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An annotated checklist of the fishes of Clipperton Atoll, tropical eastern Pacific

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Abstract: Clipperton Atoll is the most isolated, most westerly and largest coral reef in the tropical eastern Pacific (TEP). We collected and recorded fishes to depths of 60m during a two week visit in April 1994. Previous collections were made late last century and by expeditions from Scripps Institution of Oceanography in 1956 and 1958. One hundred and fifteen identified species from 89 genera and 43 families are now known from the island. The most speciose families present at the island are moray eels (Muraenidae, 14 species), jacks (Carangidae, 11 species), wrasses (Labridae, 8 species), surgeonfishes (Acanthuridae, 8 species), squirrelfishes (Holocentridae, 5 species), groupers (Serranidae, 5 species), and triggerfishes (Balistidae, 5 species). These represent ~14% of the TEP nearshore fish fauna and 40% of its genera. The 115 species include 14 offshore pelagic species, 22 inshore pelagic and midwater species, 70 demersal species that live on hard reef substrata, and nine demersal species that live in or feed on unconsolidated substrata (rubble and sand). Among the 101 non-oceanic species, 68% are carnivores on mobile organisms, 9.2% feed on sessile benthic invertebrates, 12.9% are planktivorous, and 17.8% are benthic feeding herbivores. At least 70 of the non-oceanic species appear to have resident (i.e. self sustaining) populations at the atoll, while 17 species probably are vagrants. Clipperton's fishes include 63 transpacific species (i.e. species that also occur on the western side of the Eastern Pacific Barrier) and 52 species endemic to the TEP. While most (36) of the TEP species occur throughout the region, four occur only at boh Clipperton and the Revillagigedos, the nearest shoal habitat, 950 km to the north. Nine species or subspecies from seven families are endemic to Clipperton. They represent 11.3% of Clipperton's demersal shorefishes. The sister species of one of them likely is a transpacific species, while the sister species of the other eight likely are TEP species.

Key words: Eastern Pacific, Clipperton Island, fish fauna.

Clipperton Island, at 10°18'N, 109°13'W, is a small island at the western edge of the tropical Eastern Pacific (TEP) marine biogeographic region. It lies at the eastern edge of the 4,000-7,000 km wide Eastern Pacific Barrier (EPB) (Ekman 1953), 1,100km SW of the American mainland and 950 km S from the nearest offshore shoal habitat, the Revillagigedo Islands (Fig. 1). It is the most isolated shoaling reef in the TEP and the most isolated reef in the Indo-Pacific tropics. There has been long standing interest in relations between the eastern and western Pacific fish faunas from a biogeographical perspective, because the EPB is the world's largest deep water barrier to the dispersal of marine shore

organisms (Ekman 1953), and the fishes of the TEP have obvious affinities to those of the central and western Pacific (Herre 1940, Ekman 1953, Briggs 1961, Springer 1962, 1967, Rosenblatt *et al* 1972, Leis 1984, Brothers and Thresher 1985, Clark 1995). Due to its position Clipperton may be an important stepping stone allowing a connection between those faunas.

The first fish recorded from Clipperton Island was *Bathygobius arundelii*, described by Garman in 1899. It was collected by the Hopkins-Stanford Galapagos Expedition of 1898-99. Eight other species were also collected and reported by Snodgrass and Heller (1905). The only other collections besides our's reported here were made by Scripps Institution of Oceanography (La Jolla, California) during two visits of several weeks in 1956 and 1958. Most of those collections were made on the shallow reef flat. Until now, they remain largely unreported, with the exceptions of descriptions of three Clipperton endemics - *Holacanthus limbaughi* Baldwin (1963), *Myripristis gildi* Greenfield (1965), and *Stegastes baldwini* Allen and Woods (1980). In addition, records of a few other species are scattered through the literature (Schmidt and Schultz 1940, Springer 1962, Limbaugh 1963, Berry and Baldwin 1966, Springer 1967, Rosenblatt et al 1972, Fritsche 1980, Pietsch and Grobecker 1987, McCosker and Randall 1993, Randall 1995).

Clipperton fishes were featured in faunal summaries for the TEP by Allen and Robertson (1994) and Fischer et al (1995). Descriptions of three additional Clipperton endemics, *Thalassoma robertsoni* Allen (1995a), *Pseudogramma axelrodi* Allen and Robertson (1995a), and *Xyrichtys wellingtoni* Allen and Robertson (1995b), resulted from our 1994 expedition. Summaries of the 1994 Clipperton Expedition appeared in the appendix of Allen and Robertson's *Fishes of the tropical eastern Pacific* (1994), and in a popular article by Allen (1995b), which included color photographs of most reef-dwelling species. Here we present an annotated list of Clipperton fishes based on our 1994 collections and observations, scattered references in the literature, and records of Clipperton specimens deposited at several institutions. A companion paper, Robertson and Allen (1996), presents a zoogeographic analysis of the structure of the shorefish fauna of Clipperton.

METHODS

The island and its marine habitats: The tiny island (Fig. 1) is roughly circular with a maximum diameter of 4km and a combined land and lagoon area of about 10 km^2. It consists of a narrow, unbroken 40-400m wide ring of land around a central lagoon. Except for a large basalt rock that rises to 21m on the southeastern corner, the land is less than ~5m above sea level and consists of coralline rock with a thin covering of loose rubble. The island's terrestrial flora was described in detail by Sachet (1962). Skaggs (1989) provided a comprehensive account of the history of human occupation of the island, which is a French territory. We encountered dozens of abandoned boat anchors of a variety of sizes and ages, and forms of construction (some obviously not of standard commercial origin) in 10-20m of water around the island, indicating a history of repeated recent human usage of the reef. During our 1994 visit crews from a tuna boat line-fished for reef fish from work boats at 10-20m depth, and several sailing yachts also anchored at those depths.

Clipperton is the only coral atoll in the TEP and its 3.7 km^2 coral reef is the largest in the region (Glynn *et al*, 1996). Steep rubble beaches fringe the seaward edges of the island. These beaches lead into a shallow (0.5-1m deep, depending on tides) reef flat, covered in coralline rock and rubble interspersed with small patches of shallow sand. There are only a few 10s of meters of beach rock. This 50-200m wide habitat is bordered to seaward by a 10-15m wide semi-emergent spur and groove

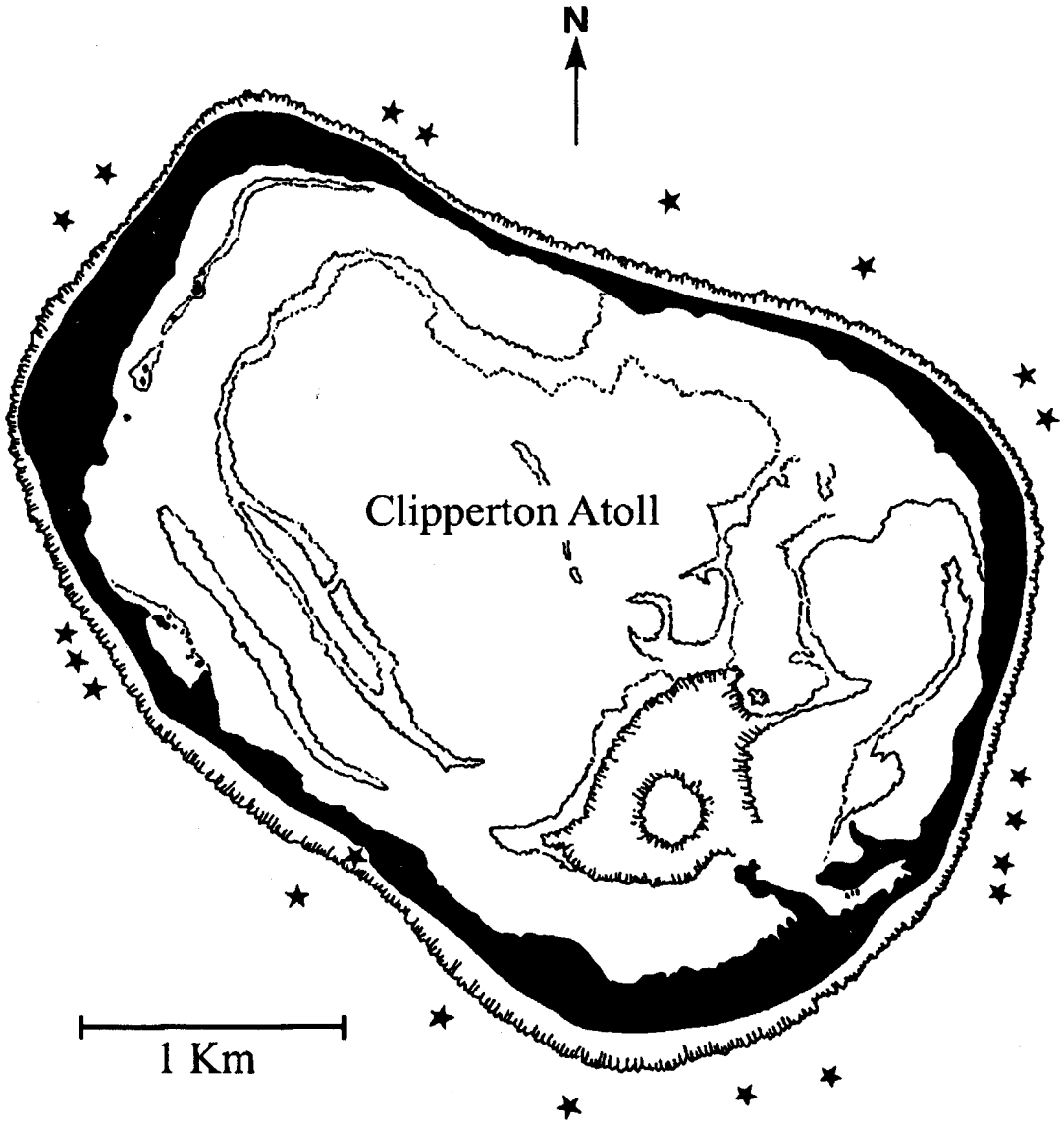

Fig 1. Map of Clipperton Atoll, showing subtidal sites (stars) we sampled in 1994. Land is solid color, bordered by an irregular line indicating the edge of the intertidal reef flat. The site of the single reef flat rotenone sample is indicated by a star on that flat on the SW side of the island.

system that stretches around the entire island. The atoll lacks a leeward seaward exposure, which is a common feature of other Pacific atolls (Glynn *et al* 1996). Ocean swells broke continuously on this spur and groove rim around the island throughout our visit. Outside this rim the reef slopes gently to ~20m depth over distances of ~100-300 m (the inner reef slope), then plunges into deep water at an angle of about 30-45 degrees (the outer reef slope). The inner reef slope consists almost entirely of hard bottom, with a scattering of small depressions containing a thin layer of coral rubble, but little sand. At the time of our visit, live coral cover was high on the reef slope; on the order of 33-83% in many areas (Glynn *et al*, 1996). There is only one significant patch of fine sand bottom in shallow water; it fills a

depression about 500m^2 in area in 15m of water off the northwest corner of the island on the outer part of the inner reef slope. However, while diving to depths of 50m we observed extensive areas of sand and rubble bottom on a terrace at the base of the outer reef slope at about 60-70m depth off the north east and western sides of the island. While this "60m terrace" varies in width from about 30-100m around much of the island, and has a slope ranging from 10-40^0, on the NW side of the island it is greatly enlarged and slopes off gradually from 50m to 110m over a distance of 1.5km (sounding profiles in Glynn *et al.* 1996). During our visit visibility was usually in the range of 25-40m, and surface water temperatures were 28-29°C.

The island has a large (7.3 km^2) central lagoon. That lagoon apparently recently had a pair of very shallow connections to the open sea, which eventually closed around the end of the last century (Sachet 1962, Skaggs, 1989). Members of the Scripps Expedition to Clipperton in 1958 found evidence of a recent channel, thought to be the result of a violent storm (Wayne Baldwin, personal communication to G.R. Allen 1995). During our visit the lagoon had no surface connection to the sea and was slightly brackish. It supported a dense growth of freshwater weed and some scattered patches of reeds and sedges. We did not find any fishes in the lagoon during several searches using a mask and snorkel. Hordes of midwater-swimming isopods were the only macroscopic animal life. Depths in most of the lagoon are shallow (less than about 10m), but Cousteau and two other divers from R.V. *Calypso,* which visited in 1980, dived to 37m in the northern section (Skaggs, 1989). They found no sign of life at this depth, only inky darkness, a high level of hydrogen sulfide, and a soft mud-ooze bottom.

The 1994 expedition: We visited Clipperton Island aboard the 29m sport-fishing boat *Royal Star* on a trip out of San Diego, California. During 13 days spent at the island between 14-26 April 1994 we made a combined total of 82 dives with SCUBA to depths of 50m. The average duration of each dive was 40-60 minutes, with an average maximum depth of 20-25m. Those dives were scattered around all sides of the island (see Fig 1). In addition we made half a dozen drift snorkel dives along the upper slope, covering distances of ~1-2km on each. The names and abundances of observed species were recorded on plastic slates, and we made collections using mini-spears powered by small rubber bands, and small rotenone stations. All but one of the ~15 rotenone collections were made on the outer reef slope at 15 to 30m depths; a single collection was made on the reef flat adjacent to shore on the southwestern side near the landing site (see Fig 1). Constant wave surge prevented us from using rotenone in the groove and spur zone and in the shallow parts of the upper reef slope.

Fishes were fixed with 10 percent formalin, and later transferred to 70 percent ethanol. Our specimens are deposited at the United States Natural History Museum, Washington, D.C. (USNM). Underwater photographs of many species are deposited at the Western Australian Museum, Perth and the Smithsonian Tropical Research Institute, Panama. If known to us we also indicate the location of previous collections from Clipperton, which are deposited at the USNM, Scripps Institution of Oceanography (SIO), the California Academy of Sciences (CAS), the University of California at Los Angeles (UCLA), and the Los Angeles County Museum (LACM). Specimens collected on the Scripps expeditions of the 1950s by W. Baldwin, C. Limbaugh, E. Reese etc. were initially deposited at UCLA, but about half that collection was subsequently transferred to LACM.

The phylogenetic sequence of families appearing in the species list follows Eschmeyer (1990). Genera and species are arranged alphabetically. Brief literature citations are included in the text for the original description of each species (including the type locality) and its first record from Clipperton. Annotations for each species refer to: (1) relative abundance and depth distribution on the Clipperton reef;

(2) growth stages collected or observed (ie. small individuals that apparently had recently recruited from the pelagic environment, larger juveniles, adults); (3) major activity mode (diurnal/nocturnal; benthic, pelagic, etc.); (4) social behaviour; (5) major feeding category; (5) reproductive mode; (6) approximate maximum known size; (7) general distributional range; (8) an indication of whether or not photographs were obtained at Clipperton (field is omitted if no photographs); and (9) the number and size range of collected specimens, or an indication that the species was observed only. Additional annotations refer to deposition of specimens at various institutions, the probable population status (resident or vagrant - see below), and systematic relationships. Lengths are given as standard length (SL) for most species, which is the distance from the tip of the snout to the base of the caudal fin. Total length (TL) is given for a few fishes which do not have a clearly defined tail (e.g eels). Fork length (FL - the distance from the snout tip to the end of the middle caudal fin rays) is used for some commercial fishes such as tunas.

Population categories: We use four categories of relative abundance derived from our impression of the overall abundance of each species at the island in 1994: ***Abundant*** - observed at almost all sites in a variety of habitats, with hundreds to thousands of individuals routinely seen on each dive; ***Common*** - seen at the majority of sites, with ~50 individuals usually seen on each dive; ***Occasional*** - often localized and not observed on most dives, usually <20 individuals seen on any dive; ***Rare*** - fewer than 20 individuals (often less), seen during the entire expedition. Based on a combination of their abundance at Clipperton during 1994, and/or in collections made in the 1950s, and our overall impressions gained from other areas scattered around the Indo-Pacific we assigned the non-oceanic species to one of three population categories: *Residents* are species that appeared sufficiently abundant to have established, self-recruiting populations. They include some species that were uncommon during our 1994 visit, but of which substantial numbers of specimens were collected at Clipperton in the 1950s; *Vagrants* are species that were so rare during our visit, and/or for which <5 specimens from Clipperton are known from previous collections, that they probably recruited from other sites (although we cannot exclude the possibility that they are remnants of a local population that is approaching extinction). We assigned a species to one of these population status only when sufficient information appeared to be available. *Uncertain* - refers to species as rare as the vagrants, but which cannot be assigned to either Resident or Vagrant status because they may be more abundant than collections indicate, due either to their cryptic behavior and/or the possibility that significant numbers of individuals could be present on sand and rubble habitats of the "60m terrace".

RESULTS

An annotated species list of the fishes known from Clipperton Atoll

Carcharhinidae - Whaler Sharks

Carcharhinus albimarginatus (Rüppell, 1837)

Carcharias albimarginatus Rüppell, 1837: 64 (Ras Mehomet, Red Sea).

Carcharias platyrhynchus.- Snodgrass and Heller, 1905: 344 (Clipperton Island).

An inshore species occasionally seen on the outer slope; adults only; roving predator; solitary or in groups; carnivore: fishes, rays, and cephalopods; viviparous; 300 cm TL; Indo-Pacific to the Americas; observed only; Limbaugh (1963) published observations made at Clipperton in the 1950s; resident.

Carcharhinus falciformis (Müller and Henle, 1841)

Carcharias falciformis Müller and Henle, 1841: 47 (Cuba).

An offshore pelagic species occasionally

seen on the outer slope, usually near the surface; adults only; roving predator; solitary or in groups; carnivore: fishes, cephalopods; viviparous; 300 cm TL; circumtropical; underwater photographs.

Carcharhinus galapagensis (Snodgrass and Heller, 1905)

Carcharias galapagensis Snodgrass and Heller, 1905: 343 (Galapagos Islands).

Carcharinus galapagensis.- Limbaugh, 1963: 75 (Clipperton Island).

A nearshore pelagic species occasionally seen on the outer slope; adults only; roving predator, solitary or in groups; carnivore: fishes and cephalopods; viviparous; 370 cm TL; circumtropical; resident; specimens at SIO, LACM. Limbaugh (1963) noted this species was abundant in the 1950s, with many juveniles.

Carcharhinus limbatus (Valenciennes 1839)

Charcharias (Prionodon) limbatus Valenciennes (1839), *in* Muller and Henle,1839: 49 (Martinique)

Carcharhinus limbatus.- Limbaugh, 1963: 75 (Clipperton Island)

Not seen by us ; a nearshore pelagic species; roving predator, solitary or in groups; carnivore: fishes and cephalopods; viviparous; 247cm TL; circumtropical; possible vagrant; specimens at LACM. Limbaugh (1963) observed several individuals in the 1950s.

Sphyrnidae - Hammerhead Sharks

Sphyrna lewini (Griffith and Smith, 1834)

Zygaena lewini Griffith and Smith, 1834: 640 (south coast of Australia).

Rare, a few seen on outer slope; a nearshore pelagic species; adults only; roving predator, solitary or in groups; carnivore: fishes, cephalopods; viviparous; 330 cm TL; circumtropical; population status uncertain. Limbaugh (1963) observed groups of adults of an unidentified species of this genus during the 1950s.

Muraenidae - Moray Eels

Anarchias galapagensis (Seale, 1940)

Uropterygius galapagenis Seale, 1940: 6 (Galapagos Islands).

Abundant on reef flat in 0-1m; juveniles and adults; cryptic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 30 cm TL; TEP, from Gulf of California to the Galapagos; 23: 79-133 mm TL; resident; specimens at USNM, LACM.

Echidna nebulosa (Ahl, 1789)

Muraena nebulosa Ahl, 1789: 5 (Indonesia).

Occasionally sighted on the outer slope in 5-15 m; juveniles and adults; cryptic; solitary; carnivore: crustaceans; pelagic eggs; 60 cm TL; Indo-west and central Pacific; 2: 110-169 mm TL; underwater photographs; resident; specimens at USNM, LACM, SIO.

Echidna nocturna (Cope, 1872)

Poecilophis nocturnus Cope 1872: 474 (Rio Grande, Costa Rica)

Not observed or collected by us; collected in the 1950s; cryptic; solitary; carnivore: crustaceans; pelagic eggs; 71 cm TL; widespread in TEP; population status uncertain due to cryptic behavior and possible presence below 50m; specimens at USNM, UCLA.

Enchelycore octaviana (Myers and Wade, 1941)

Gymnothorax octavianus Myers and Wade, 1941: 89 (Octavia Bay, Colombia.

Rare, only 3-4 individuals sighted, in 10-20 m; adults only; cryptic; solitary; carnivore: fishes; pelagic eggs; 70 cm TL; TEP; underwater photographs; population status unclear due to cryptic behavior; specimens at USNM.

Enchelynassa canina (Quoy and Gaimard, 1824)

Muraena canina Quoy and Gaimard 1824: 247 (Vaigiou and Rawak)

Enchelynassa canina.- Rosenblatt *et al* 1972: 11 (Clipperton)

Not seen or collected by us; solitary, carnivore: fishes, crustaceans; pelagic eggs; 250 cm TL; western Pacific to the Americas; classed as a resident because numerous specimens were collected in the 1950s; specimens at SIO, LACM.

Gymnomuraena zebra (Shaw, 1797)

Gymnothorax zebra Shaw, 1797: Pl. 322 (Pacific Ocean).

Echidna zebra.- Rosenblatt et al 1972: 10 (Clipperton Island)

Rare, only two individuals sighted on upper edge of outer slope in 10m of water; adults only; cryptic; solitary; carnivore: crustaceans; pelagic eggs; 150 cm TL; Indo-Pacific to the Americas; underwater photographs; population status uncertain due to cryptic behavior; specimens at SIO, LACM.

Gymnothorax buroensis (Bleeker, 1857)

Muraena buroensis Bleeker 1857: 79 (Buru Island, Indonesia)

Gymnothorax buroensis.- Rosenblatt et al 1972: 10 (Clipperton Island)

Not seen or collected by us; cryptic; solitary; carnivore: fishes; pelagic eggs; 47 cm TL; Indo-Pacific to the Americas; population status uncertain due to cryptic behavior and possible occurrence below 50m; collected in the 1950s; specimens at LACM, UCLA.

Gymnothorax dovii (Günther, 1870)

Muraena dovii Günther, 1870: 103 (Panama).

Gymnothorax dovii.- Allen and Robertson, 1994: 303 (Clipperton Island).

Relatively common, up to 10-20 individuals seen on every dive; less cryptic than most morays, frequently seen swimming away from cover; adults only; solitary or occasionally in pairs or small groups; carnivore: fishes; pelagic eggs; 124 cm TL; southern half of TEP, including the mainland and Galapagos (Fischer *et al* 1995); underwater photographs; resident; specimens at USNM, SIO, LACM.

Gymnothorax flavimarginatus (Rüppell, 1830)

Muraena flavimarginatus Rüppell, 1830: 119 (Red Sea).

Gymnothorax flavimarginatus.- Rosenblatt et al 1972: 10 (Clipperton Island).

Occasionally sighted on outer reef slope; adults only; cryptic; solitary; carnivore: fishes, crustaceans; pelagic eggs; 125 cm TL; Indo-Pacific to the Americas; 2: 109-125 mm TL; underwater photographs; resident; specimens at USNM, LACM.

Gymnothorax panamensis (Steindachner, 1876)

Gymnothorax panamensis Steindachner, 1876: 67 (Panama)

Gymnothorax panamensis.- Randall and McCosker, 1975: 16 (Clipperton Island)

Rare, only a few specimens collected by us; cryptic, solitary, carnivore: crustaceans, fishes; pelagic eggs; 43 cm TL; widespread in TEP; numerous specimens collected in 1950s therefor probable resident; specimens at USNM, LACM.

Scuticaria tigrina (Lesson, 1829)

Ichthyophis tigrinus Lesson, 1859: 399 (Indonesia).

Rare, none seen by us, but several sighted by other members of our party when turning over rocks in search of shells; adults only; cryptic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 140 cm TL; Indo-Pacific to the Americas; underwater photographs; population status unclear, because normally associates with rubble and hence may occur on "60 m terrace"; not collected in the 1950s.

Siderea picta (Ahl, 1789)

Muraena picta Ahl, 1789: 6 (Indonesia).

Common, numerous individuals seen and collected on reef flat in 0-1 m; juveniles and adults; cryptic; solitary; carnivore: crustaceans; pelagic eggs; 120 cm TL; Indo-Pacific to the

Americas; 2: 43-50 mm TL; resident; specimens at USNM, LACM, SIO.

Uropterygius macrocephalus (Bleeker, 1865)

Gymnomuraena macrocephalus Bleeker, 1865: 54 (Indonesia).

Common on reef flat in 0-1m; juveniles and adults; cryptic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 47 cm TL; Indo-Pacific to the Americas; 11: 91-284 mm TL; resident; specimens at USNM, LACM and SIO (as *U. necturus*).

Uropterygius versutus Bussing, 1991

Uropterygius versutus Bussing, 1991: 97 (Costa Rica).

Only one subadult collected on reef flat in 0-1m; cryptic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 56 cm TL; TEP, from Gulf of California to Colombia, including the Galapagos; probable resident as numerous specimens were collected in the 1950s; specimens at LACM (as *U. schultzi*).

Ophichthidae - Snake Eels

Apterichtus equatorialis (Myers and Wade, 1941)

Caecula equatorialis Myers and Wade, 1941: 75 (Galapagos Islands).

Regularly collected with rotenone on sand patches in 10-20 m; juveniles and adults; cryptic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 30 cm TL ; TEP, from Mexico to the Galapagos Islands; 3: 190-296 mm TL; resident; specimens at USNM.

Myrichthys pantostigmius Jordan and McGregor, 1899

Myrichthys pantostigmius Jordan and McGregor, 1899: 2802 (Clarion Island, Revillagigedos)

Myrichthys pantostigmius.- McCosker and Rosenblatt, 1993: 164 (Clipperton Island)

Occasionally sighted in small depressions containing sand on outer slope, to 20 m depth, and on shallow reef flat; juveniles and adults; nocturnal benthic; solitary; carnivore: small benthic invertebrates; pelagic eggs; 50 cm TL; Clipperton and Revillagigedo Islands only; 3: 145-170 mm TL; resident; specimens at CAS, USNM, LACM, UCLA.

Phaenomonas pinnata Myers and Wade, 1941

Phaenomonas pinnata Myers and Wade, 1941

Not seen or collected by us, but collected on reef flat in the 1950s; lives in sandy habitats; nocturnal; cryptic; solitary; carnivore: benthic invertebrates;TEP, at scattered localities between the Gulf of California and the Galapagos; population status uncertain; specimens at LACM.

Chanidae - Milkfishes

Chanos chanos (Forsskål, 1775)

Mugil chanos Forsskål, 1775: 74 (Red Sea).

Rare, a single adult seen near surface over upper reef slope; forms aggregations; benthic feeding herbivore: algae and detritus; pelagic eggs; 160 cm FL; Indo-Pacific to the Americas; observed only; vagrant.

Antennariidae - Anglerfishes

Antennarius coccineus (Cuvier, 1831)

Antennarius coccineus Cuvier, *in* Lesson 1831: 143 (Mauritius)

Antennarius coccineus.- Pietsch and Grobecker 1987: 149 (Clipperton Island)

Not seen or collected by us, recorded from Clipperton by Pietsch and Grobecker (1987); cryptic, solitary carnivore: fishes; pelagic eggs; 9.1 cm SL; widespread in Indo-Pacific and TEP; probably resident as numerous specimens were collected from the reef flat in the 1950s; specimens at LACM, UCLA.

Antennarius sanguineus Gill, 1863

Antennarius sanguineus Gill, 1863b: 91 (Cabo San Lucas, Baja California).

Antennarius sanguineus.- Pietsch and Grobecker 1987: 158 (Clipperton Island).

Relatively common, several collected (mainly juveniles) at each rotenone station in 10-35 m; juveniles and adults; cryptic; solitary; carnivore: fishes; pelagic eggs; 7.5 cm SL; TEP, from Gulf of California to Chile; 11: 7-52 mm SL; resident; specimens at USNM, LACM, UCLA.

Antennatus strigatus Gill (1863)

Antennarius strigatus Gill, 1863: 92 (Cabo San Lucas, Baja California).

Antennatus strigatus.- Pietsch and Grobecker 1987: 190 (Clipperton Island)

Not seen or collected by us; numerous specimens collected on reef flat in the 1950s; cryptic, solitary carnivore: fishes; pelagic eggs; 8 cm SL; widespread in TEP; probable resident; specimens at CAS, UCLA, SIO, LACM.

Belonidae - Needlefishes

Tylosurus acus melanotus (Bleeker, 1851)

Belone melanotus Bleeker, 1851a: 94 (Java)

Tylosurus acus melanotus.- Fischer et al 1995: 925 (Clipperton Island)

Common on outer slope near surface during our visit, mainly on NE side of island; adults only; roving predator; solitary or in groups; carnivore: fishes; eggs attached to floating vegetation; 83cm SL; a circumtropical species with two subspecies, *T. acus pacificus* from TEP mainland, and *T. acus melanotus* from remainder of its range, including the Revillagigedo, Clipperton and Cocos islands in the TEP (Fischer 1995); resident; specimens at LACM (as *Belone persimilis*).

Exocoetidae - Flyingfishes

Cheilopogon heterurus hubbsi Parin, 1961

Cheilopogon heterurus hubbsi Parin, 1961: 85 ($24^0$58'N, $117^0$49'W)

One adult collected from deck of *Royal Star*; a warm temperate (Fischer et al 1995), oceanic surface dweller; solitary or in groups; planktivore; eggs attached to floating vegetation; 25 cm FL; eastern Pacific; 1: 22 cm FL; specimen at NMNH.

Cheilopogon spilonotopterus (Bleeker, 1866)

Exocoetus spilonotopterus Bleeker 1866: 113 (Indonesia)

Not seen or collected by us, occurrence at Clipperton is based on distribution map of Fischer et al (1995); oceanic surface dweller; solitary or in groups; planktivore; eggs attached to floating vegetation; Indo-Pacific to the Americas; 38 cm FL.

Fodiator acutus rostratus (Gunther, 1866)

Exocoetus rostratus Gunther 1866: 280 (Hawaiian Islands, but doubtful)

Fodiator acutus rostratus.- Fischer et al (1995): 1101 (Clipperton Island)

Not seen or collected by us, occurrence at Clipperton is based on distribution map of Fischer et al (1995); oceanic surface dweller; solitary or in groups; planktivore; eggs attached to floating vegetation; 19 cm FL; temperate and tropical eastern Pacific, California to Galapagos; another subspecies *F. acutus acutus* occurs in the tropical Atlantic.

Hemirhamphidae - Halfbeaks

Euleptorhamphus viridis (van Hasselt, 1823)

Hemirhamphus viridis Van Hasselt .1823: 131 (India)

Euleptorhamphus viridis.- Fischer et al (1995): 1180 (Clipperton Island)

Not seen or collected by us, collected at Clipperton in the 1950s; Indo-Pacific to the Americas; oceanic surface dweller; solitary or in groups; planktivore; eggs attached to floating vegetation; tropical and temperate waters of Indo-Pacific; 37 cm SL; specimens at SIO, LACM.

Oxyporhamphus micropterus (Valenciennes, 1847)

Exocoetus micropterus Valenciennes *in* Cuvier and Valenciennes 1847: 127 (King

George Sound, Western Australia)

Oxyporhamphus micropterus.- Fischer et al (1995): 1181 (Clipperton Island)

Not seen or collected by us, collected at Clipperton in the 1950s; oceanic surface dweller; solitary or in groups; planktivore; eggs attached to floating vegetation; 37 cm SL; circumtropical; specimen at LACM.

Holocentridae - Squirrelfishes

Myripristis berndti Jordan and Evermann, 1903

Myripristis berndti Jordan and Evermann, 1903: 170 (Hawaii).

Myripristis murdjan (non Forsskål).- Greenfield, 1965: 240 (Clipperton Island).

Abundant, numerous individuals seen on outer slope in caves and crevices between 15-40 m; small to large adults; nocturnal benthic; solitary or in groups; carnivore: large zooplankton (crustacean larvae, etc.); spawns pelagic eggs; 24 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM (as *M. murdjan*), LACM.

Myripristis clarionensis Gilbert, 1897

Myripristis clarionensis Gilbert, 1897: 441 (Clarion Island).

Myripristis clarionensis.- Greenfield, 1965: (Clipperton Island)

Common on outer slope in caves and crevices between 15-40 m; juveniles and adults; nocturnal benthic; solitary or in groups; carnivore: large zooplankton (crustacean larvae, etc.); pelagic eggs; 18 cm SL; TEP, from Revillagigedo Islands and Clipperton only; 5: 70-110 mm SL; underwater photographs; resident population; specimens at USNM, LACM.

Myripristis gildi Greenfield, 1965

Myripristis gildi Greenfield, 1965: 241 (Clipperton Island).

Not seen or collected by us; nocturnal benthic; solitary or in groups; carnivore: large zooplankton (crustacean larvae, etc.); pelagic eggs; 25 cm SL; endemic to Clipperton Island; although we actively searched for this species we may not have recorded it because its close resemblance to *M. berntdi* (which greatly outnumbered *M.gildi* in collections made in the 1950s); resident on the basis of its restriction to Clipperton; specimens at UCLA, USNM, LACM.

There are four members of this genus in the TEP (Allen and Robertson 1994, Fischer et al 1995) *M. berntdi*, *M. clarionensis*, *M. gildi*, and *M. leiognathus*. Greenfield's (1965) non-cladistic analysis indicates that, among those species, *M. gildi* is most closely related to *M. berntdi*, and he suggested that *M. gildi* is derived from an ancestor of *M. berntdi* that previously invaded the TEP. However, since *M. berntdi* has a number of relatives in eastern Oceania the issue of the phylogenetic relationships and origins of *M. gildi* remains to be resolved through cladistic analysis of the Pacific and neotropical members of the genus.

Plectrypops lima (Valenciennes, 1831)

Myripristis lima Valenciennes, *in* Cuvier and Valenciennes, 1831: 493 (Mauritius).

Rare, a single adult collected with rotenone in 30 m; nocturnal benthic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 15 cm SL; Indo-Pacific to the Americas; 1: 63 mm SL; population status uncertain, as it normally inhabits deep water (see Randall *et al* 1985); specimen at USNM.

Sargocentron suborbitalis (Gill, 1864)

Holocentrus suborbitalis Gill, 1863a: 86 (Cabo San Lucas, Baja California).

Sargocentron suborbitalis.- Fischer et al 1995: 1185 (Clipperton Island)

Fewer than five adults seen by us at ~20m depth, and a dozen or so recently recruited juveniles collected by rotenone on the reef flat; numerous specimens collected with rotenone on the reef flat and offshore at the surface in the 1950s; nocturnal benthic; solitary or in groups; carnivore: crustaceans, worms, small fishes; pelagic eggs; 22 cm SL; TEP from Gulf of California to Ecuador, also Galapagos Islands; underwater photographs; resident; specimens at

USNM, LACM.

Aulostomidae - Trumpetfishes

Aulostomus chinensis (Linnaeus, 1766)

Fistularia chinensis Linnaeus, 1766: 515 (East Indies).

Aulostomus chinensis.- Rosenblatt et al 1972: 14 (Clipperton Island).

Both yellow- and green-phase fish relatively common, several seen on every dive in 5-60 m; mainly adults and several juveniles; diurnal benthic; solitary; carnivore: fishes, crustaceans; pelagic eggs; 62 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM, LACM.

Fistulariidae - Flutemouths

Fistularia commersonii Rüppell, 1838

Fistularia commersonii Rüppell, 1838: 142 (Red Sea).

Several adults seen by us in 10-20 m on NE side of island; specimens were collected in the 1950s; roving predator; solitary or in groups; carnivore: fishes, crustaceans; pelagic eggs; 11 cm SL; Indo-Pacific to the Americas; 1: 145 mm SL; probable resident; specimens - LACM, SIO.

Syngnathidae - Pipefishes and Seahorses

Doryrhamphus excisus excisus Kaup, 1856

Doryrhamphus excisus Kaup, 1856: 54 (no locality given).

Doryrhamphus melanopleura.- Fritzsche, 1980: 189 (Clipperton Island).

Commonly collected in most rotenone stations in 15-35 m; juveniles and adults; cryptic; solitary or in pairs; carnivore: small benthic and planktonic crustaceans; male broods eggs in pouch or on ventral surface; 4.1 cm SL; Indo-Pacific to the Americas; 12: 22-41 mm SL; resident population; specimens at USNM. There are two subspecies of this species in the eastern Pacific (Dawson 1985), *D. excisus paulus*, which is endemic to the Revillagigedo Islands, and *D. excisus excisus*, which occurs widely throughout the Indo-Pacific, and from Mexico to the Galapagos in the eastern Pacific (Fritzsche 1980).

Scorpaenidae - Scorpionfishes

Pontinus vaughni Barnhart and Hubbs, 1946

Pontinus vaughni Barnhart and Hubbs, 1946: 371 (Baja California)

Pontinus vaughni.- Fischer et al 1995: 1552 (Clipperton Island)

Not seen or collected by us; cryptic, solitary; carnivore: fishes and crustaceans; pelagic eggs; 45 cm SL; an eastern Pacific species that ranges from central to lower Baja California and has been collected at the Revillagigedos and Clipperton; probably a vagrant as only one specimen is known from Clipperton and it probably is a warm temperate species; however, because other members of the genus live in deep water (Fischer et al 1995) it is possible that it is a resident below 50 m; specimen at SIO.

Scorpaenodes xyris (Jordan and Gilbert, 1882)

Sebastopsis xyris Jordan and Gilbert, 1882a: 369 (Cape San Lucas, Baja California).

A secretive, rarely seen species, several specimens collected with rotenone on rocky slopes to depths of 35 m, numerous specimens collected in the 1950s; juveniles and adults; nocturnal benthic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 7 cm SL; TEP, from Southern California to Peru, also Galapagos Islands; 20: 13-69; probable resident; specimens at USNM, SIO, LACM.

Serranidae - Groupers

Dermatolepis dermatolepis (Boulenger, 1895)

Epinephelus dermatolepis Boulenger, 1895: 256 (Cape San Lucas, Baja California).

Epinephelus dermatolepis.- Smith 1971: 162 (Clipperton Island).

Abundant on outer slope in 10-40 m; juveniles (associated with *Diadema*) and adults; diurnal benthic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 80 cm SL; TEP,

from Baja California to Ecuador, also Galapagos Islands; underwater photographs; resident; specimens at SIO, LACM, UCLA.

Epinephelus sp.

Epinephelus labriformis.- Snodgrass and Heller, 1905: 367 (Clipperton Island).

Abundant on outer slope to 60 m depth; juveniles and adults; diurnal benthic; solitary; carnivore: fishes, crustaceans; pelagic eggs; 45 cm SL; a Clipperton endemic that we will soon describe, mainly using specimens collected in the 1950s, this species was previously confused with *E. labriformis* (see Smith 1971, Allen and Robertson 1994, Fischer et al 1995, Robertson and Allen 1996); 2: 50-54 mm SL; underwater photographs; resident; specimens at USNM, UCLA, LACM, SIO.

Smith (1971) placed *E. labriformis*, which occurs from the Gulf of California to Peru, and the Revillagigedo, Cocos and Galapagos Islands, in a group of three species that includes two Atlantic species, *E. guaza*, from Brazil and the northeast Atlantic, and *E. drummondhayi*, from Florida and Bermuda in the northwest Atlantic. Based on close similarities in their morphologies *E. labriformis* evidently is the sister species of *Epinephelus sp.*

Paranthias colonus (Valenciennes, 1855)

Serranus colonus Valenciennes, 1855: 300, pl. 2, fig. 1 (Galapagos Islands).

Paranthias furcifer.- Smith 1971: 89 (Clipperton Island).

Abundant on outer slope to 40 m depth; mainly small to large adults, but juveniles also present; diurnal midwater; forms aggregations; planktivore; zooplankton; pelagic eggs; 30 cm SL; TEP, from Gulf of California to Peru, also Galapagos Islands; 2: 75-76 mm SL; underwater photographs; resident; specimens at SIO, LACM, UCLA.

Pseudogramma axelrodi Allen and Robertson, 1995

Pseudogramma axelrodi Allen and Robertson, 1995a: 72 (Clipperton Island).

Occasional, a few collected at each rotenone station in 15-30m; juveniles and adults; cryptic; solitary; carnivore: fishes and crustaceans; pelagic eggs; 7 cm SL; endemic to Clipperton Island; 16: 13-61 mm SL, including types, which are deposited at WAM and USNM; underwater photographs; resident; specimens at USNM, LACM (as *Rhegma thaumasium*).

Including *P. axelrodi* there are six known species of *Pseudogramma* (Allen and Robertson 1995). *P. axelrodi* belongs to a complex of four species (characterised by the presence of a dermal flap on the upper edge of the eye) that also includes the widespread TEP species *P. thaumasium*, and *P. bermudensis* and *P. gregoryi* from the tropical western Atlantic. It seems likely that *P. axelrodi* and *P. thaumasium* are sister species, since they are most alike in general appearance and fin counts (Allen and Robertson 1995). However, further analysis is needed to test that phylogenetic hypothesis.

Rypticus bicolor Valenciennes, 1846

Rypticus bicolor Valenciennes, 1846: 307, pl.1, fig. 2 (Galapagos Islands).

Occasional, a few collected at each rotenone station and sometimes sighted in crevices between 15-30m; juveniles and adults; cryptic; solitary; carnivore: fishes and small crustaceans; pelagic eggs; 10 cm SL; TEP, from Baja California to Peru, also Galapagos Islands; 15: 32-123 mm SL; underwater photographs; resident; specimens at USNM, LACM.

Kuhliidae - Flagtails

Kuhlia mugil (Schneider, 1801)

Sciaena mugil Schneider *in* Boch and Schneider 1801: 541 (Tahiti)

Not seen or collected by us, however numerous specimens collected on reef flat in 1950s; diurnal, schools inshore in surf zone; carnivore: free swimming crustaceans and small fishes; pelagic eggs; Indo-Pacific to the Americas; possible resident on the basis of the

numbers of fish collected; specimens at SIO (as *K. arge*), LACM (as *K. taeniura*).

Apogonidae - Cardinalfishes

Apogon atricaudus Jordan and McGregor, 1898

Apogon atricaudus Jordan and McGregor, 1898: 277 (Revillagigedo Islands).

Common on outer slope in 15-40 m; adults only; nocturnal benthic; forms aggregations; carnivore: crabs, shrimps, worms, fishes; male broods eggs in mouth; 6.5 cm SL; TEP, at Clipperton Island, Revillagigedo Islands and, as a vagrant, at Baja California; 13: 32-77 mm SL; underwater photographs; resident; specimens at LACM, USNM.

Echineidae - Remoras

Remora remora (Linnaeus, 1758)

Echeneis remora Linnaeus (1758): 260 (Indian Seas).

Not seen or collected by us; several specimens collected in 1950s; oceanic, associated with sharks; solitary; carnivore: fish scraps, ectoparasites, various small prey; pelagic eggs; 62 cm TL; circumtropical; specimens at LACM.

Carangidae - Jacks

Carangoides orthogrammus (Jordan and Gilbert, 1881)

Caranx orthogrammus Jordan and Gilbert, 1881a: 226 (Clarion Island).

Rare, a few adults seen in midwater on outer slope in 15-25m; roving predator; solitary or in groups; carnivore: fishes, crustaceans; pelagic eggs; 70 cm FL; Indo-Pacific to the Americas; underwater photographs; probable vagrant.

Caranx caballus Günther, 1869

Caranx caballus Günther, 1869: 431 (Panama).

Rare, several adults seen in midwater at 20m on NE side of island; roving predator; solitary or in groups; carnivore: fishes, crabs, lobsters; pelagic eggs; 65 cm SL; TEP, from Southern California to Peru, also Galapagos Islands; observed only; probable vagrant.

Caranx lugubris Poey, 1860

Caranx lugubris Poey, 1860: 222 (Cuba).

Common on outer slope in 15-60m; inshore-offshore; adults only; roving predator; solitary or in groups; carnivore: fishes, crabs, lobsters; spawns pelagic eggs; 70 cm SL; Indo-Pacific to the Americas; underwater photographs; resident population; specimens at LACM.

Caranx melampygus Cuvier, 1833

Caranx melampygus Cuvier, *in* Cuvier and Valenciennes, 1833: 116 (Waigeo, Buru, Vanicolo, Mauritius).

Caranx melampygus.- Allen and Robertson, 1994: 303 (Clipperton Island).

Abundant on outer slope to a depth of 40 m; inshore-offshore; adults only; roving predator; solitary or in groups; carnivore: fishes, crabs, lobsters; pelagic eggs; 80 cm SL; Indo-Pacific to the Americas; underwater photographs; resident population; specimens at LACM.

Caranx sexfasciatus Quoy and Gaimard, 1825

Caranx sexfasciatus Quoy and Gaimard, 1825: 358 (Waigeo, Indonesia).

Caranx sexfasciatus.- Allen and Robertson, 1994: 303 (Clipperton Island).

Common on outer slope, especially on NE side of island in 15-25 m; inshore-offshore; adults only; roving predator; solitary or in groups; carnivore: fishes, crabs, lobsters; pelagic eggs; 85 cm SL; Indo-Pacific to the Americas; underwater photographs; resident population; specimens at LACM (as *C. marginatus*).

Decapterus macarellus (Cuvier, *in* Cuvier and Valenciennes 1833)

Caranx macarellus Cuvier and Valenciennes 1833: 40 (Martinique)

Not seen or collected by us; specimens collected in 1950s; offshore pelagic; roving predator; forms aggregations; carnivore: fishes, crustaceans; pelagic eggs; 32 cm TL; circumtropical; specimens at LACM.

Elegatis bipinnulata (Quoy and Gaimard, 1825)

Seriola bipinnulata Quoy and Gaimard, 1825: 363 (Keeling Island, New Guinea).

Commonly seen in midwater on outer slope in 10-60 m; adults only; inshore-offshore pelagic roving predator; forms aggregations; carnivore: fishes, pelagic crustaceans; spawns pelagic eggs; 115 cm SL; circumtropical; underwater photographs; resident population; specimens at LACM.

Naucrates ductor (Linnaeus, 1758)

Gasterosteus ductor Linnaeus, 1758: 295 (no locality given).

Rare, several subadults seen with *Carcharinus falciformis*; offshore pelagic species; roving predator, swims with sharks and other large predators; solitary or in groups; carnivore: fish scraps; pelagic eggs; 60 cm SL; circumtropical; observed only; specimens at LACM.

Selar crumenophthalmus (Bloch, 1793)

Scomber crumenophthalmus Bloch 1793: 77 (Acara, Guinea)

Not seen or collected by us; specimens collected in the 1950s; coastal pelagic; roving predator; forms aggregations; carnivore: fishes, crustaceans; pelagic eggs; 60 cm SL; circumtropical; specimens at LACM.

Seriola rivoliana Valenciennes, 1833

Seriola rivoliana Valenciennes *in* Cuvier and Valenciennes 1833: 207 (Greek Archipelago)

Not seen or collected by us; specimens collected in the 1950s; inshore-offshore pelagic-demersal; roving predator; solitary or small groups; carnivore: fishes, crustaceans; pelagic eggs; 103 cm FL; circumtropical; specimens at LACM (as *S. colburni*).

Trachinotus stilbe (Jordan and McGregor, 1898)

Zalocys stilbe Jordan and McGregor, 1898: 277 (Clarion Island).

Trachynotus stilbe.- Fischer et al 1995: 983 (Clipperton Island)

Occasional, a few schools containing about 10-50 adults seen on NE side of island to 15 m depth; adults only; specimens collected in the 1950s; roving predator; forms aggregations; carnivore: fishes, large zooplankton; spawns pelagic eggs; 35 cm SL; throughout TEP, although mainly around offshore islands; underwater photographs; resident; specimens at LACM.

Coryphaenidae - dolphinfishes

Coryphaena equiselis Linnaeus, 1758

Coryphaena equiselis Linnaeus 1758: 261 (no locality)

Not seen or collected by us, specimens collected in 1950s; offshore pelagic; roving predator; solitary or in groups; carnivore: fishes, squid, zooplankton; pelagic eggs; 75 cm FL; circumtropical; specimens at LACM.

Lutjanidae - Snappers

Lutjanus viridis (Valenciennes, 1855)

Diacope viridis Valenciennes, 1855: 303, pl.1, fig. 2 (Galapagos Islands).

Lutjanus viridis.- Allen and Robertson, 1994: 303 (Clipperton Island).

Common on outer slope in 15-60 m, usually seen in small groups, but a huge resting aggregation containing several hundred individuals sighted on one occasion; adults only; diurnal/nocturnal, benthic; forms aggregations; carnivore: fishes, crustaceans; pelagic eggs; 25 cm SL; TEP, from Baja California to Ecuador, also Galapagos Islands; underwater photographs; resident population; specimens at USNM.

Haemulidae - Grunts

Orthopristis cantharinus (Jenyns, 1842)
Pristopoma cantharinus Jenyns, 1842: 49 (Galapagos)

Not seen or collected by us; one specimen collected in the 1950s, which was apparently lost, as it is not longer in UCLA collection (D. Buth personal communication 1996); sandy bottoms; diurnal; forms aggregations; carnivore: crustaceans and molluscs; 38 cm SL; widespread in TEP; presumed vagrant; specimen formerly at UCLA.

Mullidae - Goatfishes

Mulloidichthys dentatus (Gill, 1862)
Upeneus dentatus Gill, 1862c: 256 (Cape San Lucas, Baja California).
Mulloidichthys dentatus.- Allen and Robertson, 1994: 303 (Clipperton Island).

Common on outer slope in 15-60 m, usually seen in small groups of about one dozen individuals, but several resting schools of about 50 individuals sighted; mainly medium to large adults, but a few juveniles seen; carnivore: sand-dwelling invertebrates; spawns pelagic eggs; 26 cm SL; TEP, from Gulf of California to Peru, also Galapagos Islands; underwater photographs; resident; specimens at NMNH, LACM (as *Upeneus grammorhynchus*).

Kyphosidae - Sea Chubs

Kyphosus analogus (Gill, 1862)
Pimelepterus analogus Gill, 1862b: 245 (Cape San Lucas, Baja California).

Occasionally sighted on outer slope in 15-30 m; medium to large adults only; diurnal midwater; forms aggregations; herbivore: algae; pelagic eggs; 32 cm SL; TEP, from Southern California to Peru, also Galapagos Islands; underwater photographs; resident population.

Kyphosus elegans (Peters, 1869)
Pimelepterus elegans Peters, 1869: 707 (Mazatlan, Mexico).
Kyphosus elegans.- Allen and Robertson, 1994: 303 (Clipperton Island).

Common on outer slope in 8-30 m; medium to large adults only; diurnal midwater; forms aggregations; herbivore: algae; pelagic eggs; 32 cm SL; TEP, from Gulf of California to Peru, also Galapagos Islands; underwater photographs; resident population; specimens - LACM.

Sectator ocyurus (Jordan and Gilbert, 1881)
Pimelepterus ocyurus Jordan and Gilbert, 1881b: 327 (Panama).

Rare, about 10 sighted on NE side to depths of 40 m; adults only; diurnal midwater; solitary or in groups; omnivore: algae and zooplankton; pelagic eggs; 50 cm SL; widespread in TEP; also occurs as a vagrant in the Society Islands, Hawaii (repeatedly) and as far as Japan (Randall 1961, 1985, J.E. Randall, personal communication 1996); underwater photographs; probable vagrant.

Chaetodontidae - Butterflyfishes

Forcipiger flavissimus Jordan and McGregor, 1898
Forcipiger flavissimus Jordan and McGregor, *in* Jordan and Evermann, 1898: 1671 (Clarion Island).

Common on outer slope in 15-40 m; small adults only; diurnal benthic; solitary or in pairs; carnivore: crustaceans and other benthic invertebrates; spawns pelagic eggs; 17.5 cm SL; Indo-Pacific to the Americas; underwater photographs; resident population; specimens at USNM, LACM.

Johnrandallia nigrirostris (Gill, 1862)
Sarothrodus nigrirostris Gill, 1862b: 243 (Cape San Lucas, Baja California).

Common on outer slope in 10-40 m; small adults only; diurnal benthic; solitary or in groups; omnivore: algae, molluscs, and crustaceans; pelagic eggs; 16 cm SL; TEP, from Baja California to Panama, also Galapagos Islands; underwater photographs; resident population; specimens at NMNH, LACM.

Pomacanthidae - Angelfishes

Holacanthus clarionensis Gilbert, 1890

Holacanthus clarionensis Gilbert, 1890: 72 (Revillagigedo Islands).

Rare, several large adults of this unmistakeable species sighted on NE side of island in 20-30 m; diurnal benthic; solitary or in groups; omnivore: algae, sponges, tunicates; spawns pelagic eggs; 20 cm SL; TEP, abundant endemic resident of Revillagigedo Islands, with vagrants not uncommon at southern tip of Baja California; vagrant.

Holacanthus limbaughi Baldwin, 1963

Holacanthus limbaughi Baldwin, 1963: 3 (Clipperton Island).

Abundant on outer slope in 10-60 m; juveniles and adults; diurnal benthic; solitary or in groups; omnivore: algae, sponges, tunicates; spawns pelagic eggs; 25 cm SL; endemic to Clipperton Island; underwater photographs; resident population; specimens at USNM, UCLA, LACM, SIO.

The genus *Holacanthus* is restricted to the neotropics and west Africa (R. Pyle, Bishop Museum, personal communication). It includes three species from the TEP, *H. clarionensis* (endemic to the Revillagigedos), *H. limbaughi*, and *H. passer* (widespread in the region), and three from the tropical west Atlantic - *H. bermudensis*, *H. ciliaris* and *H. tricolor*. While fin-ray counts and the juvenile color patterns of the three TEP species are similar (Baldwin 1963), the adult color pattern of *H. limbaughi* most closely resembles that of *H. passer*. Although a comprehensive analysis of relationships is lacking it appears that the sister species of *H. limbaughi* likely is *H. passer*.

Pomacentridae - Damselfishes

Chromis alta Greenfield and Woods, 1980

Chromis alta Greenfield and Woods, 1980: 630 (Baja California).

Common on NE side of island in 40-60m; adults only observed; diurnal benthic; solitary or in groups; planktivore; copepods, etc.; parental care of demersal eggs; 10 cm SL; TEP, mainly offshore islands; photographed; resident; 3: 54-81 mm SL; specimens at USNM. This species is variable in color according to geographic locality. Clipperton adults are entirely dark brown in life in contrast to the light brown individuals from the Galapagos illustrated by Allen and Robertson (1994). Adults from Clarion Island have a pale stripe at the base of the dorsal fin, similar to that of the juvenile from Galapagos illustrated by Allen and Robertson (1994).

Stegastes baldwini Allen and Woods, 1980

Stegastes baldwini Allen and Woods, 1980: 183 (Clipperton Island).

Abundant on outer slope to depths of 60 m; diurnal benthic; juveniles (including new recruits) and adults; solitary or in groups; herbivore: algae; parental care of demersal eggs (presumed males, were often observed guarding benthic eggs during our visit); 9 cm SL; endemic to Clipperton Island; 3: 19-78; underwater photographs; resident; specimens at USNM, SIO, UCLA, LACM.

There are six TEP species in this genus - *S. acapulcoensis* (Mexico to Panama), *S. arcifrons* (Galapagos and Malpelo), *S. baldwini* (Clipperton), *S. leucorus beebei* (Galapagos), *S. l. leucorus* (the Revillagigedos), *S. rectifraenum* (Mexico), and *S. redemptus* (Revillagigedos).

Allen and Woods (1980) proposed that *S. baldwini* is most closely related to *S. leucorus*. An analysis of similarities in the mitochondrial DNA sequences of all TEP species (H.A. Lessios, D.R. Robertson and B. Kessing, unpublished data) supports that hypothesis and indicates that the sister species of *S. baldwini* is *S. leucorus beebei*.

Cirrhitidae - Hawkfishes

Cirrhitichthys oxycephalus (Bleeker, 1855)

Cirrhites oxycephalus Bleeker, 1855: 408 (Ambon, Indonesia).

Common on outer slope in 3-30 m, usually associated with *Pocillopora* coral heads; juveniles and adults; diurnal benthic; solitary; carnivore: benthic crustaceans and fishes; spawns pelagic eggs; 7 cm SL; Indo-Pacific to the Americas; 4: 27-60 mm SL; underwater photographs; resident; specimens at NMNH, LACM (as *C. corallicola*), SIO.

Cirrhitus rivulatus Valenciennes, 1855

Cirrhitus rivulatus Valenciennes, 1855: 309 (Galapagos Islands).

Common on outer slope in 10-25 m; small to large adults only; diurnal benthic; solitary; carnivore: crabs, sea urchins, brittle stars, fishes; pelagic eggs; 45 cm SL, the largest member of the family; TEP, from Gulf of California to Colombia, also Galapagos Islands; underwater photographs; resident; specimens at SIO, LACM.

Mugilidae - Mullets

Chaenomugil proboscidens (Gunther, 1861)

Mugil proboscidens Gunther 1861: 459 (Nicaragua)

Not seen or collected by us; one specimen collected in the 1950s; schools in inshore shallow habitats; herbivore: algae and detritus; pelagic eggs; 22 cm SL; TEP, from Mexico to Panama; apparent vagrant; specimen at UCLA.

Labridae - Wrasses

Bodianus diplotaenia (Gill, 1862)

Harpe diplotaenia Gill, 1862a: 140 (Cabo San Lucas, Baja California).

Bodianus diplotaenius.- Snodgrass and Heller, 1905: 391 (Clipperton Island).

Common on outer slope in 10-60 m; mainly medium to large adults, but a few juveniles seen; diurnal benthic; solitary; carnivore: sea urchins, crustaceans and other small benthic invertebrates; pelagic eggs; 70 cm SL; TEP, from Baja California to northern Chile, also Galapagos Islands; underwater photographs; resident; specimens at USNM, SIO. LACM.

Novaculichthys taeniourus (Lacepède, 1801)

Labrus taeniourus Lacepède, 1801: 488 and 518 (Indian Ocean).

Occasional, sighted in rubble-filled depressions on outer slope at 10-20m depth; juveniles and adults; diurnal benthic; solitary or in pairs; carnivore: gastropods, bivalves, echinoderms, worms, etc.; pelagic eggs; 27 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM, LACM.

Stethojulis bandanensis (Bleeker, 1851)

Julis bandanensis Bleeker, 1851b: 254 (Indonesia).

Common on outer slope to 20 m depth, juveniles common in rotenone station on shallow reef flat; juveniles and adults; diurnal benthic; solitary or in groups; carnivore: small benthic invertebrates; pelagic eggs; 13 cm SL; Western and Central Pacific; underwater photographs; resident; specimens at USNM.

Thalassoma grammaticum Gilbert, 1890

Thalassoma grammaticum Gilbert, 1890: 68 (Socorro and Clarion Islands).

Thalassoma grammaticum.- Allen and Robertson, 1994: 303 (Clipperton Island).

Common on outer slope to 30m depth, juveniles confined to shallow (0-7 m) water; juveniles (including new recruits) and adults; diurnal benthic; solitary; carnivore: benthic crustaceans; pelagic eggs, spawning observed several times in mid afternoon; 20 cm SL; TEP, from Gulf of California to Panama, also Galapagos Islands; underwater photographs; spawning observed by us at Clipperton Island; resident; see Randall (1995) for clarification of the taxonomic status of *T. grammaticum* and other TEP species of *Thalassoma*; specimens at USNM.

Thalassoma purpureum (Forsskål, 1775)

Scarus purpureum Forsskål, 1775: (Red Sea).

Thalassoma purpureum.- Randall, 1995: 675 (Clipperton Island).

Occasionally but regularly sighted in areas exposed to strong surge on upper part of outer slope and on shallow reef flat, depth range 2-20 m; juveniles and adults; diurnal benthic; solitary or in groups; carnivore: benthic crustaceans; pelagic eggs; 37 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM.. Randall (1995) reported sighting this species at Darwin Island, in the Galapagos. One of us (DRR) sighted it at Isabela Island in the Galapagos in 1990, and at Cocos Island, off the coast of Costa Rica, in 1992. However, Clipperton is the only TEP locality at which this species has yet been recorded in any abundance. Fish were seen spawning on the middle of the upper reef slope at 10m depth on several occasions during our visit.

Thalassoma robertsoni Allen, 1995

Thalassoma robertsoni Allen, 1995a: 75 (Clipperton Island).

Thalassoma sp..- Allen and Robertson, 1994: 207 (Clipperton Island).

Abundant on outer slope to 50 m depth; perhaps the most abundant fish at Clipperton; diurnal benthic; forms aggregations while feeding in midwater; juveniles (including abundant new recruits) and adults; planktivore; mainly crustacean zooplankton; pelagic eggs; 9 cm SL; TEP, endemic to Clipperton; 29: 15-77 mm SL, including type specimens at USNM and WAM; underwater photographs; resident; specimens at USNM. We frequently saw this species spawning at midafternoon in 10-20m depth on the reef slope.

Strong resemblances in the structure of their color patterns (see Allen 1995) indicate that *T. robertsoni* belongs to a group of three Pacific species of this genus - *T. amblycephalum*, which is widespread in the Indo-Pacific, and *T. lucasanum*, which occurs throughout the TEP except at Clipperton. Similarities in their mitochondrial DNA (H.A. Lessios, D.R Robertson, B. Kessing, unpublished data) indicate that those three species are indeed very closely related and that the sister species of *T. robertsoni* is *T. lucasanum*.

Thalassoma virens (Gilbert, 1890)

Thalassoma virens Gilbert, 1890: 68 (Socorro Island).

Thalassoma virens.- Allen and Robertson, 1994: 207(Clipperton Island).

Occasionally sighted in areas exposed to strong surge on upper part of outer slope in 2-7 m; small to medium adults only; diurnal benthic; solitary; carnivore: benthic crustaceans; pelagic eggs; 25 cm SL; TEP, Revillagigedo Islands and Clipperton Island; underwater photographs; resident.

Xyrichtys wellingtoni Allen and Robertson, 1995

Xyrichtys wellingtoni Allen and Robertson, 1995b: 80 (Clipperton Island).

Rare, about 10-15 individuals sighted on the only large sand patch on the upper reef slope on the NW side of the island, at 15m; juveniles and adults; diurnal benthic; solitary; carnivore: small benthic and planktonic invertebrates; pelagic eggs; 6 cm SL; TEP, endemic to Clipperton; 6: 19-65 mm SL, including type specimens at USNM and WAM; underwater photographs; areas of deep sand on the "60 m terrace" presumably support a resident population; specimens at USNM.

Five species of this genus are presently known from the TEP -*X. pavo* (Indo-Pacific to the Americas), *X. perlas* (known only from Panama - see Wellington et al 1995), *X. victori* (Galapagos only - Wellington 1992), and *X. wellingtoni* (Clipperton only). In general appearance and color pattern *X. wellingtoni* most closely resembles *X. perlas* and they may be sister species. However, the three TEP members of this genus were discovered only recently, and the fish fauna of the Revillagigedos has not been thoroughly documented.

Scaridae - Parrotfishes

Scarus rubroviolaceus Bleeker, 1847

Scarus rubroviolaceus Bleeker, 1847: 162 (Java).

Occasionally sighted on outer slope in 10-60 m; mainly adults, but a few large juveniles seen; diurnal benthic; solitary or in groups; herbivore: algae; pelagic eggs; 48 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM.

Blenniidae - Blennies

Entomacrodus chiostictus (Jordan and Gilbert, 1882)

Salarias chiostictus Jordan and Gilbert, 1882c: 363 (Mazatlan, Mexico).

Entomacrodus chiostictus.- Springer 1967: 108 (Clipperton Island).

A few adults collected with rotenone on reef flat next to beach; intertidal and shallow reefs; diurnal benthic; solitary; herbivore: algae; parental care of demersal eggs; 5.5 cm SL; TEP, from Gulf of California to Panama and offshore islands; 3: 37-50 mm SL; probable resident as many specimens were collected in the 1950s; specimens at USNM, LACM, SIO.

Springer (1967) notes that, morphologically the Clipperton form is more closely allied to the Revillagigedos form than the mainland one, which ranges from Mexico to Peru.

Ophioblennius steindachneri clippertonensis Springer, 1962

Ophioblennius steindachneri Jordan and Evermann, 1898: 2401 (Tres Marias Islands, Mexico).

Ophioblennius steindachneri clippertonensis Springer 1962: 426 (Clipperton Island)

Common on outer slope to 40 m depth, also present on reef flat; mainly small adults, but a few large adults and new recruits seen; diurnal benthic; solitary; herbivore: algae; male parental care of demersal eggs; resident; endemic to Clipperton: 20 cm SL; 4: 48-100 mm SL; males often seen guarding clutches of benthic eggs during our visit; specimens at USNM, UCLA, LACM, SIO.

Ophioblennius is restricted to the TEP, and the east and west Atlantic (Springer 1962). *O. steindachneri*, the only species in the TEP, has two subspecies - *O. s. clippertonensis*, which is endemic to Clipperton, and *O. s. steindachneri*, which occurs in the remainder of the TEP, from the Gulf of California to Peru

Gobiidae - Gobies

Bathygobius arundelii (Garman, 1899)

Gobius arundelii Garman, 1899: 63 (Clipperton Island).

Mapo soporator.- Snodgrass and Heller 1905: 416 (Clipperton Island).

Common on reef flat in 0-1 m; juveniles and adults; diurnal benthic; solitary or in groups; omnivore: algae and benthic invertebrates; parental care of demersal eggs; 9 cm SL; TEP, endemic to Clipperton; 9: 2.8-6 cm SL; resident; specimens at USNM, SIO, LACM.

We provisionally recognize the Clipperton populations as a distinct species (see also Fischer et al 1995). However, there is need for revison of TEP *Bathygobius*, which include five named species - *B. andrei* (Costa Rica to Ecuador), *B. arundelii* (Clipperton), *B. lineatus* (Galapagos and Peru), *B. longipinnis* (Revillagigedos) and *B. ramosus* (Baja California to Peru).

Zanclidae - Moorish Idols

Zanclus cornutus Linnaeus, 1758

Zanclus cornutus Linnaeus, 1758: 273 (Indies).

Common on outer slope in 1-60 m, with large adults concentrated between 5-12m; mainly small to medium-sized adults; diurnal benthic; solitary or in groups; omnivore: sponges, algae, etc.; pelagic eggs; 14 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM, LACM.

Acanthuridae - Surgeonfishes

Acanthurus achilles Shaw, 1803

Acanthurus achilles Shaw, 1803: 383 (No locality)

Not seen or collected by us; known from a single pelagic juvenile (58mm SL) collected at a night light on a Tuna boat near Clipperton in 1969. The late-stage pelagic juvenile of this species is characterised by its large size and the presence of dark spots on the body (Randall 1956). Those characteristics were used by R Feeney of LACM (personal communication 1996) to confirm the identity of that specimen; surge zone; diurnal, benthic; solitary or in groups; herbivore: algae; pelagic eggs; 20 cm SL; central Pacific; one specimen at LACM (# 34354).

Acanthurus nigricans (Linnaeus, 1758)

Chaetodon nigricans Linnaeus, 1758: 274 (Red Sea).

Hepatus aliala.- Snodgrass and Heller, 1905: 403 (Clipperton Island).

Abundant on outer slope in 5-40 m; juveniles and adults; diurnal benthic; solitary or in groups; herbivore: algae; pelagic eggs; 16 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM.

Acanthurus triostegus triostegus (Linnaeus, 1758)

Chaetodon triostegus Linnaeus, 1758: 274 (Indies).

Acanthurus triostegus.- Schmidt and Schultz 1940: 8 (Clipperton Island)

Abundant on upper edge of outer slope to 10 m depth, new recruits common on reef flat; juveniles and adults; diurnal benthic; forms aggregations; herbivore: algae; pelagic eggs; 20.5 cm SL; Indo-Pacific to the Americas; represented in the TEP by the subspecies *A. triostegus triostegus*, which occurs widely in the Indo-Pacific (except for the Marquesas, and the Hawaiian region, each of which has its own subspecies - Randall 1956); underwater photographs; resident; specimens at USNM, LACM, SIO.

Acanthurus xanthopterus Valenciennes, 1835

Acanthurus xanthopterus Valenciennes, *in* Cuvier and Valenciennes 1835: 215 (Seychelles).

Rare, a few adults sighted on outer slope at depth of 20 m; diurnal benthic; solitary or in groups; herbivore: algae, diatoms, detritus, hydroids, etc.; pelagic eggs; 42.5 cm SL, the largest member in the genus; Indo-Pacific to the Americas; observed only; population status uncertain - occurs elsewhere to 90m (Randall 1985a) and may have been more common on the "60m terrace".

Ctenochaetus marginatus (Valenciennes, 1835)

Acanthurus marginatus Valenciennes, *in* Cuvier and Valenciennes, 1835: 221 (Caroline Islands).

Ctenochaetus marginatus.- Allen and Robertson, 1994: 303 (Clipperton Island).

Abundant on outer slope to 40 m depth, but large adults concentrated in surge zone and upper reef slope to 10m depth; juveniles (including new recruits) and adults; diurnal benthic; solitary or in groups; herbivore: algae and detritus; pelagic eggs; 18 cm SL; scattered localities in the central Pacific including the Mortlock Group (Caroline Islands), Kiribati, the Phoenix Islands, and the Marquesas, and, in the TEP, from Cocos Island (where it is common), Gulf of Chiriqui (Panama), and Clipperton Island; underwater photographs; resident; specimens at LACM.

Naso annulatus (Quoy and Gaimard, 1825)

Priodon annulatus Quoy and Gaimard, 1825: 377 (Timor).

Rare, two large adults sighted on NE side of island in 15-30m; diurnal midwater; solitary or in groups; planktivore; zooplankton; pelagic eggs; 85 cm SL; Indo-west Pacific; observed only; vagrant; new record for the TEP.

Naso hexacanthus (Bleeker, 1855)

Priodon hexacanthus Bleeker, 1855: 393 (Ambon, Indonesia).

Rare, several large adults sighted on NE side of island in 20-25 m; diurnal midwater; forms aggregations; planktivore; zooplankton; pelagic eggs; 50 cm SL; Indo-west and central Pacific; observed only; vagrant; new record for the TEP.

One 46.5cm SL individual was speared and its sagittal otoliths extracted. E.B. Brothers (personal communication) examined those otoliths and estimated that it had a larval life of 150 days, and that it was between 5-11y old.

Naso lituratus (Bloch and Schneider, 1801)

Acanthurus lituratus Bloch and Schneider, 1801: 216 (no locality given).

Rare; based on repeated sightings and their distribution around half the atoll there may have been several dozen large adults of this species present in 1994, in 15-25m on upper reef slope; adults only; diurnal benthic; solitary or in groups; herbivore: leafy brown algae; pelagic eggs; 28 cm SL; Indo-west and central Pacific; observed only; probable vagrant; a new record for the TEP.

Sphyraenidae - Barracudas

Sphyraena ensis Jordan and Gilbert, 1882

Sphyraena ensis Jordan and Gilbert, 1882b: 106 (Mazatlan, Mexico).

Rare, about 20 adults sighted in a group near surface on outer slope; roving predator; solitary or in groups; carnivore: fishes; pelagic eggs; 60 cm SL; TEP, from Gulf of California to Peru; observed only; possible vagrant.

Scombridae - Tunas and Mackerels

Acanthocybium solandri (Cuvier, 1831)

Cybium solandri Cuvier, in Cuvier and Valenciennes, 1831: 192 (no locality given).

Offshore pelagic species; a few individuals captured by crew members with trolling lures adjacent to the island; adults only; roving predator; solitary or in groups; carnivore: fishes, squids; pelagic eggs; 210 cm FL; circumtropical; specimens not retained.

Euthynnus lineatus Kishinouye, 1920

Euthynnus lineatus Kishinouye, 1920: 113 (Mexico).

Offshore pelagic species; occasionally caught by crew members with trolling lures; adults only; roving predator; forms aggregations; carnivore: fishes, crustaceans, squids, tunicates; pelagic eggs; 65 cm FL; TEP, from Southern California to northern Peru and offshore islands; specimens not retained.

Thunnus albacares (Bonnaterre, 1788)

Scomber albacares Bonnaterre, 1788: 140 (Jamaica).

Offshore pelagic species; frequently captured by crew members with trolling lures; adults only; roving predator; solitary or in groups; carnivore: fishes, crustaceans, squids; spawns pelagic eggs; 210 cm FL; circumtropical; specimens not retained.

Bothidae - Lefteye Flounders

Bothus mancus (Broussonet, 1782)

Pleuronectes mancus Broussonet, 1782: no pagination (Tahiti).

Bothus mancus.- Fischer et al 1995: 935 (Clipperton Island)

Rare; a few medium to large adults sighted in 15-20 m over rubble bottoms; specimens also collected in 1950s; diurnal benthic; solitary; carnivore: fishes, benthic invertebrates; spawns pelagic eggs; 38 cm SL; Indo-Pacific to the Americas; 1: 40 mm SL; underwater photographs; probable resident due to occurrence over a 40 year period; specimens at LACM, SIO.

Balistidae - Triggerfishes

Balistes polylepis Steindachner, 1876

Balistes polylepis Steindachner, 1876: 21 (Magdalena Bay, Mazatlan, and Acapulco, Mexico).

Rare, less than 10 individuals sighted,

mainly on NE side in 15-20 m; adults only; diurnal benthic; solitary; omnivore: algae, coral, echinoderms, fishes; parental care of demersal eggs; 70 cm SL; TEP, from northern California to Chile; also recorded by Randall (1985b), as a vagrant in Hawaii; underwater photographs; probable vagrant; specimens at SIO.

Canthidermis maculatus (Bloch, 1786)

Balistes maculatus Bloch, 1786: 25 (American seas)

Not seen or collected by us; a few specimens collected in the 1950s; demersal, benthic on reefs or associated with floating logs well offshore; forms aggregations; planktivore: zooplankton; parental care of demersal eggs; 50 cm TL; circumtropical; specimens at SIO, LACM.

Melichthys niger (Bloch, 1786)

Balistes niger Bloch, 1786: 27 (China Seas).

Melichthys niger.- Allen and Robertson, 1994: 303 (Clipperton Island).

Abundant, aggregations containing many hundreds of fish usually seen at each anchorage, surface to 50m; juveniles and adults; diurnal benthic; planktivore, zooplankton, occasionally live coral (see Glynn *et al*, 1996); parental care of demersal eggs; 25 cm SL; circumtropical; underwater photographs; resident; specimens at USNM, SIO, LACM.

Sufflamen verres (Gilbert and Starks, 1904)

Balistes verres Gilbert and Starks, 1904: 153 (Mazatlan, Mexico and Panama).

Balistes verres.- Snodgrass and Heller, 1905: 406 (Clipperton Island).

Common on outer slope to 30m depth; juveniles and adults; diurnal benthic; solitary; omnivore: algae, crabs, molluscs, echinoids, worms, etc.; parental care of demersal eggs; 32 cm SL; TEP, from Gulf of California to Ecuador; underwater photographs; resident population; specimens at USNM, SIO, LACM.

Xanthichthys mento (Jordan and Gilbert, 1882)

Balistes mento Jordan and Gilbert, 1882a: 228 (Clarion Island).

Xanthichthys mento.- Berry and Baldwin, 1966: 457 (Clipperton Island).

Rare, several observed in 20-50 m; collected in the 1950s; adults only; diurnal benthic; solitary or in groups; planktivore; zooplankton; parental care of demersal eggs; 25 cm SL; antitropical distribution (Randall *et al*, 1978), at scattered localities in the western and central Pacific including Ryukyu Islands, Marcus Island (Minami Tori Shima), Pitcairn Island, Easter Island, and the Hawaiian Islands (where it is abundant in the northwest islands, but rare and in deep water in the southern islands; Randall 1985a, pers. comm., 1996), in the TEP from southern California to the Galapagos, including the Revillagigedo Islands (where DRR found it in abundance in shallow water on the south side of Socorro Island in 1991) and Clipperton Island; underwater photographs; possible vagrant; specimens at LACM.

Monacanthidae - Triggerfishes and Leatherjackets

Aluterus scriptus (Osbeck, 1765)

Balistes scriptus Osbeck, 1765: 145 (China).

Rare, a few adults seen on outer slope in 10-20 m; diurnal benthic; solitary; omnivore: algae, seagrasses, cnidarians, tunicates; parental care of demersal eggs; 70 cm SL; circumtropical; underwater photographs; probable vagrant; specimens at USNM.

Cantherines dumerilii (Hollard, 1854)

Monacanthus dumerilii Hollard, 1854: 361 (Mauritius).

Common on outer slope in 10-50 m; medium to large adults; diurnal benthic; solitary or in pairs; omnivore: corals, urchins, molluscs, bryozoans, sponges; parental care of demersal eggs; 31.5 cm SL; Indo-Pacific to the Americas; underwater photographs; resident; specimens at USNM.

Ostraciidae - Boxfishes

Ostracion meleagris Shaw, 1796

Ostracion meleagris Shaw, *in* Shaw and Nodder, 1796: Pl. 253 (South Pacific).

Ostracion clippertonense Snodgrass and Heller, 1905: 410 (Clipperton Island).

Ostracion lentiginosum.- Snodgrass and Heller, 1905: 410 (Clipperton Island).

Occasionally sighted on outer slope in 10-25 m, mainly on NE side of island; juveniles and adults; diurnal benthic; solitary; omnivore: algae, polychaetes, sponges, tunicates, molluscs; spawns pelagic eggs; 15 cm SL; Indo-Pacific to the Americas; resident; specimens at USNM, LACM.

Tetraodontidae - Pufferfishes

Arothron meleagris (Bleeker, 1853)

Tetrodon meleagris Bleeker, 1853: 507 (Asia).

Tetraodon setosus.- Snodgrass and Heller, 1905: 413 (Clipperton Island).

Common on outer slope to 50 m depth; mainly medium to large adults, but a few large juveniles seen; diurnal benthic; solitary; omnivore: live corals (see Glynn *et al*, 1996), algae, sponges, worms, echinoderms, etc.; pelagic eggs; 28 cm SL; Indo-Pacific to the Americas; resident; specimens at USNM, SIO, LACM (as *A. setosum*).

Canthigaster punctatissima (Günther, 1870)

Tetrodon punctatissimus Günther, 1870: 302 (Panama).

Common on outer slope in 10-35 m; juveniles (including new recruits) and adults; diurnal benthic; solitary or in pairs; omnivore: algae and benthic invertebrates; spawns pelagic eggs; 6 cm SL; TEP, from Gulf of California to Panama, also Galapagos Islands; underwater photographs; 17 mm SL; resident; specimens at USNM, SIO, LACM.

Diodontidae - Porcupinefishes

Diodon holocanthus Linnaeus, 1758

Diodon holocanthus Linnaeus, 1758: 335 (India).

Rare, a few adults seen on NE side of island in 15 m depth; nocturnal benthic; solitary; carnivore: sea urchins, gastropods, crabs; pelagic eggs; 30 cm SL; circumtropical, widespread in the TEP, common in the Revillagigedo Islands in 1994; observed only; population status uncertain - because it is common on unconsolidated bottoms in Panama (DRR personal observations) it may occur on the "60m terrace"; specimens USNM.

Diodon hystrix Linnaeus, 1758

Diodon hystrix Linnaeus, 1758: 335 (India).

Rare, a few adults seen on outer slope in 15-20 m; nocturnal benthic; solitary; carnivore: sea urchins, gastropods, crabs; pelagic eggs; 80 cm SL; circumtropical, widespread in TEP, occasional in the Revillagigedo Islands in 1994; observed only; probable vagrant; specimen at LACM.

PROBABLE ERRONEOUS RECORDS

Serranidae

Epinephelus analogus Gill, 1864

Epinephelus analogus Gill 1864: 163 (west coast of America)

Epinephelus analogus.- Smith 1971: 149 (Clipperton Island)

This is a distinctive, shallow-living TEP species (Allen and Robertson, 1994, Fischer et al 1995). We did not see or collect it at Clipperton. The distribution map for *E. analogus* in Smith (1971) includes Clipperton, based on a "literature record". However, the text contains citations for all records shown on the map, except for the one for Clipperton. The Clipperton record shown on the distribution map for this species in Fischer et al (1995) is probably based on the Smith (1971) reference (P. Heemstra, personal communication 1996). There are no Clipperton specimens in collections at the USNM, UCLA, LACM or SIO. Hence we regard Smith's (1971) Clipperton record as an error.

Aulorhynchidae

Aulorhynchus flavidus Gill, 1862

Aulorhynchus flavidus Gill, 1862: 169 (Washington)

This is a temperate species that occurs between Alaska and northern Baja California, (Eschmeyer et al 1983). There is a specimen supposedly from Clipperton at LACM (W58-297, C68). R. Feeney of the LACM confirmed the identity of that specimen (personal communication 1996). However, that record appears to be an error. On the field sheet that included that entry, *Aulostomus chinensis* (which does occur at Clipperton) is crossed out and replaced with *Aulorhynchus flavidus*. Moreover, the length given in that entry (156mm) differs substantially from that of the *A. flavidus* specimen (125mm - measured by R. Feeney).

DISCUSSION

The known Clipperton fish fauna consists of 115 species belonging to 89 genera and 43 families. The most speciose families, which constitute 49 percent of the total fauna, are moray eels (Muraenidae, 14 species), jacks (Carangidae, 11 species), wrasses (Labridae, eight species), surgeonfishes (Acanthuridae, eight species), squirrelfishes (Holocentridae, five species), groupers (Serranidae, five species), and triggerfishes (Balistidae, five species). The most abundant reef fishes at the island in 1994 were as follows (in phylogenetic order): *Gymnothorax dovii* (Muraenidae); *Myripristis berndti* (and *M. gildi*?) (Holocentridae); *Paranthias colonus*, *Dermatolepis dermatolepis* and *Epinephelus sp.* (Serranidae); *Caranx melampygus* and *C. sexfasciatus* (Carangidae); *Lutjanus viridis* (Lutjanidae); *Mulloidichthys dentatus* (Mullidae); *Kyphosus elegans* (Kyphosidae); *Holocanthus limbaughi* (Pomacanthidae); *Stegastes baldwini* (Pomacentridae); *Thalassoma grammaticum* and *T. robertsoni* (Labridae); *Acanthurus nigricans* and *Ctenochaetus marginatus* (Acanthuridae); and *Melichthys niger* (Balistidae). The richest area in terms of both coral growth (see Glynn *et al* 1996) and fish species diversity was off the northeastern side of the island.

The total includes 14 oceanic forms (one shark, three flying-fishes, two half-beaks, three jacks, a remora, a dolphin-fish, and three tunas). Three others (a needle-fish, a jack and a triggerfish) range between offshore and inshore areas. The 98 inshore species include 19 midwater and surface forms (four sharks, seven jacks, and single representatives of eight other families), 70 demersal fishes restricted to hard-reef habitats, and nine demersal species that live in or feed on unconsolidated bottoms such as rubble and sand (*Apterichthys equatorialis*, *Myrichthys pantostigmius*, *Phaenomonas pinnata*, probably *Pontinus vaughni*, *Orthopristis cantharinus*, *Mulloidichthys dentatus*, *Novaculichthys taeniourus*, *Xyrichthys wellingtoni*, and *Bothus mancus*. Species within this last group constitute about 40% the TEP shorefish fauna but <10% of Clipperton's shorefish fauna. Because there is very little unconsolidated habitat in <60 m of water, and extensive areas of such between 60-100m, it is quite possible that further sampling will reveal additional species of that type at Clipperton. The non-oceanic species consist primarily (68%) of carnivores that eat various mobile animals. Another 9.1% feed on benthic, sessile invertebrates while 12.9% are exclusively or largely planktivorous, and 17.8% are benthic feeding herbivores.

Reef sharks often are abundant at offshore reefs and islands. They were surprisingly uncommon at Clipperton in 1994 - we did not see any during the first two days of diving. Their scarcity appears to be a recent development. Early reports refer to the abundance of sharks (Skaggs 1989), and the Scripps expeditions of 1956 and 1958 found *Carcharhinus galapagensis* to be common to the point of being a continuous nuisance (Limbaugh 1963, W. Baldwin, personal communication to G.R. Allen, 1994). The lack

of sharks in 1994 may have been due to recent fishing - unconfirmed reports indicate that six Mexican boats intensively fished this population in 1993, catching as many as ~2000 individuals (John Jackson, personal communication 1994). Clipperton is the only coral reef within the range of the reef shark *Triaenodon obesus* where we have not found it. However, as it is unclear as to what extent this shark is targetted by fishermen it is uncertain whether its absence at Clipperton was due to overfishing or natural causes, such as a failure to recruit there.

There are approximately 825 species of shore and near-shore marine fishes from ~105 families in the TEP (Allen and Robertson 1994, Fischer *et al* 1995). Thus only ~14% of the region's species and ~40% of its families occur at Clipperton. In addition to the island's extreme isolation, other factors that probably contribute to the small faunal size include its small size, reduced habitat diversity, and oceanic environment (see Robertson and Allen 1996). However, sampling effort probably also contributes, as we were not able to sample extensive areas of sand and rubble bottom on the "60m terrace", which lie below the limits of conventional SCUBA diving.

The nine Clipperton endemics represent 9.1% of the shorefish fauna and 11.3% of the strictly demersal component of that fauna. Five of those endemics (*Epinephelus sp. Holacanthus limbaughi*, *Stegastes baldwini*, *Thalassoma robertsoni*, and *Ophioblennius steindachneri clippertonensis*) were among the most abundant fishes at the island in 1994. The abundance of two others (*Myripristis gildi* and *X. wellingtoni*) is unclear (see species accounts). *Bathygobius arundelii* was common in our reef flat collections and similar collections in that habitat in the 1950s. The abundance of *Pseudogramma axelrodi* was similar to that of the related *P. thaumasium* in our collections elsewhere in the TEP.

Clipperton endemics appear to have a mixture of eastern and western Pacific origins. *M. gildi* and *T. robertsoni* both have very close relatives on the western side of the EPB, and thus likely are derived from species that recently invaded the TEP from the west Pacific. *S. baldwini* is closely related to the TEP species *S. leucorus*, and its sister species is the subspecies of *S. leucorus* endemic to the Galapagos Islands (*S. leucorus beebei*) rather than the one endemic to the much nearer (950km vs 2,100km) Revillagigedos (*S. leucorus leucorus*). The probable sister species of *Epinephelus sp. P. axelrodi*, *H. limbaughi* and *O. s. clippertonensis* are widespread TEP species that belong to genera or species groups restricted to the new world and Atlantic. The phylogenetic affinities of the two other Clipperton endemics are less clear. Both *Xyrichtys* and *Bathygobius* occur in the west Pacific as well as the TEP, and the Atlantic, and phylogenetic relationships within both these genera remain to be clarified.

Despite the fact that they have evolved in an environment dominated by live corals, none of Clipperton's endemic fishes can be considered to be "live-coral dependent", i.e. live only in and/or feed exclusively on live coral at some stage of their life cycles. Ecologically the endemics are typical members of their genera, and species of all but one of those genera are common on rocky-reefs as well as coral reefs in the TEP: *Myripristis*, *Epinephelus* and *Pseudogramma* species are carnivores; *Holacanthus* species are benthic feeding omnivores, and we saw no coral feeding by *H. limbaughi* at Clipperton; *Stegastes* species maintain territories containing algal mats; *T. robertsoni* and allied species are planktivores that also feed opportunistically on benthic animals; *Ophioblennius* species are territorial, benthic-feeding herbivores; while *Bathygobius* species are benthic feeding carnivores characteristically found in rocky intertidal habitats. *Xyrichtys* is the only genus of soft-bottom fishes with an endemic at Clipperton, and *X. wellingtoni* and its congeners are sand-living planktivores. Robertson and Allen (1996) suggested that only two of Clipperton's fishes (*Cirrhitichthys oxycephalus* and *Arothron meleagris*) could be regarded as being live-coral dependent. *A. meleagris* that occur on

coral reefs in the TEP are almost exclusively corallivorous, and that species reaches its highest densities in the TEP on coral reefs. However, that species can be quite common on rocky shores, and the diet of individuals that live on such shores is dominated by non-coral items. Further, *A. meleagris* is capable of growing (albeit slowly) on a diet composed exclusively of crustose coralline algae (Guzman and Robertson 1989). Thus whether that species is truly coral-dependent probably depends on whether adults can spawn on a coral-free diet. *C. oxycephalus*, which is a micro-carnivore, is often found in abundance in living colonies of *Pocillopora* corals on reefs in the TEP. However, one of us (DRR) found this species in abundance on both coral reefs and coral-free rocky shores at Gorgona Island (Colombia), and in abundance in both live coral and in large areas of dead coral rubble at Christmas Island, in the central Pacific. Thus at most one of Clipperton's fishes might be obligatorily live-coral dependent.

Clipperton's fish fauna is composed of roughly equal numbers of TEP and transpacific species: 63 and 52, respectively of the total, and 53 and 48, respectively of the non-oceanic component. This pattern reflects the island's great isolation and the pattern of warm surface currents that could bring fish recruits to it from distant sources: Although Clipperton is physically much nearer to eastern Pacific reefs than to reefs on the western side of the EPB (~1,000 km vs 4,000 km), it lies at the northern edge of the main east-bound surface current from Oceania, a current that flows eastwards for two thirds of the year and that is much stronger than westward flow that occurs from the remainder of the TEP during the remainder of the year. In addition, during periodic El Nino events eastward flow that could carry recruits from Oceania is much stronger than normal (see Robertson and Allen 1996, for further discussion).

The non-endemic TEP component of the Clipperton fauna has limited affinities with that of the Revillagigedos (see also Glynn *et al* 1996, for corals). Resident populations of three species, *Myripristis clarionensis*, *Apogon atricaudus* and *Thalassoma virens*, appear to be restricted to Clipperton and the Revillagigedos. In addition, populations of *Entomacrodus chiostictus* at the Revillagigedos and Clipperton share morphological characterisitics that differentiate them from conspecific populations on the mainland. Moreover, the Revillagigedos endemic *Holacanthus clarionensis* occurs at Clipperton (and Baja California) as a vagrant. The Clipperton fish fauna also has affinities, although more limited, to the fish fauna of the southern TEP: *Gymnothorax dovii* is restricted to the southern half of the TEP and Clipperton represents its northern-most resident population. The sister species of one Clipperton endemic (*S. baldwini*) is a Galapagos endemic (*S. leucorus beebei*). The remaining 36 TEP fishes found at Clipperton are all widely distributed throughout the region, at offshore island and/or continental sites. There is insufficient documentation of the shorefish faunas of the other offshore islands (the Revillagigedos, Cocos, Malpelo and the Galapagos) to allow more detailed comparison of regional affinities within the TEP.

We estimate that at least 70 of the 98 non-oceanic fishes known from Clipperton have resident populations there, and that only 17 such species likely are vagrants - i.e. are represented by individuals that recruited from other areas, and lack self-sustaining populations at Clipperton. Similar percentages 75% and 78%, respectively, of species for which sufficient information seems available, of transpacific and TEP species (other than Clipperton endemics) appear to be resident at the island.

Unfortunately, descriptions of shorefish faunas often consist simply of a species list, and lack information on their abundance, or habitat usage. Such information is vital for zoogeographic analyses: (i) It allows estimation of the occurrence of ongoing recruitment from external sources, and analyses of patterns of variation in such recruitment. (ii) It enables future workers to assess change in

population status over time, why previous workers might not have recorded certain species, and the relationship of loss of species from sites to their previous abundance there. (iii) It is relevant to assessments of the requirements for maintaining self-sustaining populations of species in different taxa, with different adult ecologies, modes of reproduction and larval life histories. (iv) It facilitates testing of ideas about mechanisms that affect faunal structure, e.g. possible effects of interspecific competition on abundance and habitat usage, effects of habitat availability (quantity and quality) on ability to maintain residency. (v) It provides comparative information on the life history and population characteristics of endemic vs non-endemic species. (vi) It provides information on the potential importance of a site as a source of propagules that might recruit to other sites and the likelihood of a site acting as a stepping stone that allows large-scale dispersal and maintains genetic cohesion between distant populations. We urge the inclusion of such data in future accounts of local fish faunas.

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RESUMEN

El Atolón de Clipperton es el arrecife de coral más grande, apartado y occidental del Pacífico tropical oriental. Durante una visita de dos semanas al Atolón, en abril de 1994, recolectamos y registramos la fauna de peces hasta profundidades de 60m. Recolectas previas fueron hechas a finales del siglo pasado y por las Expediciones del Instituto Scripps de Oceanografía en 1956 y 1958. Se conocen 115 especies de 89 géneros y 43 familias de peces en la Isla. Las familias más abundantes son las morenas (Muraenidae, 14 especies), jureles (Carangidae, 11 especies), labridos (Labridae, 8 especies), cirujanos (Acanthuridae, 8 especies), soldados (Holocentridae, 5 especies), meros (Serranidae, 5 especies), y peces puerco (Balistidae, 5 especies). Estás especies representan aproximadamente el 14% de las especies costeras del PTO y el 40% de los géneros. Las 115 especies incluyen 14 especies pelágicas oceánicas, 22 especies pelágicas costeras y de aguas intermedias, 70 especies demersales que viven en el substrato duro del arrecife y nueve especies demersales que viven o se alimentan en el substrato suave (fragmentos de piedra y arena). De las 101 especies no oceánicas, 68% son carnívoras, alimentandose de organismos móviles, 9,2% se alimentan de invertebrados bentónicos sésiles, 12,9% son planctívoros y 17,8% son hervívoros del bentos. Un mínimo de 70 especies no oceánicas parecen ser poblaciones residentes (e.g. autosostenidas) de el atolón, mientras que 17 especies probablemente son migratorias. Los peces de Clipperton incluyen 63 especies transpacíficas (i.e. especies que también se encuentran en el lado occidental de la Barrera del Pacífico Oriental) y 52 especies son endémicas de el Pacífico Tropical Oriental. Mientras la mayoría (36) de las especies del PTO se encuentran en toda la región, cuatro se localizan solo en Clipperton y las Islas Revillagigedos, el más cercano hábitat de grava, 950 km hacia el norte. Nueve especies o subespecies de siete familias son endémicas de Clipperton. Estos endemicos representan el 11.3% de los peces costeros demersales de Clipperton. Las especies hermanas de dos de estas endemicos podrían ser especies transpacíficas, mientras las especies gemelas de otras siete parecieran ser especies del Pacifico tropical oriental.

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