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Foreword

by Prince Henri of Luxembourg President, Galápagos Darwin Trust Europe

The development of a serious illustrated field guide to the marine molluscs of Galápagos started years ago thanks to Professor Cleveland Hickman of Washington and Lee University, Lexington, Virginia, USA, in an attempt to resolve a gap between the specialized molluscan literature and existing field guides to Galápagos fauna, flora, and geology. This project, begun in the 1980s, grew out of his study of intertidal and inshore macroinvertebrates, with the aim of producing a single field guide to the Galápagos marine invertebrates. He later modified this ambitious project to produce sectional guides in the Galápagos Marine Life Series, covering the common echinoderms and macrocrustaceans as well as marine molluscs.

Malacologist Yves Finet of the Museum of Natural History of Geneva, Switzerland then joined the project, bringing to it his expertise on Galápagos marine molluscs. I am especially delighted to see today the handsome result of this collaboration, which enlightens our knowledge of a fauna that is generally less familiar to the general public than the spectacular birds, reptiles or other vertebrate animals indiginous to the islands. The Galápagos Islands have always aroused worldwide interest and concern, and the present collaboration between an American professor and a scientist in Switzerland is another sign of such an international interest in this archipelago.

Years ago, I had the wonderful opportunity to visit the Galápagos for the first time. I had the immediate feeling that there was no other place on earth like this magical and still natural paradise, and that we all have to support every possible effort to study and preserve an ecosystem of such outstanding value.

Discovered in 1535, the Galápagos entered into the history of science following the visit in 1835 of the English naturalist Charles Darwin. The remarkable observations he made during his 5-week visit contributed to his theory of evolution, later set forth in *The Origin of Species* (1859), one of the greatest intellectual achievements of all time. The Galápagos Islands subsequently became a National Park, and were awarded World Heritage Site status by the UNESCO. We are responsible for leaving such a legacy to our children and forthcoming generations. But if the past belongs to the future, only the present can help preserve it.

As President of the Galápagos Darwin Trust Europe and member of the Board of Directors of the International Charles Darwin Foundation, it has now become my great interest and endeavor to contribute to this task.

The Galápagos biodiversity is unique. While the isolation of the islands helped to preserve their originality for a long time, it also heightened their vulnerability to disruptions indiscriminately introduced by humans in recent

times. Should we now allow human intervention to replace this unique biodiversity by something which can already be found elsewhere in a depauperate or artificial world?

This book treats a special facet of Galápagos biodiversity. It reviews more than 250 of some 800 known species of Galápagos marine molluscs, approximately 20% of which are endemic. These species are vital links in the web of marine life, and serve as indicators of the health and equilibrium of the coastal waters of Galápagos.

Molluscan shells are creations of natural beauty. This book will convey to its readers the delight and satisfaction of studying the exquisite variety of these handsome creatures. Furthermore, books of this kind that increase our knowledge of animals and plants in threatened habitats contribute to wise environmental protection and management. Too often we find that very little is known about the fauna and flora of habitats threatened by encroaching urban and industrial development and the resulting pollution and eutrophication of coastal waters. Curiosity about molluscs and marine life in general is the kind of healthy pursuit that fosters environmental concern.

It is thus encouraging to see that both authors of the present book are working for that purpose, and the world of malacological specialists as well as those concerned with the Galápagos environment should welcome their work. It is also gratifying to see the Charles Darwin Research Station involved and taking a special interest in the project.

Prince Henri de Luxembourg President, Galápagos Darwin Trust Europe

Acknowledgements

any people—scientists, students, and friends—have assisted in many ways with collection, photography, and identification. We prepared the photographs of shelled molluscs from several sources: our own collected material, the collection of Carmen Angermeyer in Puerto Ayora, Galápagos, the collections at the Charles Darwin Research Station, as well as those from various other museums. We are especially grateful to Carmen Angermeyer who on several occasions opened her extensive collection for inspection and photography. Others who helped with identifications were Jacqueline De Roy of Puerto Ayora, Galápagos, William K. Emerson, American Museum of Natural History; and Gene V. Coan and Terrence M. Gosliner, both of the California Academy of Sciences. Paul Humann and Terrence Gosliner contributed many of the fine photographs of opisthobranch molluscs; these are credited where they appear in the text. We also thank Larry Roberts and Terrence Gosliner for reviewing sections of the manuscript.

William C. Ober of Crozet, Virginia accompanied the first author on several trips to the Galápagos to assist in collecting and photography; he also prepared the drawings for the introduction. It is also a pleasure to acknowledge the cooperative assistance of the personnel of the Charles Darwin Research Station. Although many have helped in countless ways, we especially wish to thank marine biologist Rodrigo Bustamante and station director Robert Bensted-Smith.

Cleveland P. Hickman Jr. Yves Finet March 1999

Family Limidae

Fileclams. Fileclams (or file shells) have ears like the scallops but the shell is obliquely asymmetrical with a longer anterior end and with widely gaping valves. Fileclams are able to swim but are less active than scallops. Of four species of fileclams recorded from Galápagos, only Limaria pacifica is common.

25. Limaria pacifica (d'Orbigny, 1846) (Syn.: Lima pacifica) Pacific Fileclam

Length to 35 mm (1.4 in)

Thin ivory shell of dull texture, nearly translucent, with narrow ears; hinge line straight, without teeth. Weak concentric lines and fine radial ribs projecting slightly beyond a delicately denticulated margin. Living animal beautiful with fringed mantle extending well beyond shell. **Habitat & range:** Under rocks, low littoral and subtidal. Common. Southern California to Peru and Galápagos Islands.





Family Carditidae

Little Heart Shells. These are sturdy shells with well-developed radial ribbing and incurved beaks. Five species have been recorded from Galápagos of which only *Strophocardia megastropha* is common.

26. Strophocardia megastropha (Gray, 1825) (Syn.: Cardita

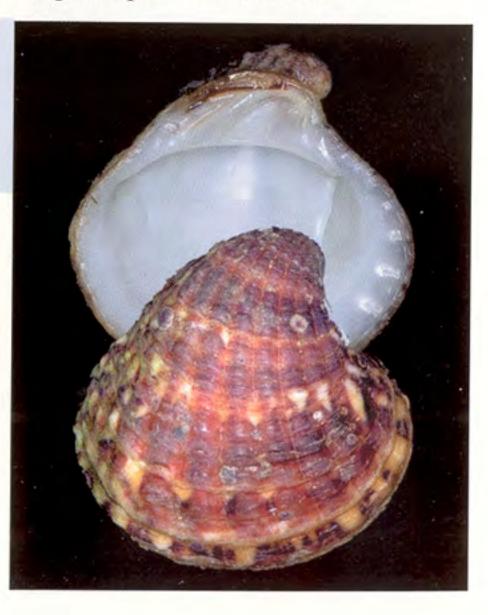
Heart shell

Length to 65 mm (2.5 in)

megastropha)

Stout shell with large and strong hinge, high and curved umbones, pointed forward, and with low, rounded ribs. Color brownish red streaked with white or yellowish flecks.

Interior white and glossy. Odd valves of this shell are commonly found on beaches; they are abundant at the visitor's landing at Darwin Bay, Genovesa. Habitat & range: Subtidal to 100 m (400 ft) on rock. Lower California to Ecuador and Galápagos Islands.



Family Lucinidae

Lucina Clams. This is a large family of circular to ovate bivalves, mostly white in color, with an elongate anterior adductor muscle scar. We describe the three most common of five species recorded in Galápagos.

27. Codakia distinguenda (Tryon, 1872)

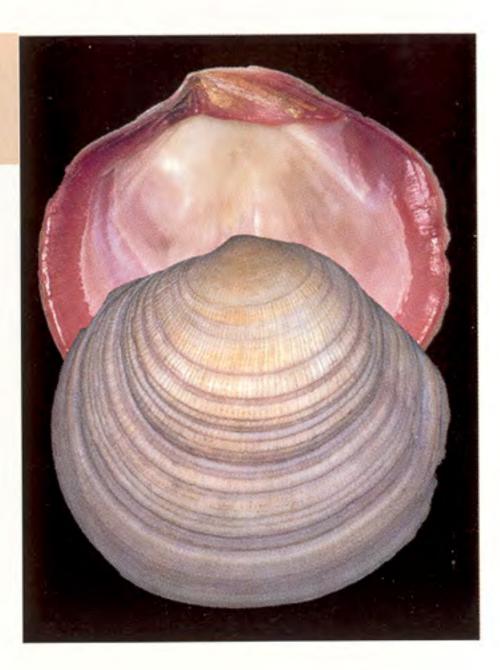
Elegant Lucine

Length 50 to 140 mm (2 to 5.5 in)

A beautifully white shell with saucer-shaped white valves much prized by collectors.

Fine radial sculpture is crossed by spaced concentric growth lines. The hinge plate and the wide inner margin are rose-red and the center is often creamy-yellow. This lucinid is perhaps the largest species in the family.

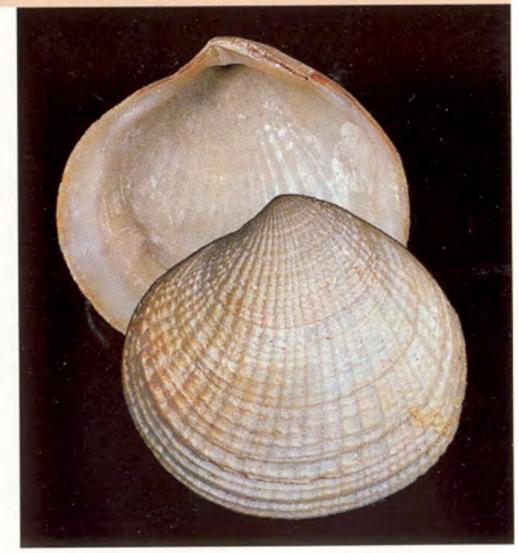
Habitat & range: Subtidal on sand, living on tide flats at extreme low tide. Lower California to Colombia and Galápagos Islands.



28. Ctena galapagana (Dall, 1901)

Galápagos Lucine

Length to 25 mm (1 in)
This small whitish lucine is easily distinguished from *Codakia* distinguenda by its much coarser ribbing, smaller size, and absence of coloration inside. The radial ribs are often irregularly beaded. Habitat & range: Intertidal and subtidal on sand, down to 25 m (80 ft). Common. Mexico to Peru and Galápagos Islands.



10. Calliostoma jacquelinae McLean, 1970

Jacqueline Calliostoma

Height to 10 mm (0.4 in)
Creamy opalescent shell with distinct whorls, each composed of several finely beaded spiral cords, and with two stronger cords at the periphery. This shell was named after its collector, Jacqueline De Roy of Puerto Ayora, Galápagos.

Habitat & range: Dredging depths down to 350 m (1150 ft) in the Galápagos Islands, where it is endemic.



11. Tegula cooksoni (E.A. Smith, 1877)

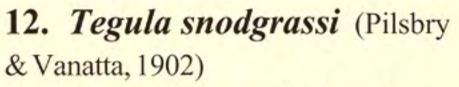
Cookson Tegula

Height 9 mm (0.35 in), diameter 12 mm (0.5 in)

A small low-spired shell with evenly rounded whorls bearing a fine spiral striation. Color brown or gray, mottled with white or pink; the umbilicus is deep, surrounded by a white umbilical area.

Habitat & range: Extreme low water,

lower littoral on rocks. This once-common shell is less common since the 1982-83 El Niño event. Cocos and Galápagos Islands.

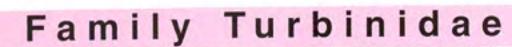


Green-tongued Tegula

Height to 15 mm (0.6 in), diameter 14 mm (0.55 in)

Small, high-spired conical shell with evenly rounded whorls and beaded spiral sculpturing. The umbilical area is green, sometimes intensely so. Color grayish-brown or bluish-brown flecked with white. Habitat & range: Lower littoral, on rocks or sand under rocks. Common. Galápagos Islands, probably endemic.





Turban Shells. Although this is a very large family of several hundred shells, many of which are prized by collectors for their ornamentation, only six species are verified to occur in Galapagos. None are common.

13. Turbo scitulus (Dall, 1919) Galápagos Turban

Height to 30 mm (1.2 in)
Solid, top-shaped shell with rounded aperture, sculptured with strong knobs on shoulder of the body whorl. Whorls flattened under the shoulder, the last whorl showing an angulation beneath, with another row of knobs. Color mottled lavender, often hidden by coralline algae.

Habitat & range: Subtidal down to 75 m (250 ft), but empty shells occasionally found intertidally. Endemic to Galápagos.



14. Arene guttata McLean, 1970 Beaded Turban

Height to 7.5 mm (0.3 in)
A small snail, rounded in outline, white spotted with pink, with even beading on spiral cords, especially prominent on the body whorl, and a deeply channeled suture. Habitat & range: Intertidal and subtidal down to 250 m (820 ft), on rocks. Cocos Island (Costa Rica) and Galápagos Islands (type locality).



15. Arene echinata McLean,1970 Scaly Turban

Height to 10 mm (0.4 in)
Small turbinate shell, although it is the largest of the genus in the eastern
Pacific. Rounded whorls sculptured with spiral cords and fluted scales projecting sharply on cords. Suture deeply channeled. Color pinkish brown with lighter areas. Habitat & range: Intertidal and subtidal, down to 275 m (900 ft), on sand, rock, or light rubble. Cocos Island (Costa Rica) and Galápagos Islands (type locality).



52. Cypraea albuginosa Gray, 1825

White-spotted Cowrie

Length to 33 mm (1.3 in)

The dorsal surface of this rather elongate cowrie is distinctively colored with large dark brown circles with light grayish centers, interspersed with smaller white spots, all on a tan ground color. The aperture is wider anteriorly and the margins are rounded. The convex base is whitish lavender. Habitat & range: Intertidal and subtidal, down to 80 m (260 ft), under rocks and in crevices. Gulf of California and Revillagigedo Islands to Manzanillo, Mexico; and Cocos Island to Panama and Ecuador, including the Galápagos Islands.





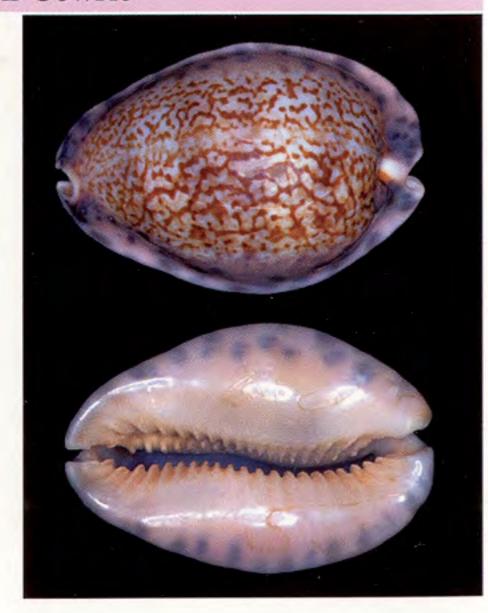
Living white-spotted cowrie with its mantle partially withdrawn.

53. Cypraea arabicula (Lamarck, 1811)

Little Arabian Cowrie

Length to 35 mm (1.4 in)

A wide shell with humped dorsum and central, nearly straight aperture. The numerous aperture teeth are especially sharply chiseled, an important diagnostic feature. The base is nearly flat and the margins rather sharply angulate. Color light gray to greenish blue and flecked with a net of brown coalescent worm-like patterns. Margins pink with black spots; base pinkish-yellow, with black spots near the margins. Juvenile specimens are delicate, blue-gray in color, finely speckled with brown, often with three darker broad bands. Habitat & range: Intertidal or subtidal to 20 m (65 ft), under rocks. Gulf of California south to Peru and the Galápagos Islands.

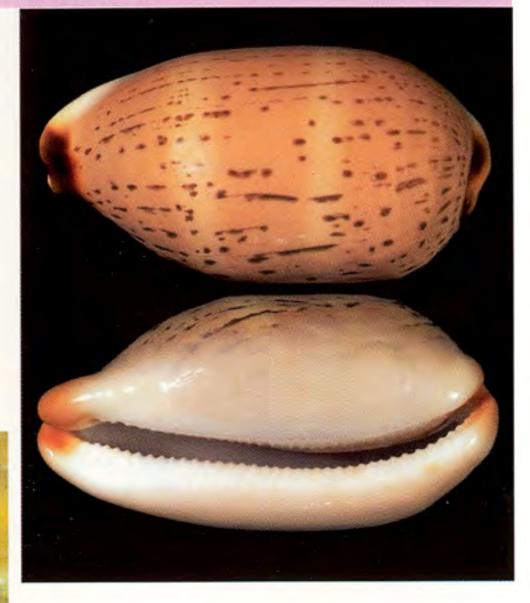


54. Cypraea isabellamexicana Steams, 1893

Banded Cowrie

Length to 38 mm (1.5 in)

This uncommon cowry is distinguished by brown trail-like streaks on a pale brown dorsum. Margins of aperture light, interior white. The ends bear a conspicuous orange and brown spot. Aperture teeth small and numerous. Habitat and range: Intertidal and subtidal under rocks. Gulf of California to Panama and the Galápagos Islands.





Left. Living banded cowrie with the two folds of the black mantle covering the shell.

55. Cypraea robertsi Hidalgo, 1906

Roberts Cowrie

Length to 29 mm (1.15 in)
Species similar to *Cypraea arabicula* but less humped dorsally, wide, oval in outline and with the margins somewhat thickened by a rounded callus, not so angulate as in *arabicula*. Dorsum light grayish with small, irregular brown flecks or spots. Margins pinkish-brown to flesh-colored, with dark brown spots, base almost white. The aperture is narrow and the teeth are rather blunt and coarse.

Habitat & range: Low intertidal, under rocks. Reported from Mazatlan, Mexico, south to Peru and the Galápagos Islands. Common at Panama.



Family Terebridae

Auger Shells. These are very long, slender shells, many-whorled with short anterior canal or notch and a short aperture. Sculpturing is more strongly axial than spiral, but in many species a spiral groove below the suture, called subsutural groove, delimits a "subsutural band" between it and the suture above; there are usually one or two low folds on the columella. Auger shells prefer a fine, sandy sea floor, where they move about just under the surface, hidden under a small mound of sand. They are active at night. Some species paralyze their prey with poison injected with a harpoon-like radula.

148. Terebra frigata Hinds, 1844 Striated Auger

Length to 30 mm (1.2 in)
Shell whitish with slightly concave whorls. Axial ribs are undulating and swollen posteriorly, below suture to the preceding whorl. A subsutural spiral band is outlined by a row of punctuations in the interspaces between the swollen ribs. Fine spiral striae fill the remainder of the interspaces between ribs. Habitat & range: Subtidal to 40 m (130 ft), on sand with rock patches. Galápagos Islands (type locality), probably endemic.



149. Terebra jacquelinae

Bratcher & Burch, 1970 (Syn.: *Terebra hertleini* Bratcher & Burch, 1970)

Jacqueline Auger

Length to 36 mm (1.4 in)
This shiny whitish to cream-colored auger resembles *T. frigata*, with concave whorls and curved axial ribs that swell into knobs at both ends, where they meet the suture.
There is no subsutural spiral groove.
Depressions (interspaces) between the ribs and the knobs are almost smooth and tinted yellowish. This auger is named after Jacqueline De Roy of Puerto Ayora.

Habitat & range: Subtidal below 4 m (13 ft), down to 50 m (165 ft), on sandy

bottoms. Endemic to Galápagos Islands.



150. Terebra maculata (Linnaeus, 1758) Spotted Auger

Length to 30 cm (12 in)

A robust auger, cream colored with two rows of squarish dark brown spots on each whorl, the upper row near the suture larger than the lower one. There are also fawn to light brown bands of aligned squares below periphery on the last whorl. Subsutural spiral groove apparent only on early whorls. Surface smooth and shiny, with very fine growth striae. Body whorl elongate. Habitat & range: Subtidal. Tropical Indo-Pacific to tropical eastern Pacific, Mexico to Panama, Cocos Island, Costa Rica, and the Galápagos Islands.



151. Terebra ornata Gray, 1834 Ornate Auger

Length to 82 mm (3.2 in)

A long but slightly stubby auger, ivory beige with three rows of squarish brown spots on the spire whorls and four rows on the body whorl, the uppermost row on the subsutural band delimited by a deep spiral groove. This subsutural band is convex or moderately noded in early whorls. Surface is otherwise smooth. Body whorl short, and columella strongly recurved. Habitat & range: Intertidal and subtidal to dredging depths, on coral sand bottom. Gulf of California to Panama and the Galápagos Islands.



152. Terebra plicata Gray, 1834 Braided Auger

Length to 70 mm (2.75 in)
A shiny, pinkish cream or ivory shell, sometimes covered by a natural dark brick-red varnish; early whorls are tinted with violet. Axial ribs straight to wavy, thin with wide interspaces. Subsutural band very prominent, with elongate nodes that prolong the axial ribs above the subsutural spiral groove. In some specimens, finely punctate spiral lines may cross the ribs.

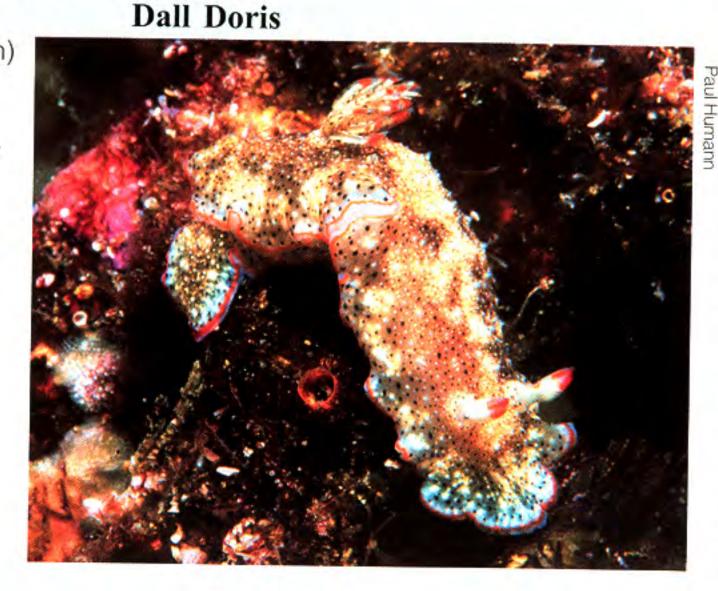
Habitat & range: Coral sand bottom, subtidal to dredging depths. Common by dredging in Galápagos (type locality), but Keen (1971) notes it is rare on the continent (Central America).



Family Chromodorididae

172. Glossodoris dalli (Bergh, 1879)

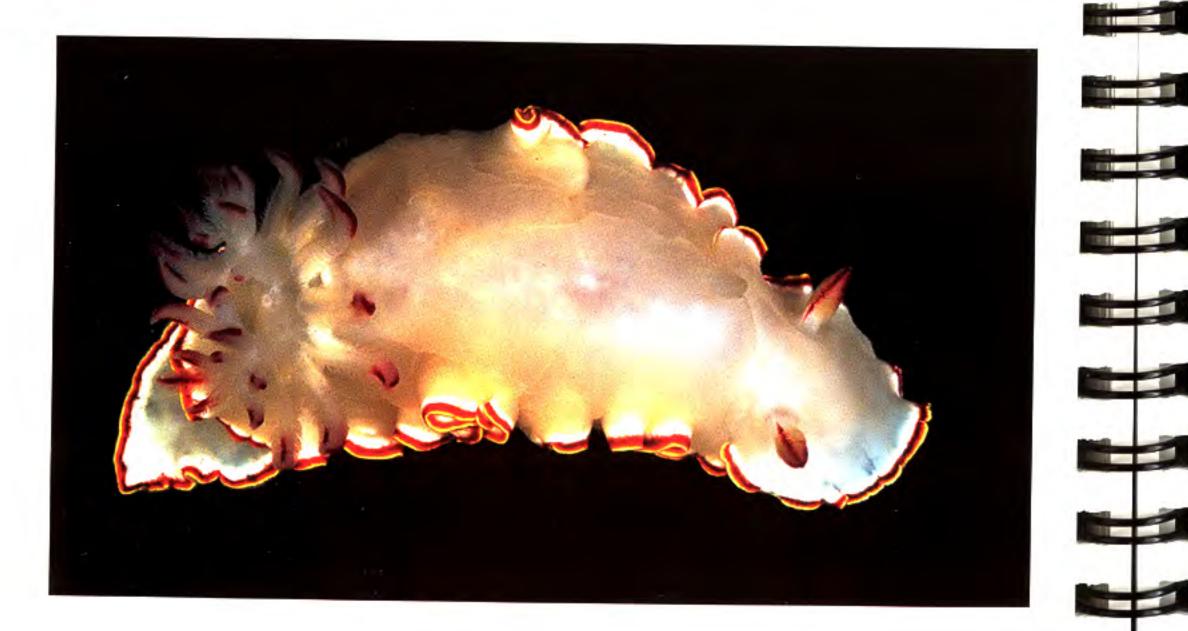
Length to 40 mm (1.6 in) The background color is white or cream with scattered red, brick-red, or orange spots. The rhinophores and gills are of the background color with scattered red spots. Habitat & range: Intertidal and subtidal rocks. Gulf of California to Costa Rica and the Galápagos Islands.



173. Glossodoris sedna (Marcus & Marcus, 1967) (Syn.: Casella sedna) Red-tipped Sea Goddess

Length to 47 mm (1.9 in)

This dorid is transparent white, bordered by a red band and, lateral of this, a faint yellow band. The rhinophores and gills are tipped with red. As with some chromodorids, the gills are in constant motion. Habitat & range: Rocky intertidal. Gulf of California south to Costa Rica and the Galápagos Islands.



174. Chromodoris baumanni Bertsch, 1970

Baumann Doris

Length to 62 mm (2.4 in)

Dorsum covered with interspersed deep red and light brown patches. Margin of dorsum is white with red spots. The gills are white with red ends. Habitat &



range: Intertidal and subtidal to 20 m (65 ft), under rocks. Common. Gulf of California to Ecuador and the Galápagos Islands.

175. Chromodoris ruzafai Ortea, Bacallado & Valdéz, 1992

Ruzafa Doris

Length to 20 mm (0.8 in)The pale-blue body of this chromodorid is obscured with an irregular reddish band marked with small yellow spots, extended nearly the entire length of the animal. The rhino-



phores are a dark reddish-brown; the gills are light pink. Habitat & range: Galápagos Islands, endemic.

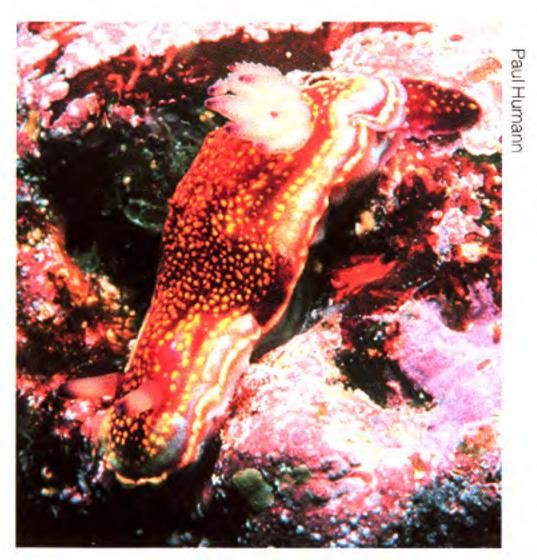
176. Chromodoris sphoni

(Marcus, 1971) (Syn.: Felimida sphoni [Marcus, 1971])

Sphon Doris

Length to 40 mm (1.6 in)

This species is recognized by the elongate band of red spotted with yellow extending from the animal's head to the posterior circlet of white gills. At body center this band extends laterally to form a crude, elongate cross. The margin of the cross is lined with bright yellow spots. Habitat & range: Intertidal and subtidal. This species has been reported from Mexico, Costa Rica, Panama, and Galápagos Islands.



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