing (blue morph)
Heliconius doris

Doris longwing (red morph)
Heliconius doris

Doris longwing (underwing)
Heliconius doris

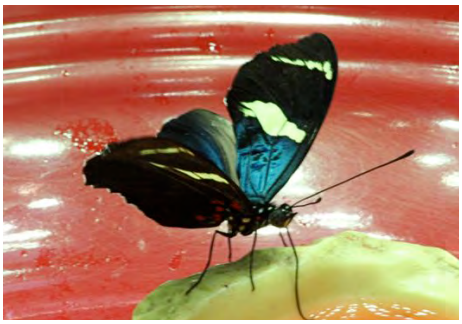
Postman
Heliconius melpomene



Postman (underwing)
Heliconius melpomene

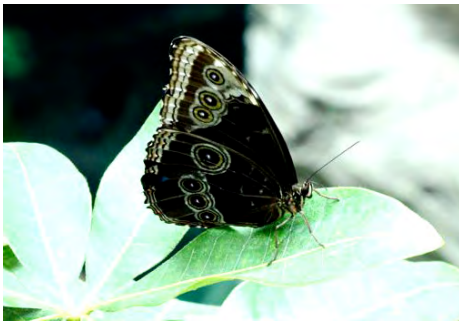
Hecale longwing
Heliconius hecale

Sapho longwing
Heliconius sapho



Sara longwing
Heliconius sara

Blue morpho
Morpho peleides



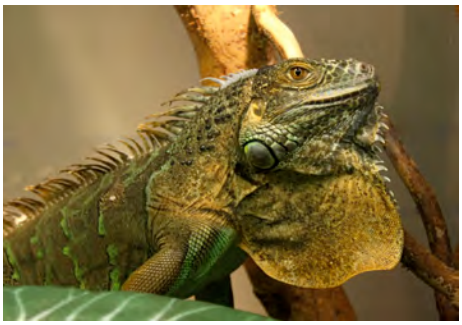
Blue morpho (underwing)
Morpho peleides

Orange barred sulfur
Phoebis philea

Malachite
Siproeta stelenes

FLOODED AMAZON ANACONDA TANK

Green anaconda
Eunectes murinus



Green iguana
Iguana iguana

Silver tetra
Ctenobrycon spilurus

Banded leporinus
Leporinus fasciatus

Flagtail prochilodus
Semaprochilodus insignis

Common silver dollar
Mytennis sp.

Earth-eater cichlid
Geophagus altifrons

All photographs of the Amazon Flooded Forest, except the pike cichld, are by Ron DeCloux

FLOODED AMAZON

MAIN TANK

Pirarucu (Arapaima)
Arapaima gigas

Silver arawana
Osteoglossum bicirrhosum

Atlantic tarpon
Megalops atlanticus

Banded leporinus
Leporinus fasciatus

Sweepline Brycon
Brycon melanopterus

Tambaqui (Black pacu)
Colossoma macropomum

Pirapitinga (Red-bellied pacu)
Piaractus brachypomus

Red-bellied piranha
Pygocentrus nattereri

Ripsaw catfish
Oxydoras niger

Tiger shovelnose catfish
Pseudoplatystoma fasciatum

Redtail catfish
Phractocephalus hemioliopterus

Peacock bass
Cichla ocellaris

Pike cichlid
Crenicichla lepidota

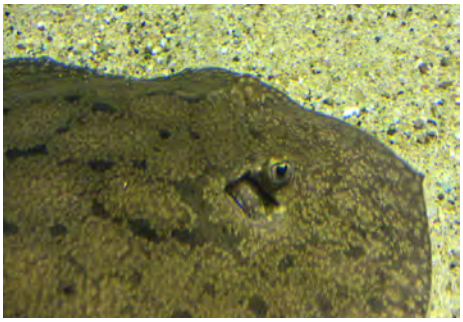
Turquoise severum
Heros severus

Arrau river turtle
Podocnemis expansa

FRESHWATER STINGRAYS

White-blotched river stingray
Potamotrygon leopoldi

Ocellated river stingray
Potamotrygon motoro



Smooth back river stingray
Potamotrygon orbignyi

STEINHART AQUARIUM SPECIES LIST 9.19.10			
Tank/ Exhibit #	**Focus Area and Theme**	**Common Name**	**Scientific Name**
	AFRICA HALL		
	Malawi Cichlids	Cichlids	*Many species*
AF02	African Hall Penguins	African Penguins	*Spheniscus demersus*
AF08	Monitor Lizard	Monitor Lizard - Off display	*Varanus albigularis*
AF18	Chameleons	Jackson's Chameleon	*Chamaeleo jacksoni*
AF20	Tortoise and Lizard	Pancake Tortoises & Plated Lizards	*Malacochersus tornieri* *Gerrhosaurus major*
	ISLANDS OF EVOLUTION		
	Madagascar Spiny Desert	Radiated tortoise	*Astrochelys radiata*
		Spider tortoise	*Pyxis arachnoides*
		Madagascar plated lizard	*Zonosaurus* sp.
	Madagascar Diversity	Hissing cockroaches	*Gromphadorhina portentosa*
	Galapagos Fishes	Zebra moray	*Gymnomuraena zebra*
	"	Klein's butterflyfish	*Chaetodon kleinii*
	"	King angelfish	*Holacanthus passer*
	"	Falco's hawkfish	*Cirrhitichthys falco*
	"	Rainbow wrasse	*Thalassoma lucasanum*
	"	Goldrim tang	*Acanthurus nigricans*
	"	Panamic cushion sea star	*Pentaceraster cumingii*
	CALIFORNIA COAST EXHIBIT		
CCO1	**Soft Coast**	Green sea anemone	*Anthopleura xanthogrammica*
	"	Bat star	*Asterina miniata*
CCO3	**Salt Marsh Pop-up**	Topsmelt	*Atherinops affinis*
	"	Bay pipefish	*Syngnathus leptorhynchus*
	"	Pacific staghorn sculpin	*Leptocottus armatus*
	"	Barred surfperch	*Amphistichus argenteus*
	"	Pile perch	*Damalichthys vacca*
	"	Dwarf surfperch	*Micrometrus minimus*
CC06	**Rocky Coast Main Tank**	Bull kelp	*Nereocystis luetkeana*
	"	Club-tipped anemone	*Corynactis californica*
	"	Giant plumose anemone	*Metridium giganteum*
	"	Cloned plumose anemone	*Medtridium senile*
	"	Aggregating anemone	*Anthopleura elegantissima*
	"	Giant green sea anemone	*Anthopleura xanthogrammica*
	"	Painted urticina	*Urticina crassicornis*
	"	White-spotted rose anemone	*Urticina lofotensis*
	"	Fish-eating anemone	*Urticina piscivora*
	"	Mossy chiton	*Mopalia muscosa*
	"	Gumboot chiton	*Cryptochiton stelleri*
	"	Red abalone	*Haliotis rufescens*
	"	Rough keyhole limpet	*Diodora aspera*
	"	California mussel	*Mytilus californianus*
	"	Scallops (artifical on rock walls)	*Crassedoma giganteum*
	"	Red rock crab	*Cancer productus*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Red sea urchin	*Strongylocentrotus franciscanus*
	"	Purple sea urchin	*Strongylocentrotus purpuratus*
	"	Giant acorn barnacles (artificial)	*Balanus nubilus*
	"	Gooseneck barnacles (artificial)	*Pollicipes polymerus*
	"	Bat star	*Asterina miniata*
	"	Pink star	*Pisaster brevispinus*
	"	Giant seastar	*Pisaster giganteum*
	"	Ochre star	*Pisaster ochraceus*
	"	Leather star	*Dermasterias imbricata*
	"	Leviuscula sea star (Blood star)	*Henricia leviuscula*
	"	Leopard shark	*Triakis semifasciata*
	"	Jacksmelt	*Atherinopsis californiensis*
	"	Red Irish lord	*Hemilepidotus hemilepidotus*
	"	Brown rockfish	*Sebastes auriculatus*
	"	Gopher rockfish	*Sebastes carnatus*
	"	Copper rockfish	*Sebastes caurinus*
	"	Black & yellow rockfish	*Sebastes chrysomelas*
	"	Starry rockfish	*Sebastes constellatus*
	"	Quillback rockfish	*Sebastes maliger*
	"	Black rockfish	*Sebastes melanops*
	"	Vermillion rockfish	*Sebastes miniatus*
	"	Blue rockfish	*Sebastes mystinus*
	"	China rockfish	*Sebastes nebulosus*
	"	Tiger rockfish	*Sebastes nigrocinctus*
	"	Bocaccio	*Sebastes paucispinis*
	"	Canary rockfish	*Sebastes pinniger*
	"	Rosy rockfish	*Sebastes rosaceus*
	"	Flag rockfish	*Sebastes rubrivinctus*
	"	Olive rockfish	*Sebastes serranoides*
	"	Treefish	*Sebastes serriceps*
	"	California scorpionfish	*Scorpaena guttata*
	"	Cabezon	*Scorpaenichthys marmoratus*
	"	Kelp greenling	*Hexagrammos decagrammus*
	"	Rock greenling	*Hexagrammos superciliosus*
	"	Painted greenling	*Oxylebius pictus*
	"	Ocean whitefish	*Caulolatilus princeps*
	"	Redtail surfperch	*Amphistichus rhodoterus*
	"	Pile perch	*Damalichthys vacca*
	"	Black surfperch	*Embiotoca jacksoni*
	"	Striped surfperch	*Embiotoca lateralis*
	"	Walleye surfperch	*Hyperprosopon argenteum*
	"	Rainbow surfperch	*Hypsurus caryi*
	"	Rubberlip surfperch	*Rhacochilus toxotes*
	"	Wolf eel	*Anarrhichthys ocellatus*
	"	C-O turbot	*Pleuronichthys coenosus*
	Rocky Reef Cluster	Articulaing and encrusting coralline algae	*Corallina* sp.
	"	Red rock shrimp	*Lysmata californica*
	"	Ochre star	*Pisaster ochraceus*
	"	Red brotula	*Brosmophycis marginata*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
CC10	Abalone	Red abalone	*Haliotis rufescens*
	"	Green sea anemone	*Anthopleura xanthogrammica*
	"	Turban snails	*Tegula* spp.
	"	Decorator crab	*Loxorhynchus crispatus*
	"	Purple sea urchin	*Strongylocentrotus purpuratus*
CC11	Nudibranchs	Sea lemon nudibranch	*Peltodoris nobilis*
	"	White dorid	*Doris odhneri*
	"	Red algae	Rhodophyta spp.
	"	Club-tipped anemone	*Corynactis californica*
	"	Barnacles feeding (sometimes)	*Balanus* sp.
	"	Vermillion sea star	*Mediaster aequalis*
	"	Blood star	*Henricia leviuscula*
	"	Northern ronquil	*Ronquilus jordani*
CC12	Chitons	Mossy chiton	*Mopalia muscosa*
	"	Lined chiton	*Tonicella lineata*
	"	Articulating coralline algae	*Coralllina* spp.
CC13	Sculpins/Kelpfish	Orange cup coral	*Balanophyllia elegans*
	"	Brown cup coral	*Paracyathus sternsi*
	"	Creeping petal sea cucumber	*Psolus chitonoides*
	"	Scalyhead sculpin (male)	*Artedius harringtoni*
	"	Grunt sculpin	*Rhamphocottus richardsoni*
	"	Decorated warbonnet	*Chirolophis decoratus*
	"	Spotfin sculpin	*Icelinus tenuis*
	"	Crevice kelpfish	*Gibbonsia* sp.
CC14	**Southern California**	Giant kelp (synthetic)	*Macrocystis pyrifera*
	"	Laminaria (synthetic)	*Laminaria* sp.
	"	Red gorgonian	*Lophogorgia chilensis*
	"	Golden gorgonian	*Muricea californica*
	"	Brown gorgonian	*Muricea fruticosa*
	"	Wavy turban snails	*Lithopoma undosum*
	"	Blood star	*Henricia leviuscula*
	"	Warty sea cucumber	*Parastichopus parvimensis*
	"	Swell shark (often hiding)	*Cephaloscyllium ventriosum*
	"	California scorpionfish (juvenile)	*Scorpaena guttata*
	"	Gopher rockfish (juvenile)	*Sebastes carnatus*
	"	Kelp bass	*Paralabrax clathratus*
	"	Opaleye	*Girella nigricans*
	"	Halfmoon	*Medialuna californiensis*
	"	Blacksmith	*Chromis punctipinnis*
	"	Garibaldi	*Hypsypops rubicundus*
	"	Rock wrasse	*Halichoeres semicinctus*
	"	Senorita wrasse	*Oxyjulis californica*
	"	California sheephead	*Semicossyphus pulcher*
	"	Blue-banded goby	*Lythrypnus dalli*
CC15	**Discovery Tidepool**	Likely species as available	
	"	Red algae	Phylum Rhodophyta
	"	Articulaing coralline algae	*Corallina* sp.
	"	Encrusting coralline algae	*Corallina* sp.
	"	Iridescent seaweed	*Iridea* sp.

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Turkish towel	*Mastocarpus papillatus*
	"	Sea lettuce	*Ulva* spp.
	"	Fucus	*Fucus* sp.
	"	Sea sacs	*Halosaccion glandiforme*
	"	Feather boa kelp	*Egregia menziesii*
	"	Oar Weed	*Laminaria* sp.
	"	Giant kelp	*Macrocystis pyrifera*
	"	Orange cup coral	*Balanophyllia elegans*
	"	Aggregating anemone	*Anthopleura elegantissima*
	"	Cloned plumose anemone	*Medtridium senile*
	"	Green sea anemone	*Anthopleura xanthogrammica*
	"	Gumboot chiton	*Cryptochiton stelleri*
	"	Red abalone	*Haliotis rufescens*
	"	Owl limpet	*Lottia gigantea*
	"	Rough keyhole limpet	*Megathura crenulata*
	"	Shield limpet	*Collisella pelta*
	"	Owl limpet	*Lottia gigantea*
	"	Blue ring top snail	*Calliostoma annulatum*
	"	Blue top snail	*Calliostoma ligatum*
	"	Red top snail	*Lithopoma gibberosum*
	"	Brown turban snail	*Tegula brunnea*
	"	Black turban snail	*Tegula funebralis*
	"	California sea hare	*Aplysia california*
	"	Opalescent nudibranch	*Hermissenda crassicornis*
	"	California mussel	*Mytilus californianus*
	"	Red octopus	*Octopus rubescens*
	"	Red rock crab	*Cancer productus*
	"	Pacific mole crab (in small tank)	*Emerita analoga*
	"	Green shore crab	*Hemigrapsus oregonensis*
	"	Purple shore crab	*Hemigraspus nudus*
	"	Decorator (or Masking) crab	*Loxorhynchus crispatus*
	"	Northern kelp crab	*Pugettia producta*
	"	Hermit crab	*Pagurus spp.*
	"	Black-eyed hermit crab	*Pagurus armatus*
	"	Striped shore crab	*Pachygraspus crassipes*
	"	Acorn barnacle	*Balanus glandula*
	"	Gooseneck barnacle	*Pollicipes polymerus*
	"	Bat star	*Asterina miniata*
	"	Pink sea star	*Pisaster brevispinus*
	"	Leather star	*Dermasterias imbricata*
	"	Giant sea star	*Pisaster giganteus*
	"	Ochre star	*Pisaster ochraceus*
	"	Blood star	*Henricia leviuscula*
	"	Brittle star(s)	Family Ophiodermatidae
	"	Red sea urchin	*Strongylocentrotus franciscanus*
	"	Purple sea urchin	*Strongylocentrotus purpuratus*
	"	California sea cucumber	*Parastichopus californicus*
	"	Warty sea cucumber	*Parastichopus parvimensis*
	"	Skate egg cases	*Raja* sp.

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Swell shark egg cases	*Cephaloscyllium ventriosum*
	"	Horn shark egg cases	*Heterodontus francisci*
	"	Northern clingfish	*Gobiesox maeandricus*
	"	Tidepool sculpin	*Oligocottus maculosis*
	"	Dwarf surfperch	*Micrometrus minimus*
	"	Shiner surfperch	*Cymatogaster aggregata*
	"	Penpoint gunnel	
	"	Rockweed gunnel	*Apodichthys fucorum*
CC16	Sand Dollars	Sand dollars	*Dendraster excentricus*
	"	Big skate	*Raja binoculata*
	"	Blackeye goby	*Coryphopterus nicholsii*
CC17	Sea Pen	Giant sea pen	*Ptilosarcus gurneyi*
	"	Northern spearnose poacher	*Agonopsis vulsa*
	"	Vermillion rockfish (juvenile)	*Sebastes miniatus*
	"	Flag rockfish (juvenile)	*Sebastes rubrivinctus*
	"	Yelloweye rockfish (juvenile)	*Sebastes ruberrimus*
	"	Other rockfish juveniles as available	
CC18	Flatfish	Tube anemone	*Pachycerianthus fimbriatus*
	"	Speckled sanddab	*Citharichthys stigmaeus*
	"	English sole	*Pleurinectes vetulus*
	"	Pacific sanddab	*Citharichthys sordidus*
CC19	**Giants**	Giant kelp (synthetic)	*Macrocystis pyrifera*
	"	White-spotted rose anemone	*Urticina lofotensis*
	"	Sunflower seastar	*Pycnopodia helianthoides*
	"	California horn shark	*Heterodontus francisci*
	"	California moray eels	*Gymnothorax mordax*
	"	Garibaldi	*Hypsypops rubicundus*
	"	Giant sea bass	*Stereolepis gigas*
	"	Kelp bass	*Paralabrax clathratus*
	"	California halibut	*Paralichthys californicus*
CC20	**Giant Octopus**	Giant Pacific octopus	*Enteroctopus doffleini*
	"	Giant plumose anemone	*Metridium giganteum*
	"	Painted urticina (anemone)	*Urticina crassicornis*
	"	White-spotted rose amemone	*Urticina lofotensis*
	"	Leather star	*Dermasterias imbricata*
	"	Black rockfish (juvenile)	*Sebastes melanops*
	"	Blue rockfish (juvenile)	*Sebastes mystinus*
	"	Various (changing) juvenile rockfishes	
CC23	**Jewel Cave Wave Crash Tank**	Club-tipped anemone	*Corynactis californica*
	"	Green sea anemone	*Anthopleura xanthogrammica*
	"	Black turban snail	*Tegula funebralis*
	"	Bat star	*Asterina miniata*
	"	Ochre star	*Pisaster ochraceus*
	"	Purple sea urchin	*Strongylocentrotus purpuratus*
	"	Shiner surfperch	*Cymatogaster aggregata*
	"	Black surfperch	*Embiotoca jacksoni*
	"	Rainbow surfperch	*Hypsurus caryi*
	"	Monkey-faced prickleback (blenny)	*Cebidichthys violaceus*
CC24	**Plankton/Sea Drifters**	Sea nettle	*Chrysaora fuscescens*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	PHILIPPINE CORAL REEF		
PRO2	Lagoon	Blacktip reef shark	*Carcharhinus melanopterus*
	"	Bowmouth guitarfish	*Rhina ancylostoma*
	"	Javanese cownose ray	*Rhinoptera javanica*
	"	Blue-spotted ray	*Dasyatis kuhlii*
	"	Pacific tarpon	*Megalops cyprinoides*
	"	Mono	*Monodactylus argenteus*
	"	Neon damselfish	*Neoglyphidodon oxyodon*
	"	Moon wrasse	*Thalassoma lunare*
	"	Humphead wrasse aka Maori wrasse	*Cheilinus undulatus*
	"	Canary wrasse	*Halichoeres chrysus*
	"	Naso	*Naso* sp.
PR03	Mangrove Pop-up	Red mangrove	*Rhizophora mangle*
	"	Barred mudskipper	*Periophthalmus argentilineatus*
PR03a	Sea Grass Shallows	Bryopsis algae	*Bryopsis* sp.
	"	Striped mushroom	*Discosoma* sp.
	"	Zoanthid	*Zoanthus* sp.
	"	Sarcophyton	*Sarcophyton* spp.
	"	Sinularia leather coral	*Sinularia* sp.
	"	Cauliflower coral	*Pocillopora damicornis*
	"	Acanthastrea	*Acanthastrea* sp.
	"	Meat coral	*Acanthophyllia deshayesiana*
	"	Lobed brain coral	*Lobophyllia* sp.
	"	Open brain coral	*Trachyphyllia geoffroyi*
	"	Euphyllia coral	*Euphyllia* sp.
	"	Corkscrew tentacle sea anemone	*Macrodactyla doreensis*
	"	Bubble coral	*Plergyra* sp.
	"	Bubbletip sea anemone	*Entacmea quadricolor*
	"	Magnificent sea anemone	*Heteractis magnifica*
	"	Tridacna clam	*Tridacna derasa*
	"	Tridacna clam	*Tridacna gigas*
	"	Tridacna clam	*Tridacna squamosa*
	"	Tridacna clam	*Tridacna maxima*
	"	Long-spined sea urchin	*Diadema setosum*
	"	Jewel fairy basslet	*Pseudanthias squamapinnis*
	"	False clown anemonefish	*Amphiprion ocellaris*
	"	Green chromis	*Chromis viridis*
	"	Yellowtail blue damselfish	*Chrysiptera parasema*
	"	Banded goby	*Amblygobius phalaena*
	"	Orangebanded surgeonfish	*Acanthurus olivaceous*
	"	Palette tang	*Paracanthurus hepatus*
	"	Various other "visitors" from the deep reef	*Paracanthurus hepatus*
PRO4	Main Coral Reef Tank	Lobophytum	*Lobophytum* spp.
	"	Sarcophyton	*Sarcophyton* spp.
	"	Sinularia	*Sinularia* spp.
	"	Pacific gorgonian	*Rumphella* sp.
	"	Zoanthid	*Zoanthid* spp.
	"	Beaded mushroom	*Discosoma* spp.

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Hairy mushroom	*Rhodactis* spp.
	"	Bullseye mushroom	*Rhodactis inchoata*
	"	Blue coral	*Heliopora coerulea*
	"	Cauliflower coral	*Pocillopora damicornis*
	"	Bird's nest coral	*Seriatopora* sp
	"	Club finger coral (Cat's paw coral)	*Stylophora* sp.
	"	Montipora coral	*Montipora capricornis*
	"	Acropora coral	*Acropora* spp.
	"	Pavona coral	*Pavona* sp.
	"	Disk coral	*Fungia or Cycloseris* sp.
	"	Slipper coral	*Polyphyllia* sp.
	"	Galaxy coral	*Galaxea fascicularis*
	"	Chalice coral	*Oxypora* sp.
	"	Acanthastrea coral	*Acanthastrea* sp.
	"	Symphyliia coral	*Symphyllia*
	"	Echinopora coral	*Echinopora lamellosa*
	"	Horn coral coral	*Hydnophora grandis*
	"	Horn coral	*Hydnophora rigida*
	"	Plating hydnophora coral	*Hydnophora* sp.
	"	Maze brain coral	*Platygrya* sp.
	"	Trumpet coral	*Caulestrea* sp.
	"	Moon coral	*Diploastrea helipora*
	"	Moon coral	*Favia* sp.
	"	Closed brain coral	*Favites* sp.
	"	Euphyllia coral	*Euphyllia* spp.
	"	Small bubble coral	*Plerogyra* sp.
	"	Turbinaria cup coral	*Turbinaria reniformis*
	"	Bubbletip anemone	*Entacmea quadricolor*
	"	Leathery sea anemone	*Heteractis crispa*
	"	Magnificent anemone	*Heteractis magnifica*
	"	Giant carpet anemone	*Stichodactyla gigantea*
	"	Giant clam (all Tridacnas as available)	*Tridacna gigas*
	"	Giant clam	*Tridacna crocea*
	"	Giant clam	*Tridacna derasa*
	"	Giant clam	*Tridacna maxima*
	"	Giant clam	*Tridacna squamosa*
	"	Blue linckia seastar	*Linckia laevigata*
	"	Spotted garden eel	*Heteroconger hassi*
	"	Soldierfish	*Myripristis* sp.
	"	Red-cheeked fairy basslet	*Pseudanthias huchti*
	"	Squarespot fairy basslet	*Pseudanthias pleurotaenia*
	"	Jewel fairy basslet (Lyretail anthias)	*Pseudanthias squamipinnis*
	"	Spotted cardinalfish	*Apogon maculatus*
	"	Seale's cardinalfish	*Apogon sealei*
	"	Pajama cardinalfish	*Sphaeramia nematoptera*
	"	Yellow and blueback fusilier	*Caesio teres*
	"	Bluestreak fusilier	*Pterocaesio tile*
	"	Striped large-eye bream	*Gnathodentex aurolineatus*
	"	Paradiise whiptail	*Pentapodus paradiseus*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Copperbanded butterflyfish	*Chelmon rostratus*
	"	Longnose butterflyfish	*Forcipiger longirostris*
	"	Pyramid butterflyfish	*Hemitaurichthys polylepis*
	"	Bannerfish	*Heniochus diphreutes*
	"	Lemonpeel angelfish	*Centropyge flavissima*
	"	Flame angelfish	*Centropyge loricula*
	"	Lamarck's angelfish	*Genicanthus lamarck*
	"	Blackspot angelfish	*Genicanthus melanospilos*
	"	Emperor angelfish	*Pomacanthus imperator*
	"	Bluegirdled angelfish	*Pomacanthus navarchus*
	"	Clark's anemonefish	*Amphiprion clarkii*
	"	False clown anemonefish	*Amphiprion ocellaris*
	"	Ternate chromis	*Chromis ternatensis*
	"	Green chromis	*Chromis viridis*
	"	Yellowtail blue damselfish	*Chrysiptera parasema*
	"	Southseas devil	*Chrysiptera taupou*
	"	Blacktail damselfish	*Dascyllus melanurus*
	"	Goldbelly damselfish	*Pomacentrus auriventris*
	"	Spinecheek anemonefish	*Premnas biaculeatus*
	"	Harlequin tuskfish	*Choerodon fasciatus*
	"	Longnose hawkfish	*Oxycirrhites typus*
	"	Flame hawkfish	*Neocirrhites armatus*
	"	Exquisite fairy wrasse	*Cirrhilabrus exquisitus*
	"	Yellowfin fairy wrasse	*Cirrhilabrus flavidorsalis*
	"	Lubbock's wrasse	*Cirrhilabrus lubbocki*
	"	Redeye fairy wrasse	*Cirrhilabrus solorensis*
	"	Bird wrasse	*Gomphosus varius*
	"	Canary wrasse	*Halichoeres chrysus*
	"	Pastel green wrasse	*Halichoeres chloropterus*
	"	Two-tone wrasse	*Halichoeres prosopeion*
	"	Striped cleaner wrasse	*Labroides dimidiatus*
	"	Leopard wrasse	*Macropharyngodon meleagris*
	"	Six-line wrasse	*Pseudocheilinus hexataenia*
	"	Sixbar wrasse	*Thalassoma hardwicke*
	"	Moon wrasse	*Thalassoma lunare*
	"	Bicolor blenny	*Ecsenius bicolor*
	"	Midas blenny	*Ecsenius midas*
	"	Convict blenny (engineerfish)	*Pholidichthys leucotaenia*
	"	Jeweled blenny (eyelash)	*Salarias fasciatus*
	"	Zebra goby	*Ptereleotris zebra*
	"	Bluestreak goby	*Valenciennea strigata*
	"	Blue-spotted spinefoot	*Siganus corallinus (tetrazonus)*
	"	Orange-spotted spinefoot	*Siganus guttatus*
	"	Masked spinefoot	*Siganus puellus*
	"	Gold-spotted spinefoot	*Siganus punctatus*
	"	Barhead spinefoot	*Siganus virgatus*
	"	Foxface rabbitfish	*Siganus vulpinus*
	"	Blotched foxface rabbitfish	*Siganus unimaculatus*
	"	Achilles surgeonfish	*Acanthurus achilles*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Ringtail surgeonfish	*Acanthurus blochii*
	"	Eyestripe surgeonfish	*Acanthurus dussumieri*
	"	Powder brown tang	*Acanthurus japonicus*
	"	Lined surgeonfish	*Acanthurus lineatus*
	"	Mata tang	*Acanthurus mata*
	"	Bluelined surgeonfish	*Acanthurus nigroris*
	"	Goldrim tang	*Acanthurus nigricans*
	"	Orangebanded surgeonfish	*Acanthurus olivaceous*
	"	Mimic surgeonfish	*Acanthurus pyroferus*
	"	Convict tang	*Acanthurus triostegus*
	"	Goldring bristletooth	*Ctenochaetus strigosus*
	"	Orangetip bristletooth	*Ctenochaetus tominiensis*
	"	Palette tang	*Paracanthurus hepatus*
	"	Spotted unicornfish	*Naso brevirostris*
	"	Orangespine unicornfish	*Naso lituratus*
	"	Bluespine unicornfish	*Naso unicornis*
	"	Bignose unicornfish (Bumphead naso)	*Naso vlamingii*
	"	Brown scopas tang	*Zebrasoma scopas*
	"	Sailfin tang	*Zebrasoma veliferum*
	"	Clown triggerfish	*Balistoides conspicillum*
	"	Black triggerfish	*Melichthys niger*
	"	Pinktail triggerfish	*Melichthys vidua*
	"	Redtooth triggerfish	*Odonus niger*
	"	Picassofish (Blackbar triggerfish)	*Rhinecanthus aculeatus*
	"	Bluechin triggerfish	*Xanthichthys auromarginatus*
	Color Cluster		
PRO5	Ribbon eels	Black ribbon eels	*Rhinomuraena quaesita*
	"	Blue ribbon eels	*Rhinomuraena quaesita*
	"	Sinularia leather coral	*Sinularia* sp.
	"	Zoanthids	*Parazoanthus* sp.
	"	Striped mushroom	*Discosoma* sp.
	"	Mushroom corallimorph	*Ricordea* sp.
	"	Mycedium coral	*Mycedium* sp.
	"	Brittlestar spp.	Family Ophiodermatidae
PR06	Hector's Goby	Hector's goby	*Amblygobius hectori*
PR07	Hiding the Eye	Pajama cardinalfish	*Sphaeramia nematoptera*
	"	Coral beauty	*Centropyge bispinosus*
	"	Raccoon butterflyfish	*Chaetodon lunula*
	"	Mystery wrasse	*Pseudocheilinus ocellatus*
	"	Moorish idol	*Zanclus cornutus*
	"	Papuan toby	*Canthigaster papua (solandri)?*
	"	Fire urchin	*Astropyga radiata*
	"	Green-spined salmacis (urchin)	*Salmacis sphaeroides*
PR08	Alligator Pipefish	Alligator pipefish	*Syngnathoides biaculeatus*
	"	Chocolate chip seastar	*Protoeaster nodosus*
PRO9	Sea Apple	Sea apple	*Pseudocolochirus violaceus*
	"	Yellow sea cucumber	*Colochirus robustus*
	"	Zoanthids	*Zoanthus* sp.
	"	Orange sun coral	*Tubastrea* sp.

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
PR10	Harlequin Shrimp	Harlequin shrimp	*Hymenocera picta*
	"	Lobophytum leather coral	*Lobophytum* sp.
	"	Striped mushroom	*Discosoma* sp.
	"	Zoanthids	*Parazoanthus sp.*
	"	Spotted dragonet	*Synchiropus picturatus*
PR11	Coral Rubble	Candy shrimp (cleaner)	*Rhynchocinetes durbanensis*
	"	Chaetodon vagabundus	*Chaetodon vagabundus*
PR12	Frogfish	Frogfish	*Antennarius* sp.
	"	Lobophytum	*Lobophytum* spp.
	"	Pulsing xenia	*Xenia* sp.
	"	Mushroom corallimorph	*Discosoma* sp.
	"	Mushroom corallimorph	*Ricordea* sp.
	"	Zoanthid	*Parazoanthus* sp.
	"	Chalice coral	*Echinophyllia* sp.
	"	Oxpora	*Mycedium* sp.
	"	Symphyllia coral	*Symphyllia* sp.
	"	Brittlestar spp.	Family Ophiodermatidae
	"	Fire urchin	*Astropyga radiata*
	Life in the Dark		
PR21	Flashlight Fishes	Flashlightfish	*Photoblepharon palpbratum*
	"	Splitfin flashlight fish	*Anomalops katoptron*
PR22	Moray Eel	Honeycomb (Laced) moray eel	*Gymnothorax favagineus*
	"	Whitemouth moray	*Gymnothroax meleagris*
	"	Snowflake moray	*Echidna nebulosa*
	"	Zebra moray	*Gymnomuraena zebra*
	"	Cleaner shrimp	*Lysmata amboinensis*
PR 23	Chambered Nautilus	Chambered nautilus	*Nautilus pompilius*
	"	Sea fan	*Species unknown*
	Venoms Cluster		
PR 24	Fire Coral	Fire coral (branching)	*Millepora* sp.
	"	Yellowstriped cardinalfish	*Apogon cyanosoma*
	"	Pink and yellow scorpionfish	*Sebastapistes cyanostigma*
	"	Canary blenny	*Meiacanthus oualanensis*
	"	Sinularia	*Sinularia* sp.
	"	Waving hand coral	*Anthelia* sp.
	"	Zoanthid	*Palythoa* sp.
	"	Miniature carpet anemone	*Stichodactyla tapetum*
	"	Pocillopora coral	*Pocillopora* sp.
	"	Acropora coral	*Acropora* spp.
	"	Montipora coral	*Montipora* spp. inc. *capricornis*
	"	Chalice coral	*Mycedium* sp.
	"	Miniature carpet anemone	*Stichodactyla tapetum*
	"	Brittlestar spp.	Family Ophiodermatidae
PR25	Stonefish	Stonefish	*Synanceia verrucosa*
PR26	Cone Snail	Cone snail	*Conus marmoreus*
	"	Bullseye mushroom	*Rhodactis* sp.
	"	Striped mushroom	*Discosoma* spp.
PR27	Lionfish	Lionfish	*Pterois volitans*
	"	Various artifical corals	

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	Reef Partners Cluster		
PR29	Shrimp Goby/Pistol Shrimp	Shrimp goby	*Amblyeleotris* sp.
	"	Pistol shrimp	*Alpheus* sp.
PR30	Decorator crab	Hermit crab wearing anemones	*Dardanus pedunculatus*
	"	Symbiotic anemone	*Calliactis* sp.
PR31	Shrimpfish	Spotted shrimpfish	*Aeoliscus strigatus*
	"	Copperbanded butterflyfish	*Chelmon rostratus*
	"	Randall's prawn-goby	*Amblyeleotris randalli*
	"	Tomini tang	*Ctenochaetus tominiensis*
	"	Encrusting gorgonian	*Erythropodium* sp.
	"	Pacific gorgonian	*Rhumphella* sp.
	"	Green star polyp	*Briareum* sp.
	"	Hydnophora coral	*Hydnophora rigida*
PR32	Commensal Shrimp on Corals	Sexy anemone shrimp	*Thor amboinensis*
	"	Cleaner shrimp	*Periclimenes* sp.
	"	Coral hermit crab	*Paguritta* sp.
	"	Diploastrea coral	*Diploastrea* sp.
	"	Branching frogspawn coral	*Euphyllia paradivisia*
	"	Frogspawn coral	*Euphyllia divisa*
	"	Anchor coral	*Euphyllia parancora*
	"	Fox coral	*Nemenzophyllia* sp.
	"	Redspot cardinalfish	*Apogon parvulus*
PR33	Small Giant Clams	Tridacna clams (species as available)	*T.maxima,squamosa,crocea,dersa*
	"	Royal dottyback	*Pseudochromis paccagnellae*
	"	Dog-toothed cardinalfish	*Cheilodipterus isostigmus*
	"	Pinsptriped wrasse (immature)	*Halichoeres melanurus*
	"	Tree coral	*Capnella* sp.
	"	Zoanthid (button polyps)	*Protopalythoa* sp.
	"	Chalice coral	*Mycedium* sp.
PR34	Clownfish and Anemones	Pink clownfish	*Amphiprion perideraion*
	"	Bicolor chromis	*Chromis margaritifer*
	"	Beaded and striped mushroom	*Discosoma* spp.
	"	Magnificent anemone	*Heteractis magnifica*
PR35	Upside-down Jellyfish	Upside-down jellyfish	*Cassiopea andromeda*
	"	Sand-eating seastar	*Archaster typicus*
	"	Banded goby	*Amblygobius phalaena*
PR36	**Caribbean Reef**	Encrusting gorgonian	*Erythropodium caribaeorum*
	"	Sea plume	*Muriceopsis flavida*
	"	Sea rod	*Plexaura* sp.
	"	Silt-pore sea rod	*Plexaurella* sp.
	"	Porous sea rod	*Pseudoplexaura* sp.
	"	Purple frilly sea plume	*Pseudopterogorgia elizabethi*
	"	Sea plume	*Pseudopterogorgia* sp.
	"	Zoanthid	*Protopalythoa grandis*
	"	Discosoma	*Discosoma sanctithomae*
	"	Ricordea mushroom coral	*Ricordea florida*
	"	Condylactis sea anemone	*Condylactis gigantea*
	"	Sun anemone	*Stichodactyla helianthus*
	"	Pencil sea urchin	*Eucidaris tribuloides*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Cherubfish	*Centropyge argi*
	"	Queen angelfish (adolescent)	*Holacanthus ciliaris*
	"	Flame cardinalfish	*Apogon maculatus*
	"	Reef butterflyfish aka painted butterflyfish	*Chaetodon sedentarius*
	"	Harlequin bass	*Serranus tigrinus*
	"	Chalk bass	*Serranus tortugarum*
	"	Blue chromis	*Chromis cyanea*
	"	Beaugregory	*Stegastes leucostictus*
	"	Spanish hogfish	*Bodianus rufus*
	"	Yellowhead wrasse	*Halichoeres garnoti*
	"	Royal gramma	*Gramma loreto*
	"	Redspotted hawkfish	*Amblycirrhitus pinos*
	"	Blue tang	*Acanthurus coeruleus*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	WATER PLANET		
	Centerpiece Exhbits		
	H2O Dependence/Independence		
WP01	Independent of Standing Water	Black-headed python	*Aspidites melanocephalus*
	"	Woma (python)	*Aspidites ramsayi*
	"	Centralian python	*Morelia bredli*
WP03	Moist Environment	Vietnamese mossy frog	*Theloderma corticale*
WP04	Total Immersion	Leafy seadragon	*Phycodorus eques*
	"	Potbelly seahorse	*Hippocampus abdominalis*
	H2O Chemistry /Salinity		
WP09	Open Water Marine	Moon jellies	*Aurelia aurita*
	H2O Temperature		
WP10	Cold (Perch under Ice)	Yellow perch	*Perca flavescens*
	Concept Clusters		
	In and Out of Water Cluster		
WP12	Air breather in low-oxygen conditions	Australian lungfish	*Neoceratodus fosteri*
WP13		Siamese fighting fish	*Betta splendens*
WP14	Arid-adapted breeding cycle	Redtail killifish	*Nothobranchius guentheri*
	Reproduction Cluster		
WP15	"	Butterfly splitfin (Buttefly goodeid)	*Ameca splendens*
WP16	Weedy seadragons	Weedy seadragon	*Phyllopteryx taeniolatus*
WP17	Lined Seahorse	Lined seahorse	*Hippocampus erectus*
	"	Longsnout seahorse	*Hippocampus reidi*
	"	Janss' pipefish	*Doryrhamphus janssi*
	"	Banded pipefish	*Doryrhamphus dactyliophorus*
	"	Saddled Butterflyfiish	*Chaetodon ephippium*
	"	Sponge	unknown species
	"	Striped mushroom	*Discosoma* sp.
	"	Hairy mushroom	*Rhodactis* sp.
	"	Pulsing xenia	*Xenia* sp.
WP18	Livebearers	Endler's livebearer	*Poecilia wingei*
	"	Black bee shrimp	*Caridina cantonensis*
WP19	Retailed flasher wrasse	Retailed flasher wrasse	*Paracheilnus rubricaudalis*
	"	Redspot cardinalfish	*Apogon parvulus*
	"	Bank butterflyfish	*Prognathodes aya*
	"	Lobophytum	*Lobophytum* sp.
	"	Sarcophyton	*Sarcophyton* sp.
	"	Sinularia	*Sinularia* sp.
	"	Beaded and striped mushrooms	*Discosoma* spp.
	"	Bullseye mushroom	*Rhodactis inchoata*
	"	Hairy mushroom	*Rhodactis* sp.
WP21	Dive Station Tank	Banggai cardinalfish	*Pterapogon kauderni*
	"	Bubble coral	*Plerogyra sinuosa*
	"	Long-spined sea urchin	*Diadema setosum*
	Locomotion Cluster		
WP22	Vampire Crabs	Vampire crab	*Geosesarma* sp
WP23	Precision movement (pectoral/dorsal)	Shaw's boxfish	*Aracana aurita*
	"	Ornate boxfish	*Arcana ornate*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
WP24	Adhesion	Pacific spiny lumpsucker	*Eumicrotremus orbis*
	"	Grunt sculpin	*Rhamphocottus richardsoni*
	"	Coralline algae	*Corallina* sp.
	"	Club-tipped anemone	*Corynactis californica*
	"	Cloned plumose anemone	*Medtridium senile*
	"	Turban snail	*Tegula* sp.
	"	Giant acorn barnacles (shells)	*Balanus nubilis*
WP25	Pignose Turtle	Pignose turtle	*Carettochelys insculpta*
WP26	Seastars (tube feet)	Brittle stars	*Iohiura incrassata & 2 others*
	"	Euphyllia coral	*Euphyllia divisa*
WP27	Swimming Crab	Blue crab	*Callinectes sapidus*
	"	Encrusting gorgonian	*Erythropodium* sp.
	"	Bullseye mushroom	*Rhodactis inchoata*
	Feeding Cluster		
WP28	Diving Beetle	Sunburst diving beetle	*Thermonectus marmoratus*
WP29	Aquatic Insect	Being updated	
WP30	Fishing Spider	Fishing spider	*Dolomedes okefinokensis*
WP31	Various Feeding Strategies	Paddlefish	*Polyodon spathula*
	"	Spotted gar	*Lepisosteus oculatus*
	"	Longnose gar	*Lepisosteus osseus*
	"	Pallid sturgeon	*Scaphirhynchus albus*
	"	Shovelnose sturgeon	*Scaphirhynchus platorynchus*
	"	Smallmouth buffalofish	*Ictiobus bubalus*
	"	Longear sunfish	*Lepomis megalotis*
	"	Black crappie	*Pomoxis nigromaculatus*
WP32	Fishing snake	Burmese vine snakes	*Ahaetulla fronticincta*
	Defenses Cluster		
WP33	Venom, Camouflage	Scorpionfish - off exhibit	*Rhinopias frondosa*
	"	Organ pipe coral	*Tubipora musica*
	"	Sinularia leather coral	*Sinularia* sp.
	"	Sarcophyton leather coral	*Sarcophyton* sp.
	"	Pulse coral	*Xenia* sp.
	"	Cauliflower coral	*Pocillopora* sp.
	"	Bird's nest coral	*Seriatopora* sp.
	"	Montipora coral	*Montipora capricornis*
	"	Montipora coral	*Monitpora digitata*
	"	Encrusting montipora	*Montipora* spp.
	"	Acropora coral	*Acropora tenius*
	"	Acropora coral	*Acropora* spp.
	"	Chalice coral	*Echinophyllia* sp.
	"	Button coral	*Scolymia* sp.
	"	Acanthastrea (stony coral)	*Acanthastrea* sp.
	"	Meat coral	*Australomussa* sp.
	"	Blastomussa coral	*Blastomussa wellsi*
	"	Trumpet coral	*Caulastrea* sp.
	"	Maze coral	*Platygrya* sp.
	"	Goniastrea coral	*Goniastrea* sp.
	"	Diploastrea coral	*Diploastrea* sp.
WP34	Behavior	Upsidedown catfish	*Synodontis nigriventris*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
WP35	Camouflage by transparency	Glass catfish	*Kryptopterus minor*
	"	Glassfish	*Parambassis ranga*
WP36	Camoulfage - color change	Dwarf cuttleflish	*Sepia bandensis*
	"	Lobophytum leather coral	*Lobophytum* sp.
	"	Sarcophyton leather coral	*Sarcophyton* sp.
	"	Meat coral	*Acanthophyllia deshayesiana*
	"	Chocolate chip seastar	*Protoeaster* spp.
WP37	Behavior	Feather duster worm	*Sabellastarte* sp.
	"	Coco worm	*Protula* sp.
	"	Flambuoyant cuttlefish	*Metasepia pfefferi*
WP38	Protective shell	Queen conch	*Strombus gigas*
	"	Spaghetti algae	Chaetomorpha
	"	Pulsing xenia	*Xenia* sp.
	Senses Cluster		
WP39	Sight	Peacock mantis shrimp	*Odontodactylus scyllarus*
	"	Lobophytum leather coral	*Lobophytum* sp.
	"	Sinularia	*Sinularia* sp.
	"	Beaded mushrooms	*Discosoma* spp.
	"	Hairy mushroom	*Rhodactis* sp.
	"	Zoanthids	*Zoanthus* sp.
	"	Green star polyp	*Briareum* sp.
	"	Caulastrea coral	*Caulastrea* sp.
WP40	Sound	Humming toadfish	*Porichthys notatus*
		Coralline algae	*Corallina* spp.
	"	Green anemone	*Anthopleura xanthogrammica*
WP41	Lack of Sight	Blind cave fish	*Astyanax fasciatus*
WP42	Electric Signals	Elephantnose	*Gnathonemus petersi*
	Desert Cluster		
WP43	Beaded Lizard	Mexican Beaded lizard	*Heloderma horridum*
WP44	Desert hairy scorpion	Desert hairy scorpion	*Hadrurus arizonensis*
WP45	Desert Pupfish	Desert pupfish	*Cyprinodon macularius*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	RAINFORESTS OF THE WORLD		
	Neotropical Rainforest		
	"	Black olive tree	*Bucida buceras*
	"	Brazilian beauty leaf	*Calophyllum brasiliense*
	"	Peach palm	*Bactris gasipaes*
	"	Water chestnut aka Saba nut	*Pachira aquatica*
	"	West Indian mahogany	*Swietenia mahogani*
	Birds	Silver-beaked tanager	*Ramphocelus carbo*
	"	Red-shouldered tanager	*Tachyphonus phoeniceus*
	"	Rufous-crowned tanager	*Tangara cayana*
	"	Paradise tanager	*Tangara chilensis*
	"	Turquoise tanager	*Tangara mexicana*
	"	Opal-rumped tanager	*Tangara velia*
	"	Blue-gray tanager	*Thraupis epicopus*
	"	Bananaquit	*Coereba flaveola*
	"	Red-legged honeycreeper	*Cyanerpes cyaneus*
	"	Saffron finch	*Sicalis flaveola*
	"	Violaceous euphonia	*Euphonia violacea*
	"	Yellow-green grosbeak	*Caryothraustes canadensis*
	Macaws	Blue and yellow macaw	*Ara ararauna*
	"	Scarlet macaw	*Ara macao*
	Buttterflies	Species commonly on display:	
	"	Banded orange heliconian	*Dryadula phaetusa*
	"	Giant owl butterfly	*Caligo* sp.
	"	Julia	*Dryas julia*
	"	Isabella tiger	*Eueides isabella*
	"	Zebra longwing	*Heliconius charithonia*
	"	Doris longwing	*Heliconius doris*
	"	Small Postman	*Heliconius erato*
	"	Hecale longwing aka Tiger longwing	*Heliconius hecale*
	"	Postman	*Heliconius melpomene*
	"	Sapho longwing	*Heliconius sapho*
	"	Sara longwing	*Heliconius sara*
	"	Blue morpho	*Morpho peleides*
	"	Orange barred sulfur	*Phoebis philea*
	"	Malachite	*Siproeta stelenes*
	Borneo		
B002	Cave Cluster	Dog-faced fruit bat	*Cynopterus brachyotis*
B003	"	Cave rat snake	*Elaphe taeniura ridleyi*
B004	Scolopendra Centipede	Scolopendra centipede	*Scolopendra subspinipes*
B005	Wagler's Pit Viper	Wagler's pit viper	*Tropidolaemus wagleri*
	"	Asian horned frog	*Megophrys nasuta*
B006	Plant Models	Rafflesia and pitcher plants	*Rafflesia arnoldi/Nepthenes* sp.
B008	Cobalt Blue Tarantula	Cobalt blue tarantula	*Haplopelma lividum*
B009	Freshwater Fishes of Borneo	Celestial pearl danio	*Celestichthys margaritatus*
	"	Red tailed black shark	*Epalzeorhynchus bicolor*
	"	Cherry barb	*Puntius titteya*
	"	Red-striped rasbora	*Rasbora pauciperforata*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Harlequin rasbora	*Trigonostigma heteromorpha*
	"	Dwarf loach	*Botia sidthimunki*
	"	Siamese algae eater	*Crossocheilus siamensis*
	"	Striped betta	*Betta taeniata*
	"	Pearl gourami	*Trichogaster leeri*
	"	Moonlight gourami	*Trichogaster microlepis*
	"	Blue gourami	*Trichogaster trichopterus*
	"	Wood shrimp	*Atyopsis moluccensis*
B010	Lowland Forest Herps	Mangrove snake (off exhibit)	*Boiga dendrophila*
	"	Red-tailed green rat snake	*Gonyosoma oxycephela*
	"	Borneo river toad	*Phrynoidis juxtaspera*
B011	Borneo Gliding Herps	Kuhl's flying gecko	*Ptychozoon kuhlii*
	"	Borneo eared frog	*Polypedates otilophus*
	"	Harlequin flying frog	*Rhacophorus pardalis*
BO12	Pitcher Plants/Orchids	Many species on wall	*Nepenthes* spp. and Orchid spp.
BO13	Flying Snake	Paradise flying snake	*Chrysopelea paradisi*
	Forest Floor		
BO14	Leafcutter Ants	Leafcutter ants	*Atta cephalotes*
	Madagascar		
MAO2	Insects	Ghost praying mantis	*Phyllocrania paradoxa*
MA03	Tomato Frog	Sambava tomato frog	*Dyscophus guineti*
	"	Sakalava's velvet gecko	*Blaesodactylus sakalava*
MA04	Cichlids of Mad	Saroy	*Ptychochromis grandidieri*
	"	Tarantsy	*Ptychochromis* sp. Tatantsy
	"	Marakely	*Paratilapia polleni*
	"	Katria	*Katria katria*
MAO5	Rainbowfish of Mad	Madagascar rainbowfish	*Bedotia geayi*
	"	Patriciae killifish	*Pachypanchax patriciae*
	Herps of Mad Cluster		
MA06	Madagascar tree boa	Madagascar tree boa	*Sanzinia madagascariensis*
	"	Painted mantella frog	*Mantella baroni*
MAO7	Geckos 1	Standing's day gecko	*Phelsuma standingi*
	"	Henkel's leaf-tail gecko	*Uroplatus henkeli*
MA08	Geckos 2	Madagascar giant day gecko	*Phelsuma grandis*
	"	Lined leaf-tail gecko	*Uroplatus lineatus*
MA13	Mantellas/Orb-weaving Spider	Orb weaving spiders	*Nephila madagascariensis*
	"	Golden mantella	*Mantella aurantiaca*
MAO9	Chameleons 1	Panther chameleon	*Furcifer pardalis*
MA10	Chameleons 2	Panther chameleon	*Furcifer pardalis*
MA12	Geckos 3	Klemmer's yellow-headed day gecko	*Phelsuma klemmeri*
	"	Green mantella	*Mantella viridis*
	"	Madagascar reed frog	*Heterixalus madagascariensis*
MA14	Madagascar leaf-nosed snake	Madagascar leaf-nosed snake	*Langaha madagascariensis*
	"	Madagascar reed frog tadpoles	*Heterixalus madagascariensis*
	Costa Rica		
CR02	Green Basilisk	Green basilisk lizard	*Basiliscus plumifrons*
	"	Green and black poison dart frog	*Dendrobates auratus*
CRO3	Poison Dart Frog	Striped poison dart frog	*Phyllobates* sp.
CRO4	Cockroach	Giant cockroach	*Blaberus giganteus*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
CR05	Poison Dart Frogs	Strawberry poison dart frog	*Oophaga (Dendrobates) pumilio*
	"	Green and black poison dart frog	*Dendrobates auratus*
CRO6	Red-eye treefrog	Red-eye treefrog	*Agalychnis callidryas*
	Flooded Amazon		
AM02	Matamata	Matamata turtle	*Chelus fimbriatus*
	"	Emerald tree boa	*Corallus caninus*
AMO3	Anaconda	Green anaconda	*Eunectes murinus*
	"	Green iguana	*Iguana iguana*
	"	Banded leporinus	*Leporinus fasciatus*
	"	Silver tetra	*Ctenobrycon spilurus*
	"	Suckermouth catfish	*Hypostomus* sp.
	"	Flagtail prochilodus	*Semaprochilodus insignis*
	"	Silver dollar	*Metynnis* sp.
	"	Earth-eater cichlid	*Geophagus altifrons*
AM05	Altum Angelish	Orinoco angelfish	*Pterophyllum altum*
AMO6	Electric eel	Electric eel	*Electrophorus electricus*
AMO8	Piranha	Red-bellied piranha	*Pygocentrus nattereri*
	"	Bucktooth tetra	*Exodon paradoxus*
	"	Dwarf cichlid	*Apistogramma macmasteri*
AM10	Surinam Toad	Surinam toad	*Pipa pipa*
AM11	Amazon Flooded Tunnel	Pirarucu (Arapaima)	*Arapaima gigas*
	"	Silver arowana	*Osteoglossum bicirrhosum*
	"	Atlantic tarpon	*Megalops atlanticus*
	"	Banded leporinus	*Leporinus fasciatus*
	"	Sweepline brycon	*Brycon melanopterus*
	"	Tambaqui (Black pacu)	*Colossoma macropomum*
	"	Pirapitinga (Red-bellied pacu)	*Piaractus brachypomus*
	"	Ripsaw catfish	*Oxydoras niger*
	"	Tiger shovelnose catfish	*Pseudoplatystoma fasciatum*
	"	Redtail catfish	*Phractocephalus hemioliopterus*
	"	Perruno catfish	*Perrunichthys perruno*
	"	Peacock bass	*Cichla ocellaris*
	"	Pike ciclid	*Crenicichla johanna*
	"	Ringtail pike cichlid	*Crencichla saxatilis*
	"	Turquoise Severum	*Heros appendiculatus*
	"	Chocolate cichlid	*Hypselecara temporalis*
	"	Arrau river turtle	*Podocnemis expansa*
AM12	Freshwater Stingrays	Ocellate river stingray	*Potamotrygon motoro*
	"	White-blotched river stingray	*Potamotrygon leopoldi*
	"	Smooth back river stingray	*Potamotrygon orbignyi*
	"	Sailfin plecostomus	*Pterygoplichthys gibbiceps*
	"	Rummy nose tetra	*Hemigrammus bleheri*
	"	Rummy nose tetra	*Hemigrammus rhodostomus*
AM14	Cardinal Tetras	Cardinal tetras	*Paracheirodon axelrodi*
	"	Amazon pufferfish	*Colomesus asellus*
	"	Orange neon corydoras	*no species name (undescribed)*
	"	Golden pencilfish	*Nannostomus beckfordi*
	"	Midget sucker	*Otocinclus affinis*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	SWAMP		
SW02	Alligator Tank	American alligator	*Alligator mississippiensis*
	"	Alligator snapping turtle	*Macroclemys temminckii*
	"	Spotted gar	*Lepisosteus oculatus*
	"	Common carp	*Cyprinus carpio*
	"	Koi carp	*Cyprinus carpio*
	"	Suckermouth catfish	*Hypostomus plecostomus*
	"	Sailfin plecostomus	*Pterygoplichthys* spp.
	"	Walking catfish	*Clarias batrachus*
	"	Channel catfish	*Ictalurus punctatus*
	"	Red oscar	*Astronotus ocellatus*
	"	Midas cichlid	*Amphilophus citrinellus*
	"	Umbee cichlid	*Cichlasoma umbriferum*
	"	Jaguar cichlid	*Nandopsis managuensis*
	"	Hornet tilapia	*Tilapia buttikofferi*
	"	Black belt cichlid	*Vieja maculicauda*
	"	Largemouth bass	*Micropterus salmoides*
	"	Redbreast sunfish	*Lepomis auritus*
	"	Longear sunfish	*Lepomis megalotis*
	"	Black crappie	*Pomoxis nigromaculatus*
SW03	Eastern Diamondback	Eastern diamondback snake	*Crotalus adamanteus*
	"	Everglades rat snake	*Elaphe obsoleta*
SW04	Lesser Siren	Lesser siren	*Siren intermedia*
	"	Golden topminnow	*Fundulus chrysotus*
SWO5	Pygmy Sunfish	Pygmy sunfish	*Elassoma evergladei*
SWO6	Spider	Black Widow	*Latrodectus mactans*
SW07	Treefrogs & pitcher plants	Green treefrog	*Hyla cinerea*
SW08	Alligator Gars	Alligator gar	*Atractosteus spatula*
	"	Texas cichlid	*Herichthys cyanoguttatus*
	"	Redbreast sunfish	*Lepomis auritus*
	STAFF PICKS		
SP01	Nicole Chaney	Blue poison dart frog	*Dendrobates azureus*
	"	Electric-blue day gecko	*Lygodactylus williamsi*
SP02	Brooke Weinstein	Whiteseam betta	*Betta albimarginata*
SP03	Ken Howell	South American leaf fish	*Monocirrhus polyacanthus*
SP04	Bart Shepherd	Engineerfish	*Pholidichthyes leucotaenia*
	"	Threadfin cardinalfish	*Zoramia leptacantha*
	"	Pacific sailfin tang	*Zebrasoma veliferum*
SP05	Tom Tucker	Fluffy sculpin	*Oligocottus snyderi*
SP06	Pam Schaller	Tiger shark stomach contents	*Galeocerdo cuvier*
SP07	Rich Ross	Orange spotted file fish	*Oxymonacanthus longirostris*
	"	Orchid dottyback	*Pseudochromis fridmani*
	"	Striped fangblenny	*Meiacanthus grammistes*
	"	Organ pipe coral	*Tubipora musica*
	"	Sarcophyton leather coral	*Sarcophyton* sp.
	"	Sinularia	*Sinularia* sp.

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Tree coral	*Nephthea* sp.
	"	Pulse coral	*Xenia* sp.
	"	Zoanthids	*Palythoa* sp.
	"	Bullseye mushroom	*Rhodactis inchoata*
	"	Ricordea yuma mushroom coral	*Ricordea yuma*
	"	Lettuce coral	*Agaricia* sp.
	"	Montipora (stony coral)	*Montipora capricornis*
	"	Green star polyps	*Briareum* sp.
	"	Chalice coral	*Echinophyllia* sp.
	"	Trumpet coral	*Caulastrea* sp.
	"	Echinopora (stony coral)	*Echinopora* sp.
	"	Maze coral	*Platygyra* sp.
	"	Frogspawn coral	*Euphyllia divisa*
	"	Whiskers coral	*Duncanopsammia axifuga*
SP08	Frank Glennon	Common kribensis	*Pelvicachromis pulcher*
SP09	Tanganyikan Fishes	Mtoto zebra	*Lamprologus brevis* zebra
	"	Black calvus and white color morph	*Altolamprologus calvus*
SP10	"	Brazilian salmon-pink birdeater	*Lasiodora parahybana*
SP11	Alison Rusch	Waxy monkey tree frog	*Phyllomedusa sauvagii*
SP12	Jim Evans	Dwarf African frogs	*Hymenochirus boettgeri*
SP13	Kristen Natoli	Butterworts and sundews	*Pinguicula and Drosera* spp.
SP14	Matt Wandell - Coral Reef Fishes	Peach fairy basslet	*Pseudanthias dispar*
	"	Lori's anthias	*Pseudanthias lori*
	"	Yellowstriped fairy basslet	*Pseudanthias tuka*
	"	Fathead anthias	*Serranocirrhitus latus*
	"	Indian butterflyfish	*Chaetodon mitratus*
	"	Purple tilefish	*Hoplolatilus purpureus*
	"	Firefish goby (Helfrich's dartfish)	*Nemateleotris helfrichi*
	"	Sea rod	*Diodogorgia nodulifera*
	"	Orange sun coral	*Tubastrea* sp.
SP15	Chris Andrews 2 -Coral Fuoresence	Actinodiscus (striped mushroom)	*Actinodiscus* sp.(Discosoma)
	"	Chalice coral	*Echinophyllia* sp.
	"	Favia coral	*Favia* sp.
	"	Bubble coral	*Plerogyra sinuosa*
	"	Banggai cardinalfish	*Pterapogon kauderni*
SP16	Seth Wolters	Pacific gopher snake (two-headed)	*Pituophis catenifer catenifer*
SP17	Jim Evans	Crystal red shrimp	*Caridina cantonensis*
	"	Moss ball	*Aegagropila linnaei*
	"	White cloud minnow	*Tanichthys albonubes*
SP18	Bart Shepherd 2	Coelacanth (CAS preserved)	*Latimeria chalumnae*
	Academy Cafe		
AC01	Asian River Fishes (mostly)	Tricolor sharkminnow	*Balantiocheilos melanopterus*
	"	Black ruby barb	*Rasbora borapetensis*
	"	Clown loach	*Botia macracanthus*

Tank/ Exhibit #	Focus Area and Theme	Common Name	Scientific Name
	"	Redtail loach	*Botia modesta*
	"	Longfin tetra	*Brycinus longipinnis*
	"	Redtail brycon	*Brycon rubricauda*
	"	African glass catfish	*Pareutropius debauwi*
	"	Suckermouth catfish	*Hypostomus plecostomus*
	"	Vampire pleco	*Leporacanthicus galaxias*
	"	Splendid rainbowfish	*Melanotaenia splendid*
	"	Banded rainbowfish	*Melanotaenia trifasciata*
	"	Freshwater angelfish	*Pterophyllum scalare*
	"	Lionhead cichlid	*Steatocranus casuarius*
	"	Golden tilapia	*Tilapia brevimanus*
	"	Flagtail prochilodus	*Semaprochilodus taeniurus*
	"	Morgunda morgunda	*Morgunda morgunda*
	Moss Room		
MRO1	Barbs (mostly)	Java barb	*Barbonymus gonionotus*
	"	Tinfoil barb	*Barbonymus schwanenfeldii*
	"	Hampala barb	*Hampala macrolepidota*
	"	T-barb	*Puntius lateristriga*
	"	Red devil cichlid	*Amphilophus labiatus*
	Display Birds		
	"	Swainson's hawk	*Buteo swainsoni*
	"	Barn owl	*Tyton alba*
	"	Turkey vulture	*Cathartes aura*

GLOSSARY

abyssal pertaining to the great depths of the ocean

advanced character state *see* derived character state

allele one of the variant forms of a gene at a particular locus, or location, on a chromosome

allelopathic the inhibition of grown in one species of plant or animal by chemicals produced by another species

alternation of generations life cycle in which haploid and diploid generations alternate with each other; common in ferns and some algae

amplexus the mating clasp of the male frog or toad: he clings to the back of the female and fertilizes her eggs as she ejects them into the water

anadromous moving from the ocean to fresh water to spawn (*e.g.*, salmon)

anal fin median, unpaired, ventrally located fin that lies behind the anus; most often provides stability

aposematic serving as a warning, with reference particularly to colors and structures that signal possession of defensive devices

asexual reproduction a type of reproduction involving only one parent that usually produces genetically identical offspring, a clone. Asexual reproduction occurs without meiosis or syngamy, and may happen though budding, by the division of a single cell, or the breakup of an entire organism into two or more parts.

asymmetrical not symmetrical; one side is not the mirror image of the other (*e.g.* most sponges)

barbel fleshy projection near the mouth, chin or snout as in catfish, generally used for locating food

batch spawner a fish that sheds eggs more than once during a spawning season

benthic pertaining to the sea bottom and the organisms that inhabit the bottom of a body of water

bilateral symmetry a shape in which the left and right sides of a longitudinal plane that runs through an organism's body are approximately mirror images of each other

brackish pertaining to water less salty than sea water because of the mixing of fresh and salt water (*e.g.*, in an estuary)

budding a form of asexual reproduction, especially by pinching off a small part of the parent

calcareous consisting of or containing calcium carbonate or calcium

calyx the cuplike structure of a colonial coral from which the individual polyp protrudes and into which it can usually be withdrawn

camouflage avoidance or reduction of detection by means of blending with the environment

carapace a chitinous or bony case or shell covering the back or part of the back of an animal, such as a crab or turtle

carnivore an animal that feeds on other animals

cartilage a translucent elastic tissue that composes the skeleton of the embryos and very young of vertebrates; for the most part is converted to bone in higher vertebrates, a notable exception being sharks and rays

catadromous moving from fresh water to the ocean to spawn (*e.g.*, American eel)

caudal relating to or being a tail; situated toward the hind part of the body

caudal fin the tail fin, which, for most fish, functions to provide thrust and acceleration

caudal peduncle slender part of a fish's body just ahead of the caudal fin.

character heritable trait possessed by an organism

cephalization an evolutionary tendency toward concentration of sensory and neural organs in the anterior head

chitin the tough, resistant organic substance that is the major component of arthropod exoskeletons

chordate member of an animal phylum whose members possess a notochord, a dorsal nerve cord, gill slits, and a tail, at least at some stage of development

cilia hairlike structures that serve, especially in free unicellular organisms, to produce movement or, in higher forms, a current of fluid (*e.g.*, sponges)

cirri (singular cirrus) short bristlelike projections from the epidermis of certain invertebrates and fishes

clade a group of organisms that includes a common ancestor and all of that ancestor's descendants

cladogram a branching diagram indicating a hypothesized sequence of evolutionary changes using cladistic methodology

clone an organism derived from a founding individual by asexual means that is genetically identical to the founding individual

coelom a body cavity in which the digestive tract and other internal organs are suspended

commensalism relationship between species that is beneficial to one, but neutral or of no benefit to the other

compressed flattened from side to side

congeneric belonging to the same genus

conspecific belonging to the same species; individuals or populations of the same species

consumer an organism that obtains nutrients and energy by eating other organisms

convergence or convergent evolution the evolution of similar characters in genetically unrelated species, mostly because they have been subjected to similar environmental selective pressures

countershading said of the coloration of an animal whose ventral surface is lighter than its dorsal surface, thus helping the animal blend into its background when viewed from above or below

demersal sinking to or lying on the bottom; living on or near the bottom and feeding on benthic organisms

denticle literally, "small tooth;" usually refers to modified scales on some fishes, especially sharks and rays

deposit feeder an animal which takes in masses of sediments and processes them through its digestive tract to extract organic material

derived character state inferred to be a modified version of the primitive condition of that character, and to have arisen later in the evolution of the clade

desiccation removal of water; the process of drying

detritivore organisms that live on dead organic matter, usually in small particles

detritus fine, particulate debris, mostly derived from the decomposition of plant and animal remains; often an important source of nutrients in a food web

deuterostome an animal in whose embryonic development the anus forms first and the mouth forms secondarily. Deuterostomes are also characterized by radial cleavage and by formation of the coelom from outpocketings of the gut. Echinoderms and chordates are deuterostomes

DNA "deoxyribonucleic acid;" the nucleic acid which carries the genetic code of an organism; DNA is the primary component of chromosomes

dichotomous dividing into two parts; branching; paired

dichromatic members of a species having different coloration; usually related to sexual or growth differences

dinoflagellate dominant planktonic algal form

diploid referring to cells having two sets of chromosomes (2n): in animals, twice the number characteristic of gametes; in plants, the chromosome number characteristic of the sporophyte generation; in contrast to haploid (1n)

diurnal active during the day

dominant 1) referring to an allele that is almost always expressed, even if only one copy is present; 2) used to describe a male fish which is the chief spawner and which endeavors to exclude other males from the spawning act

dorsal pertaining to the back or upper side of the body

dorsal fin unpaired fin on the dorsal surface of fishes; most often used for stabilization to prevent pitch and roll. A few fish species (*e.g.*, bowfin, moray eel, and seahorse) use the dorsal fin for movement

ectotherm an organism that regulates its body temperature by taking in heat from the environment or giving it off to the environment; "cold-blooded"

ecosystem a major interacting system that includes both organisms and their physical environment

ectoparasite a parasite that lives on the outside of its host; opposite of endoparasite

endosymbiont a symbiotic organism that lives within the body of an individual of an associated species.

endotherm an organism that uses metabolic energy to regulate body temperature independent of the environment

epipodal on or near the edge of the foot

estivation dormancy of animals through a drought or warm season

evolution descent with modification; changes in the genetic makeup of a population over time that produce cumulative changes in the characteristics of the population

extinction the total disappearance of a species or higher taxon

extracellular outside of the cell

fertilization the union of sperm and egg

filter feeder an animal that feeds by filtering out and ingesting small particles of food suspended in the water

fin ray one of the bony or horny rods that support the fins of rayfin fishes; may be soft or spiny

foliaceous a growth form of corals exhibiting leaflike sheets and plates

food chain movement of energy and nutrients from one feeding group of organisms to another in a series that begins with plants and ends with carnivores, detrital feeders, and decomposers

food pyramid a graphic representation showing all the energy and biomass contained in each trophic level of an ecosystem at any given time, moving from producers (autotrophs) up the food web to top-level consumers (heterotrophs)

food web the food relationships within a community; a diagram of who eats what or whom

founder effect genetic drift observed in a population founded by a small non-representative sample of a larger population

fusiform spindle-shaped; tapered at both ends

gamete an egg cell or sperm cell; a mature reproductive cell with a haploid set of chromosomes

gametophyte a haploid (1n) plant or plant part that can produce gametes

gene flow the movement of genes from one population to another by way of interbreeding of individuals in the two populations

genetic code the DNA sequence of a gene; the genetic code determines the sequence of amino acids in a protein or enzyme, and thus the functions of a living organism

genetic drift random variation in gene frequency from one generation to another

genotype the total set of genes present in the cells of an organism, as contrasted with phenotype, which is the realized expression of the genes

habitat the area in which an organism lives and finds the essentials it needs to survive

halophyte a plant adapted to living in a saline environment

haploid pertaining to cells that have only one copy of each chromosome; typically are sex cells (sperm or egg) produced through meiosis

herbivore an animal that feeds on plants or plantlike organisms

hermaphrodite an animal which has the sex organs of both male and female. May be sequential or synchronous (*See protandrous* and *protogynous*)

heterocercal describes a caudal fin in which the spinal column extends into the larger upper lobe

holotype the single physical example (or illustration) of an organism, known to have been used when the species (or lower-ranked taxon) was initially and formally described

homocercal describes a caudal fin that is nearly or completely symmetrical and that is supported by a complex internal V-shaped bony plate; characteristic of teleosts

hydrostatic skeleton a skeleton in which the body's shape and/or function is maintained by an incompressible fluid such as blood or hemolymph

intracellular within the cell

laminar arranged in, consisting of, or resembling plates or scales

larva the early form of any animal that changes structurally when it becomes an adult

lateral line a series of sensory pores along the head and sides of fish and some amphibians by which water currents, vibrations, and pressure changes are detected

longitudinal fission asexual reproduction by a lengthwise division of the cell or body into two or more parts of roughly equal size

mandible lower part of the jaw; the "jawbone"

mantle layer of tissue over a mollusk body that secretes the shell, if present

maxilla in vertebrates, the upper jaw

medusa the free-swimming, bell- or umbrella-shaped stage in the life cycle of many cnidarians

meiosis a special type of cell division that occurs when mature eggs and sperm are formed. Through the process of meiosis the number of chromosomes present

in a cell is decreased by half. Unlike what occurs in mitosis, the daughter cells produced in meiosis are not identical to each other

metamorphosis the change of an immature animal into an adult. More generally, change in the form of an organ or structure

mimic a species, or individual, that closely imitates another

mitosis the process of nuclear division in cells that produces daughter cells genetically identical to each other and to the parent cell

model the species, or individual, imitated by a mimic

mutation any heritable change in DNA sequence; can occur randomly (naturally) or can be deliberately caused in the laboratory

mutualism the living together of two or more organisms in a symbiotic association from which both members benefit

nauplius free-swimming larval form characteristic of crustaceans

natural selection the process recognized by Charles Darwin as the primary mechanism of evolution. The differential reproduction of genotypes, caused by factors in the environment

nematocyst a specialized stinging cell characteristic of cnidarians (*e.g.*, anemones and corals) that contains a barbed, threadlike tube that delivers a paralyzing sting; the term also often refers to the **bar**bed structure itself

notochord in lower chordates and in the embryos of higher vertebrates, a flexible supportive rod running longitudinally through the back, ventral to the nerve cord

ocellus an eyelike, pigmented spot

omnivore an organism that eats both plant and animals

operculum 1) the gill cover of bony fish; 2) a plate that many gastropod mollusks produce and pull into place as a "door" to resist desiccation and intruders

organ a part of the body composed of several different tissues that form a structural unit and function together; *e.g.*, heart, stomach

oviparous egg-laying; the eggs develop into embryos after being laid by the female

ovoviviparous relating to animals that retain eggs within the body of the female in a brood chamber in which the development of the embryo takes place; the young hatch inside the mother and are usually born shortly afterwards

pectoral fins paired fins, located either low on the body in some species or on the side just behind the operculum in many others; used by most fishes for fine control of movements. Provide lift for many sharks; used for propulsion by rays

pedicellariae pincerlike structures that occur around the base of spines of sea stars, sea urchins, and sand dollars, apparently used to catch and crush small animals that try to settle on surface of these echinoderms

pelagic living and feeding in the open sea, not in association with the bottom

pelvic fins paired fins, located ventrally; used most often for breaking and steering

pharynx part of the throat into which the gill slits open; part of the alimentary canal between mouth and esophagus

phenotype the realized expression of the genotype; the physical appearance or functional expression of a genetic trait

pheromone chemical substance released by one organism that influences the behavior or functioning of another organism of the same species; often serve as sex attractants, trail markers or alarm signals

photic zone lighted water column of lake or ocean where photosynthesis can take place

photosynthesis a complex process used by many plants and other organisms, such as algae, to build carbohydrates from carbon dioxide, inorganic substances, and water, using energy derived from light. Oxygen is released as a by-product.

pinnate having leaflets arranged in opposite rows along an axis, like a feather

pinnule leaflets of a pinnately-compound leaf; a side branch structure on the tentacles of many soft corals, giving them a feathery appearance

piscivore an organism that feeds exclusively or preferably on fish

plankton free-floating, usually minute, organisms of the sea

planula larval form characteristic of cnidarians

polyp one of the two principal body forms of cnidarians, typically sessile with the base attached to a substrate

population a group of individuals belonging to the same species, occupying the same area at the same time and sharing the same gene pool

preopercle the bone between the cheek and the gill cover

primitive character state present in the common ancestor of a clade; a primitive character state is inferred to be the original condition of that character within the clade under consideration

producers in an ecosystem, organisms, such as plants, that are able to produce their own food from inorganic substances

protandrous referring to a sequential hermaphrodite in which the fish functions first as a male and then changes to a female

protogynous refers to animals that are sequential hermaphrodites, where the animal functions first biologically as a female, having only female sexual organs, then changes to be biologically male

radial symmetry a type of symmetry in which an organism can be divided into equal halves by passing a plane through the central axis in any direction

radula rasping tongue found in most mollusks

recessive refers to an allele that causes a phenotype (visible or detectable characteristic) that is only seen in an organism that has two copies of the same allele

scavenger an organism that obtains nutrients from dead animals or other dead organic material

selection pressure in a population, the force for genetic change resulting from natural selection

sessile permanently attached or stationary

sexual reproduction reproduction that involves male and female gametes, usually produced by different parents. The central event is fertilization (the joining of egg and sperm)

species (1) a group of organisms that have a unique set of characteristics (like body shape and behavior) that distinguishes them from other organisms. If they reproduce, individuals within the same species can produce fertile offspring. (2) the basic unit of biological classification

spore a reproductive cell, usually unicellular, capable of developing into an adult without fusion with another cell

sporophyte the spore-producing, diploid (2n) stage in the life cycle of a plant having alternation of generations

symbiosis the living together of two dissimilar organisms in close association; includes parasitism, commensalism, and mutualism

synchronous hermaphrodite organism that possesses both active male and active female reproductive organs at the same time

syngamy the union of a sperm cell and an egg cell to form a zygote; fertilization

taxon (*pl*. **taxa**) a named group of organisms, not necessarily a clade; a group of organisms of any taxonomic rank, such as a given phylum, order, family, genus, species

terminal phase male the dominant breeding male of certain fish families, such as wrasses and parrotfishes. Usually has a distinctive color phase and may be transformed initial phase males or transformed females.

thallus a plant body without true stems or roots or leaves or vascular system; the body of a seaweed

tissue a group of cells organized into a structural or functional unit

trochophore the larval form characteristic of marine annelids and most groups of mollusks as well as several other phyla

variation the differences that occur in the offspring of a particular population or species

veliger the larval form common to most bivalves and gastropods; develops from the trochophore larva

ventral pertaining to the undersurface

viviparous producing live young from within the body of the female

zoochlorellae symbiotic unicellular green algae

zoospore a motile flagellated asexual spore, as of certain algae and fungi; typically produces a gametophyte

zooxanthellae symbiotic dinoflagellate algae

zygote the cell formed by the union of a sperm cell and an egg cell

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A FEW TIPS FOR NAVIGATING THE STEINHART FIELD GUIDE
in
Adobe Reader 9

- If you're new to Adobe Reader, set up your navigation bar as shown above: Pull down the View Menu and select "Toolbars," then be sure File, Find, Page Display, Page Navigation, and Select Zoom are checked. Your navigation bar should then look like the one above, though in a single line. Now just experiment and discover. Select the cursor/pointer icon and then hold the pointer on any of the icons for a few moments and that icon's function will appear.

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