

Examples of Antitropical and Antiequatorial Distribution of Indo-West-Pacific Fishes¹

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ABSTRACT: Hubbs (1952) introduced the term "antitropical distribution" in reference to species found north and south of the tropical zone but not in the tropics. To this may be added the term "antiequatorial distribution" for those animals and plants that occur south of the Tropic of Cancer and north of the Tropic of Capricorn but not within the equatorial latitudes. The following species of Indo-West-Pacific fishes not mentioned by Hubbs (1952) exhibit antitropical or antiequatorial distribution. *Sphyræna zygaena*, *Cirrhhigaleus barbifer*, *Meadia abyssalis*, *Lycodontis eurostus*, *Diaphus brachycephalus*, *Lepadichthys frenatus*, *Adioryx furcatus*, *Myripristis chryseres*, *Ostichthys archiepiscopus*, *O. oligolepis*, *Zenopsis nebulosa*, *Neosebastes entaxis*, *Aploactes aspera*, *Plectranthias kelloggi*, *Aulacocephalus temmincki*, *Amblycirrhitus unimacula*, *Cirrhitops fasciatus*, *Cheilodactylus vittatus*, *Trachurus novaezealandiae*, *Pseudocaranx dentex*, *Carangoides equula*, *Erythrocles schlegeli*, *Pristipomoides auricilla*, *Randallichthys filamentosus*, *Pentapodus nagasakiensis*, *Pentaceros richardsoni*, *Histiopaterus acutirostris*, *Microcanthus strigatus*, *Chromis chrysuræ*, *C. flavomaculata*, *Chrysiptera starcki*, *C. tricinatus*, *Bodianus vulpinus*, *B. perditio*, *B. leucostictus*, *B. izuensis*, *B. tanyokidus*, *Choerodon fasciatus*, *Novaculichthys woodi*, *Coris picta*, *Pseudojuloides elongatus*, *Suezichthys gracilis*, *Limnichthys fasciatus*, *Entomacrodus niuafoouensis*, *Kelloggella oligolepis*, *Psilogobius mainlandi*, *Coradion altivelis*, *Hemitaurichthys thompsoni*, *Genicanthus watanabei*, *Centropyge interruptus*, *Acanthurus leucopareus*, *Xanthichthys mento*, *X. lineopunctatus*, *Thamnaconus modestoides*, *T. hypargyreus*, and *Arothron firmamentum*. It is expected that other examples of this discontinuous north-south distribution will be revealed, particularly when systematic studies are completed for some groups of Indo-Pacific fishes in need of revision. Further collecting in tropical areas will undoubtedly invalidate some of the examples listed above as antitropical.

THE OCCURRENCE OF THE SAME ORGANISMS to the north and south of the tropical zone but not within the tropics is one of the most interesting phenomena of biogeography. Historically, this phenomenon has been termed "bipolar distribution," or, simply, "bipolarity."

Hubbs (1952) pointed out that there are many patterns of this distribution especially related to latitude: polar, boreal, cool tem-

perate, warm temperate, "and even subtropical." He proposed the encompassing term "antitropical" for all these patterns collectively, and the term has come into general use.

For marine species, there are two presently accepted explanations for antitropical distribution. The most obvious, promulgated by Berg (1933), assumes that the tropical zone was transgressed by cool-water forms at the time of the Ice Ages when the seas were colder, most recently during the late Pleistocene. The other involves descent into the cooler, deeper waters of the tropics, an event

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probably achieved chiefly during the Pleistocene, when lesser depths would have been involved.

Hubbs (1952) believed that the latter mode of crossing the tropics is particularly probable for some bitemperate genera of sharks, such as *Hexanchus*, *Heptranchias*, *Notorhynchus*, *Heterodontus*,³ *Cephaloscyllium*, other scyliorhinids, *Galeorhinus*, *Mitsukurina*, *Carcharias* (= *Odontaspis*), *Lamna*, *Cetorhinus*, *Somniosus*, *Echinorhinus*; and certain species groups of *Mustelus* and *Squalus*. Other fishes for which he suggested the deep isothermal route are the hagfish genera *Eptatretus* and *Polistotrema*; the john dory genus *Zeus*; various gurnards (Triglidae); certain sinistral flatfishes (Bothidae); *Cheilotrema*; *Pimelometopon* (= *Semicossyphus*); *Caulolatilus* (no longer antitropical; see Dooley 1978: fig. 18); *Sicyogaster* (= *Gobiesox*, not antitropical; see Briggs 1955: map 11); *Sebastes*; *Oplegnathus*; and some clinids.⁴ *Semicossyphus*, *Oplegnathus*, and clinids are shallow-water fishes, and it seems more likely that they utilized surface transport during a period of cooler sea surface temperatures.

Recent studies have shown that the cooling of sea surface temperatures during the Pleistocene may have been only 1–2°C. When shown a copy of this manuscript, Brian White (personal communication) wrote, "I contend that most present-day antitropical distributions have a common origin during a time of global cooling that extended from late Eocene to mid-Miocene times. Tropical surface temperatures were then approximately 20°C (Savin, Douglas, and Stehli

1975: figs. 6, 7a). Vicariance occurred when tropical surface waters warmed in the mid-Miocene. In other words, continuous distributions made possible by the late Eocene cooling were disrupted by mid-Miocene warming. I believe that during the Oligocene, the shallow-water fishes you list in your paper ranged continuously across the equator and became disjunct during the subsequent mid-Miocene warming of tropical surface waters. The occurrence of antitropicality in shallow-water forms such as these strongly argues against the idea of tropical submergence."

White's hypothesis assumes that the northern and southern populations of the antitropical and antiequatorial fishes listed herein have not evolved differently since the mid-Miocene. While it is possible that the two isolated populations of some of these species would remain unchanged relative to each other since the Miocene, it seems more likely that differences would become manifest in most species over such a long span of time. A temperature change of only 1 or 2°C during the Pleistocene may seem small, but for those subtropical species that were barely able to extend their range across the tropical zone during an ice age, a warming of 1 or 2°C might be enough to cause a break in their north-south distribution.

Hubbs' examples of "surface-bound recent transgressors of the Tropics" include the clupeid genera *Sardinops* and *Etrumeus*; the anchovy genus *Engraulis*⁵ and similar engraulids; the jack mackerel *Trachurus*; the chub mackerel *Pneumatophorus* (= *Scomber*); the saury genus *Scomberesox*; the species of the carangid genus *Seriola* related to *S. dorsalis*; *Centrolophus*; *Alepisaurus* (no longer antitropical; see Gibbs 1966: fig. 174); several tunas⁶ and tuna-like fishes; and "various other pelagic types." One of the latter group is the daggertooth, *Anotopterus pharao* Zugmayer. Hubbs, Mead, and Wilimovsky (1953) and Rofen (1966) have shown that this fish, which is the only species of the Anotopteridae, has an antitropical distribution. All these fishes are pelagic or semipelagic species.

The purpose of the present paper is to list examples of antitropical fishes of the Indo-

³ Fourmanoir (1965: 12, pl. IB) recorded *Heterodontus zebra* Gray from Nha-Trang, Viet Nam (12° N).

⁴ The true clinids (as restricted by George and Springer 1980) are bitemperate in the New World, Mediterranean, and southeast Atlantic, but not in the Indo-West-Pacific (the clinid genus *Springeratus* is tropical there).

⁵ Peter J. Whitehead (personal communication) has informed the author that species of *Engraulis* have been reported from the Seychelles and Indonesia.

⁶ From our present knowledge of tuna distribution, no species has an antitropical distribution, but it should be noted that the albacore (*Thunnus alahunga*) tends to move into deeper water in the tropics (Bruce B. Collette, personal communication).

West-Pacific not mentioned by Hubbs. Most of these are bottom-dwelling species of relatively shallow water. A few of these fishes which venture south of the Tropic of Cancer or north of the Tropic of Capricorn but which do not penetrate lower latitudes cannot properly be designated as antitropical. For these, the term "antiequatorial" will be used.

This listing is provisional. Additional examples of Indo-West-Pacific fishes with antitropical distributions will undoubtedly be recorded, particularly when more study is given to some groups in need of revision. Further collecting may also reveal the presence in tropic seas of some fishes now considered to be absent from warm-water areas.

The following Indo-West-Pacific genera of fishes appear to be antitropical or antiequatorial in their distribution: *Gonorhynchus*, *Iso*, *Neosebastes*, *Pseudocaranx*,⁷ *Caprodon*, *Callanthias*, *Assessor*,⁸ *Cheilodactylus*,⁷ *Labracoglossus*, *Girella*, *Microcanthus*,⁷ *Pseudolabrus*, and *Prionurus*. (two eastern Pacific and one West African species occur in lower latitudes).

The Aracanidae (regarded by some authors as a subfamily of the Ostraciidae) is antitropical, with six genera confined to southern latitudes of Australia and Africa and one to Hawaii and Japan. The one specimen of *Strophiuichthys inermis* Fraser-Brunner (1941) reported from the Solomon Islands is a locality error for Australia (Michael Walker, personal communication). Fraser-Brunner's three other specimens of this species were from Australia, two of them from the Sydney area.

The following examples, arranged under family headings in approximate phylogenetic sequence, are of species of fishes that appear to be the same in the northern and southern hemispheres but are not in continuous distribution across the tropics.

⁷ See accounts of species of these genera below.

⁸ E. O. Murdy (personal communication) has recently collected *Assessor randalli* Allen and Kuitert at Bolinao, Philippines (16°26' N).

⁹ After this paragraph was written, Peter H. J. Castle (personal communication) reported specimens of this eel taken from Samoa and the Philippines.

SPHYRNIDAE

Of the smooth hammerhead shark, Gilbert (1967) wrote: "*Sphyræna zygaena* has an antitropical distribution, occurring in cooler waters of both the northern and southern hemispheres but apparently absent from the intervening warmer areas." The only low-latitude records are from the eastern Pacific.

SQUALIDAE

J. A. F. Garrick of Victoria University of Wellington, New Zealand, wrote (personal communication, June 1980): "*Squalus acanthias* is an example of antitropical distribution. My work in squaloids suggests other possibilities—*Deania calcea*, *Centroscymnus owstonii*, *C. crepidater*, and *Centrophorus squamosus*. Also in the chimaeroids there is *Rhinochimaera pacifica*."

Garrick and Paul (1971) recorded two specimens of the squalid shark *Cirrhigaleus barbifer* Tanaka from 360–440 m off New Zealand, the first known from outside Japanese waters. Although this may be another example of antitropical distribution, it is possible that the apparent discontinuity is due to insufficient deep-water collecting in the intervening areas.

SYNAPHOBRANCHIDAE

In their review of the Dysommmininae, Robins and Robins (1976) recorded *Meadia abyssalis* (Kamohara) from Hawaii, Japan, and Réunion in the Indian Ocean. This is a deep-water eel (Hawaiian specimens were taken in 180 fathoms). Until more deep-water collecting is carried out in tropical localities, one cannot be certain that it has an antitropical distribution.⁹

MURAENIDAE

Randall and McCosker (1975) have shown that the many collecting localities for the wide-ranging moray *Lycondontis eurostus*

(Abbott) are all between 16° and 32° N or S, with the exception of a single eastern Pacific record.

MYCTOPHIDAE

Kawaguchi and Shimizu (1978) ascribed an antiequatorial distribution to the lanternfish *Diaphus brachycephalus* Tåning in the western Pacific and eastern Indian oceans, where a close relative, *D. richardsoni* Tåning occurs. In the central Pacific, where *D. richardsoni* is absent, *D. brachycephalus* is found in equatorial waters.

GOBIESCOCIDAE

Briggs (1955) listed the following localities for the clingfish *Lepadichthys frenatus* Waite: Lord Howe Island, Capricorn Group of the Great Barrier Reef (Briggs referred to the Capricorn Group as "Northern Queensland," however, these islands are off the southern Queensland coast), New Caledonia, New Hebrides, Okinawa, and several localities in Japan. The author has collected it at islands of the Pitcairn Group. The most tropical locality is Vila Harbor in the New Hebrides (18° S). Briggs noted that *L. sandaracutus* Whitley from Shark Bay, Western Australia, may only be subspecifically different from *L. frenatus*.

HOLOCENTRIDAE

Adioryx furcatus (Günther) was described from one specimen from the "South Sea." Other examples have come from the Hawaiian Islands (*Holocentrus ensifer* Jordan and Evermann is a junior synonym) and southern Japan (Shimizu and Yamakawa 1979). The author has collected this species in 43 m at Pitcairn Island (25° S), thus establishing its occurrence in the subtropical South Pacific.

The soldierfish *Myripristis chryseres* Jordan and Evermann would seem to be another example of antitropical distribution except for one record from Indonesia by Greenfield

(1974:15). The species is otherwise known in the literature only from the Hawaiian Islands, Japan, and Réunion in the Indian Ocean. The author has also collected it at Mauritius, and Phillip C. Heemstra (personal communication) reported that a specimen was taken at Aliwal Shoal off Durban, South Africa, in early 1980. The Indonesian record is based on a specimen (RMNH 5414) in the Rijksmuseum von Natuurlijke Historie in Leiden. M. Boeseman, who was asked to check the locality of the specimen, reported that the locale is not Indonesia but Bourbonia (= Bourbon = Réunion), and the specimen is apparently the one identified as *M. borbonicus* by Bleeker and Pollen (1874:15, pl. 6). A specimen, now deposited in the Bernice P. Bishop Museum (BPBM 24452), was recently collected by Richard C. Wass at Tutuila, American Samoa (14° S).

The holocentrid *Ostichthys archiepiscopus* (Valenciennes) (*Myripristis pillwaxii* Steindachner is a junior synonym) is known from the Hawaiian Islands, Japan, Réunion, and Mauritius (Randall, Shimizu, and Yamakawa, in press). This species is found in relatively deep waters (known depth range, 146–360 m).

Another holocentrid usually assigned to *Ostichthys* that has an antitropical distribution is *O. oligolepis* (Whitley). This fish, often misidentified as *O. japonicus* (Cuvier), will be placed in a separate genus to be described by Randall, Shimizu, and Yamakawa (in press). It is known from Western Australia at about 27° S, Lord Howe Island, Easter Island, the Hawaiian Islands, and Japan. Although usually found at depths of about 50–200 m, it has been taken as shallow as 14 m.

ZEIDAE

Hubbs (1952) listed the john dory (*Zeus*) as an example of antitropical distribution. Another zeid fish, *Zenopsis nebulosa* (Temminck and Schlegel), also has a discontinuous north-south distribution: California, Hawaii, and southern Australia (Heemstra 1980).

SCORPAENIDAE

William N. Eschmeyer (personal communication) has determined that the scorpaenid genus *Neosebastes* is antitropical in distribution, with six species in Australian waters and one, *N. entaxis* Jordan and Starks, in Japan. He has examined specimens of what appears to be *entaxis* taken on the west coast of Australia between Cape Cuvier (24° S) and Cape Lévêque (16.4° S).

APLOACTINIDAE

Stuart G. Poss (personal communication) has informed the author that *Aploactis aspera* Richardson has a disjunct north-south distribution. It is known in the north from Kyushu, the northern Ryukyu Islands, and China, and in the south from southeastern Australia.

SERRANIDAE

In a revision of the anthiine genus *Plectranthias*, Randall (1980) regarded *P. azumanus* (Jordan and Richardson) from Japan as a subspecies of *P. kelloggi* (Jordan and Evermann) from the Hawaiian Islands. Small specimens were identified from south of the Isle of Pines, New Caledonia, as *kelloggi*, but named as a different subspecies from the northern two, *P. k. melanesius*. The specimens have all come from deep water, about 274 m in Hawaii. Since relatively little deep-water collecting has been carried out in the lower latitudes of the central and western Pacific, it may be premature to regard this species as antitropical.

GRAMMISTIDAE

Randall et al. (1971) listed the localities for the soapfish *Aulacocephalus temmincki* as Japan, northeast China, Korea, Taiwan, New Zealand, Kermadec Islands, Mauritius, the Natal coast of South Africa, and Thailand. They pointed out that all these localities except Thailand lie between about 20° and

36° N or S. Doubt was cast on the validity of the Thailand record. However, they overlooked the report by Rangarajan (1969) of this fish from Port Blair, Andaman Islands (11°41' N, 92°46' E), thus making the Thailand record more credible and eliminating *A. temmincki* as an example of antitropical distribution. This species may still be antiequatorial. The Bishop Museum now has a specimen from Rapa (27.5° S).

CIRRHITIDAE

The hawkfish *Amblycirrhitus unimacula* (Kamohara), previously known only from Japan and Taiwan (Randall 1963), has recently been collected in the Samoa Islands (14° S) (Wass, in press).

The shallow-water *Cirrhitops fasciatus* (Bennett) was shown by Randall (1963) to have both a north-south and east-west disjunct distribution. It is still known only from the Hawaiian Islands, Japan, Madagascar, and Mauritius.

CHEILODACTYLIDAE

The subgenus *Goniistius* of the genus *Cheilodactylus* is represented by three species in Japan, Korea, and China; one in Hawaii; three in Australia and New Zealand; and an undescribed species from Easter Island and Rapa (Randall, in press). None occur in tropical waters. *Cheilodactylus (Goniistius) vittatus* Garrett, the Hawaiian species, was unknown from the southern hemisphere until photographs of live individuals were sent to the author from two southern localities. One is an underwater photograph of what appears to be a fish of about 150 mm standard length, taken at Lord Howe Island by Neville Coleman (duplicate sent through the courtesy of Rudie H. Kuiter). Two other individuals were photographed in the Nouméa Aquarium, New Caledonia (one by the former director, René Catala, and one by the present director, Yves Magnier). The distinctive color pattern of these three fish is the same as individuals from Hawaii, but no southern

specimens have been deposited in any museum, and until one or more are obtained so that a direct comparison can be made with Hawaiian material, this southern form is only provisionally regarded as *C. vittatus*.

CARANGIDAE

A synopsis of the genus *Trachurus* is given in Berry and Cohen (1974). Their Figure 1 suggests an antitropical distribution for the entire genus, thus confirming Hubbs (1952). Stephenson and Robertson (1977) have shown that *T. japonicus* (Temminck and Schlegel), recorded from Japan to Hong Kong, is a junior synonym of *T. novaezealandiae* Richardson, which occurs in New Zealand and temperate Australian waters.

Pseudocaranx dentex (Bloch) (*P. georgianus* and *P. cheilio* are junior synonyms) is also antitropical in the Atlantic and Indo-Pacific. The Indo-Pacific localities include South Africa, Australia, Tasmania, Norfolk Island, Lord Howe Island, New Zealand, Japan, and Easter Island, and it was recently collected at Pitcairn and Rapa by the author.

Carangoides equula (Temminck and Schlegel), described from Japan, is also known from the Hawaiian Islands, Easter Island, and South Africa (carangid distributions from William F. Smith-Vaniz, personal communication).

EMMELICHTHYIDAE

Erythrocles schlegeli (Richardson), is clearly antitropical. Heemstra and Randall (1977) gave the distribution as Japan, Okinawa, Korea, and off Durban, South Africa. A record from the Gulf of Oman could not be confirmed, but even if valid, the latitude would probably be that of the Tropic of Cancer or greater.

Emmelichthys struhsakeri Heemstra and Randall is an example of a deep-water fish that was believed to have an antitropical distribution. This species was known only from the Hawaiian Islands, Japan, and New South Wales. Recently, a specimen was

obtained from the fish market at Cebu City, Philippines, by Norbert Rau (formerly of the University of San Carlos).

LUTJANIDAE

Though the present range of two relatively deep-dwelling snappers appears to be anti-equatorial, further collecting may reveal their presence in lower latitudes. *Pristipomoides auricilla* (Jordan, Evermann, and Tanaka) is known from the Hawaiian Islands, Japan, Bonin Islands, Ryukyu Islands, and Guam (13.5° N). Wass (in press) will report it from Samoa (14° S). It is usually taken at depths of about 180–270 m (Kami 1973). Fourmanoir and Laboute (1976) recorded it from New Caledonia in 250 m.

Randallichthys filamentosus (Fourmanoir) is known from the Hawaiian Islands, Okinawa, and New Caledonia from depths of 152–293 m (Anderson, Kami, and Johnson 1977).

NEMIPTERIDAE

Pentapodus nagasakiensis (Tanaka) was known only from southern Japan until Fourmanoir and Laboute (1976) recorded it in their *Poissons de Nouvelle Calédonie et des Nouvelles Hébrides*. A direct comparison should be made of specimens from the two hemispheres, however, before this species can be regarded definitively as antitropical.

PENTACEROTIDAE

Smith (1964) revised the pentacerotid fishes. In his Figure 2, he plotted the bitemperate distribution of *Pentaceros richardsoni* A. Smith (South Africa, Cape Horn, New Zealand, Japan, and California to Alaska).

Smith (1964) discussed the taxonomic problem of three other nominal species of *Pentaceros*: *P. decacanthus* Günther, pelagic in the Atlantic and Pacific; *P. japonicus* Döderlein from Japan; and *P. hendeca-*

canthus (Norman) from Australia (also to be reported from Easter Island by Randall and Cea Egaña, in press). Smith (1964:576) stated, "it would appear that there is little of significance other than locality to distinguish between these three forms, excepting only the low gill-raker count of *decacanthus*," He added that gill-raker counts apparently can increase with age. If *P. japonicus* and *P. hendecacanthus* are shown to be synonymous, then a second antitropical species of this genus may be documented.

Another member of the family, *Histiop-terus acutirostris* Temminck and Schlegel, is also antitropical. It is known in the north from Japan and the Hawaiian Islands (Smith corrected the previous identification of Hawaiian specimens as *H. typus* to *H. acutirostris*) and in the south from Lord Howe Island (Allen et al. 1976).

SCORPIDIDAE

The family Scorpididae has no tropical representatives. The shallow-water *Micro-canthus strigatus* (Cuvier in Cuvier and Valenciennes), popularly known as stripey, is recorded from the Hawaiian Islands, Japan, Ryukyu Islands, Taiwan, Hong Kong, New Caledonia, South Queensland, New South Wales, Lord Howe Island, and Western Australia. Species of the remaining genera are exclusively southern except the monotypic *Medialuna* from California.

POMACENTRIDAE

Two damselfishes of the genus *Chromis* have antitropical distributions, though this has become apparent only from recent clarification of synonymy. As shown by Allen (1975), *C. chrysurus* (Bliss), described from Mauritius, has the following synonyms: *C. isharae* Schmidt and *C. lepidostethicus* (Fowler), both from the Ryukyus, and *C. westalli* (Whitley) from Kenn Reef, Coral Sea. It is also known from the Great Barrier Reef, New South Wales, New Caledonia, Loyalty Islands, New Hebrides, and Fiji Islands, all localities of 16° or more of

latitude. *Chromis flavomaculata* Kamohara was described from Kochi Prefecture, Japan; *C. kennensis* Whitley from Kenn Reef (21° S) is a junior synonym (Randall, Ida, and Moyer, in press). This species also occurs in New Caledonia, Loyalty Islands, Lord Howe Island, and New South Wales.

Based on currently known distributions, two other damselfishes of the genus *Chrysiptera* (*Glyphidodontops* is a junior synonym) are antiequatorial in the western Pacific. *Chrysiptera starcki* (Allen) was described from Osprey Reef, Coral Sea (14° S). Allen (1975) extended the range to New Caledonia, Loyalty Islands, New South Wales, and Taiwan, and Ida and Moyer (1975) extended the range to southern Japan. *Chrysiptera tricinctus* (Allen and Randall) was named from specimens from Tutuila, American Samoa. Allen (1975) reported additional specimens from New Caledonia and the Fiji Islands. The record of this species by Masuda, Araga, and Yoshino (1975) from the Izu Peninsula, Japan, is the first from the northern hemisphere.

LABRIDAE

Gomon and Randall (1978:42) documented the distribution of *Bodianus vulpinus* (Richardson) (*Cossyphus oxycephalus* Bleeker is a junior synonym) as follows: "*B. vulpinus* is distributed along the periphery of the tropical Pacific region (southern Queensland and New South Wales, Australia, Lord Howe Island, New Zealand, Easter Island, Hawaiian Islands, and Japan). It occurs in shallow water (as little as 6 m) at the northern and southern extremes of its range, but has evidently been forced deeper by the warm shallower waters in the Hawaiian Islands. In this area it has only been taken by deep water hook-and-line fishermen. A record of this species from New Guinea often repeated in the literature appears to be a mistake in the citation of a specimen of *Cheilinus oxycephalus* first reported by Macleay (1882)."

Four other species of *Bodianus* also exhibit antitropical distributions. *B. perditio* (Quoy

and Gaimard) occurs at Mangareva (collected by the author), Loyalty Islands, New Caledonia, Lord Howe Island, eastern Australia, Japan, Mauritius, Réunion, Natal, and St. Brandon Shoals (the latter locality at 16° S is the most tropical). *Bodianus leucostictus* (Bennett) and *B. tanyokidus* Gomon and Madden are both known only from Mauritius and Japan (Gomon 1979). *B. izuensis* Araga and Yoshino occurs in Japan, New Caledonia, and New South Wales.

The colorful wrasse usually known as *Lienardella fasciata* (Günther) has an anti-equatorial distribution in the western Pacific. It is known from Queensland (type locality), New Caledonia (Whitley 1961), and Lord Howe Island (Allen et al. 1976) in the southern hemisphere and from Taiwan (Shen and Choi 1976) and the Ryukyu Islands (first recorded as *Lepidaplois mirabilis* Snyder) in the north. Fowler and Bean (1928) proposed *Lienardella* as a subgenus, though they had no specimens from the Philippines or East Indian area. However, the species does occur in the Philippines, though rarely. Kent E. Carpenter (personal communication) has indicated that on occasion, it enters the aquarium trade from collections in Luzon. Gomon (1979) has classified this labrid fish in *Choerodon*.

Novaculichthys woodi Jenkins (placed by some authors in the genera *Novaculops* and *Xyrichtys*) is known in the literature from the Hawaiian Islands and Japan. In 1969 the author and Gerald R. Allen obtained three large specimens (BPBM 6715, 6716) of what appears to be this species from fishermen at Easter Island (27° S). The fish were caught with hook and line in 50–250 m. They differ from Hawaiian specimens in their deep red color (perhaps a function of the depth of capture) and large size, 196–210 mm standard length. In Hawaii, the species attains a maximum size of about 150 mm standard length. In view of other similarities, these differences seem to be subspecific.

Randall and Araga (1978) showed that the Japanese labrid fish *Coris musume* (Jordan and Snyder) is a junior synonym of the Australian *Coris picta* (Bloch and Schneider). It ranges in the western Pacific

from about 25° to 35° in the northern hemisphere and from 27° to 37° in the southern hemisphere.

In their review of the labrid fish genus *Pseudojuloides*, Ayling and Russell (1977) described *P. elongatus* from specimens from New Zealand, Norfolk Island, New South Wales, Western Australia (20.5°–28.5° S), and Miyake-jima, Izu Islands, Japan (34° N).

Suezichthys gracilis (Steindachner) is another labrid fish with a similar anti-tropical distribution. It occurs in Japan from central Honshu to Kyushu (Masuda, Araga, and Yoshino 1975). Its southern form, named *Guntheria devisi* by Whitley (1941), ranges from the Capricorn Group of the Great Barrier Reef (23°30' S) to Bass Point, New South Wales (35° S) (Barry C. Russell, personal communication).

CREIDIIDAE

Limnichthys fasciatus Waite was recorded from the following localities by Nelson (1978): Japan, Okinawa, Taiwan, New South Wales, Capricorn Group of the Great Barrier Reef, Lord Howe Island, Norfolk Island, Kermadec Islands, islands off Western Australia (Garden, Kendrew, and Rottnest), and Abaiang, Gilbert Islands. All these localities are of latitudes higher than 20° N except Abaiang, which lies at 2° N. Nelson examined six small specimens from this atoll and stated that they appear to be *L. fasciatus*. He was asked by the author to reexamine these specimens and wrote in response, "I am not at all certain of the identity of AMS I.18051–36 from Abaiang Atoll, Gilberts. The largest were about 16.5 mm standard length and all were without a trace of pigment. I would now conclude on the basis of characters then examined, that they are more likely to be *L. donaldsoni*. I would then agree that as far as we can now tell *L. fasciatus* has an antitropical distribution."

BLENNIIDAE

Springer (1967, 1972) has given the localities for the inshore blenny *Entomacrodus*

niuafouensis (Fowler) as Niuafoou Island, Tonga Islands, Pitcairn Group, Guam, Bonin Islands, Taiwan, and Madagascar. The most tropical northern hemisphere locality is Guam at 13.5° N, and of the southern hemisphere, Niuafoou at 15.5° S (the locality within Madagascar was not known; the latitude of this large island ranges from about 12° to 26° S). The Madagascar population, which may be relict, is differentiated from the Pacific in color and size of the nuchal cirrus.

GOBIIDAE

In his review of the gobiid genus *Kelloggella*, Hoese (1975) recorded the only localities for the common inshore goby *K. oligolepis* (Jenkins) as Hawaiian Islands, Easter Island, and the Ryukyu Islands (however, he now identifies the Ryukyu species as *K. centralis* Hoese).

Hoese (1973) noted the appearance in Sydney harbor of the Japanese gobiid fishes *Acanthogobius flavimanus* (Temminck and Schlegel) and *Tridentiger trigonocephalus* Tomiyama. It is believed that these fishes were inadvertently transported to Australia in ships from Japan, perhaps in seawater intake pipes or ballast seawater. The same two gobies have also colonized San Francisco Bay, California.

The gobiid fish *Psiologobius mainlandi* Baldwin, previously known only from the Hawaiian Islands, was recently collected at One Tree Island in the Capricorn Group of the Great Barrier Reef (5 specimens, AMS I.20578-002). The Australian record is from Barry C. Russell (ms) in an annotated checklist of the fishes of the Capricorn-Bunker Group. This goby lives symbiotically in a burrow with alpheid shrimps.

CHAETODONTIDAE

The butterflyfish *Coradion altivelis* McCulloch was described from Wide Bay, Queensland. Based on material from southern Japan, *C. fulvocinctus* Tanaka is a junior synonym. There appear to be no valid

reports from tropical areas. Gerald R. Allen (personal communication) wrote, "The only record of this species outside of Australia and S. Japan is a very questionable one from Java. I would therefore be inclined to use this species to illustrate antitropicality."

Another butterflyfish, the drab *Hemitaurichthys thompsoni* Fowler, is antiequatorial in distribution. It has been described from the Hawaiian Islands, and has since been reported from Johnston Island (16°45' N) and Manihiki (10°23' S). The author has also collected it at Guam (13°30' N), and Wass (in press) has observed it off Tutuila, American Samoa (14° S).

POMACANTHIDAE

The angelfish *Genicanthus watanabei* (Yasuda and Tominaga) has been recorded only from the Ryukyu Islands, Tahiti, Austral Islands, Pitcairn, New Caledonia, and Osprey Reef, Coral Sea (Randall 1975). The most tropical of these localities is Osprey Reef at 14° S.

Centropyge interruptus (Tanaka) is known in the literature only from Japan (the type locality), and one specimen from Kure, Hawaiian Islands (Ralston 1981). However, a color photograph of a specimen from Réunion (sent to the author by Paul Guézé) reveals its presence at this Indian Ocean island. Two Réunion specimens (84.7–85 mm standard length) have been deposited at the Museum National d'Histoire Naturelle in Paris (MNHN 1979–569).

ACANTHURIDAE

Acanthurus leucopareius (Jenkins) was cited by Randall (1956) as a relict species, with definite records only from Hawaii, Marcus Island, and Easter Island. Randall (1976) mistakenly listed Lord Howe Island instead of Marcus Island for this surgeonfish. The species is now known from southern Japan (illustrated by Masuda, Araga, and Yoshino 1975: pl. 129 H) and from Bishop Museum collections from Rapa (27°30' S), nearby Îlots de Bass, islands of the Pitcairn

Group, Temoe Atoll in the southern Tuamotu Archipelago (23° S), and Rarotonga in the Cook Islands (21° S). All these localities are of 19° or higher latitude. However, in 1968, the author sighted a subadult individual of this species at Guam, Mariana Islands, at 13°30' N. Later, Robert S. Jones (personal communication) reported on the collection of a specimen from Guam. *A. leucopareius* is common in the northern Marianas, but very rare at Guam (where probably there is no breeding population).

BALISTIDAE

The triggerfish genus *Xanthichthys* has two antitropical species: *X. mento* (Jordan and Gilbert) from the eastern Pacific, Hawaiian Islands, Marcus Island (Minami Tori Shima) (24° N), Japan, Easter Island (27° S), and Pitcairn (25° S); and *X. lineopunctatus* (Hollard) from Ryukyu Islands, Australia, and the Natal coast of South Africa (distributions from Randall, Matsuura, and Zama 1978).

MONACANTHIDAE

The filefish genus *Thamnaconus* Smith, as redefined by Hutchins (1977), comes close to being antitropical. Most of the species live at latitudes greater than 20°. The exceptions are *T. melanoproctes* (Boulenger), described from Muscat, Oman, which was reported from the Andaman Sea by Kyushin et al. (1977; exact locality 11°12' N, 97°22' E, supplied by Ida), and *T. modestoides* (Barnard). The latter was described from Algoa Bay, South Africa (34° S). Bauchot and Maugé (1978) named a new subspecies of this filefish, *T. m. erythraeensis*, from the Gulf of Aqaba, northern Red Sea (29° N); however, the records by Norman (1939) from the Gulf of Aden (about 12° N) and Kyushin et al. (1977; as *Navodon* sp.) from the Chagos Archipelago (6° S) clearly place this species in the tropics.

One species of this genus, *Thamnaconus hypargyreus* (Cope), is marginally antiequatorial. It occurs off the central Queensland coast, Japan, and the Philippines (where it was named *Monacanthus tessellatus* by Gün-

ther 1880; the holotype was collected from 175 m). This filefish is known from the depth range of about 50–200 m (J. Barry Hutchins, personal communication).

TETRAODONTIDAE

Hardy (1980) has documented the antitropical distribution of the puffer *Arothron firmamentum* (Temminck and Schlegel); it is known from Korea, the southern half of Japan, Taiwan, southeastern Australia including Tasmania, and the northern half of New Zealand. Some authors in New Zealand and Australia have used the junior synonym *Tetrodon gillbanksii* Clarke for this species. Its known latitudinal limits are 25°–37° N and 27°–43° S. It occurs to depths of 180 m, but is usually found between 30 and 82 m. Of its antitropical distribution, Hardy (1980: 123) wrote, "Because of its depth tolerance, *A. firmamentum* may have been able to exploit the permanent thermocline extending between the cool temperate regions in the western Pacific (see Sverdrup et al. 1942), especially during Pleistocene glacial periods,"

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