Review of the Fishes of the Genus *Kuhlia* (Perciformes: Kuhliidae) of the Central Pacific[1]

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Abstract: Ten species of fishes of the genus *Kuhlia* are recognized from Palau to Hawai'i in the North Pacific and from Fiji to Easter Island in the South Pacific: *K. malo* (Valenciennes) from fresh water in the Society Islands; *K. marginata* (Cuvier) from fresh water in the western Pacific, east to Kosrae, Caroline Islands, and Fiji; *K. mugil* (Forster) (*K. taeniura* is a synonym) from most of the Indo-Pacific (not the Hawaiian Islands) and the tropical eastern Pacific; *K. munda* (De Vis) from fresh and brackish water in Fiji, Vanuatu, New Caledonia, and Queensland (*K. proxima* Kendall & Goldsborough and *K. bilunulata* Herre are synonyms); *K. nutabunda* Kendall & Radcliffe from Easter Island; *K. petiti* Schultz from the Phoenix Islands, Malden Island, and the Marquesas Islands (*Dules taeniurus marquesensis* Fowler is a synonym); *K. sandvicensis* (Steindachner) from the Hawaiian Islands and other islands of the central Pacific; *K. rupestris* (Lacépède) from fresh water from East Africa to Samoa (*K. caerulescens* Regan from the Solomon Islands is a new synonym); *K. salelea* Schultz from fresh water in the Samoa Islands; and *K. xenura* (Jordan & Gilbert) from the Hawaiian Islands, with a mistaken type locality of El Salvador, Central America. The name *K. sandvicensis* has long been used for the common endemic species in the Hawaiian Islands; however, the original description leaves little doubt that it should apply to the species widely distributed in the central Pacific and only recently discovered in Hawai'i; it has usually been misidentified as *K. marginata*. The endemic Hawaiian species therefore takes the only available name, *K. xenura* (Jordan & Gilbert). *Kuhlia sandvicensis* differs from *K. xenura* in having a smaller eye (3.0–3.45 in head length, compared with 2.55–2.95 for *K. xenura*), straight dorsal profile of the head of adults (concave in *xenura*); usually 14 pectoral-fin rays (usually 15 in *xenura*), usually 50 lateral-line scales (usually 49 in *xenura*), gill rakers 38–43 (35–39 for *xenura*), and a dark reticular pattern dorsally on the head in life.

THE FISHES OF the family Kuhliidae are moderately deep-bodied and compressed, with two opercular spines, a deeply notched dorsal fin of 10 spines and 9–13 rays, and a scaly sheath at the base of the dorsal and anal fins. They have large eyes and are primarily nocturnal, at least as adults, feeding principally on planktonic crustaceans. These fishes are generally silvery, often with dark markings on the caudal fin, the basis for the common name flagtails. The Hawaiian name āholehole is also sometimes used beyond Hawai'i. The family consists of a single genus, *Kuhlia*, the species of which occur in tropical and subtropical waters of the Indo-Pacific region, and one is also found in the tropical eastern Pacific. Only one species exceeds 320 mm in total length. Some species occur mainly in fresh water, whereas others are primarily marine. The latter tend to form schools by day and are typically found inshore; the young may be common in tide pools. At least some of the marine species are

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able to live in fresh water, and the freshwater species often occur in brackish environments.

In total 40 nominal species and subspecies of *Kuhlia* have been described (Eschmeyer 1998:2343), 18 of these in the genus *Dules*, now determined as a genus of Serranidae. *Kuhlia* was revised by Regan (1913), who recognized 12 species, three of which he described as new. Six species and subspecies of the genus have been described since 1913.

A second species of *Kuhlia* was recently discovered in the Hawaiian Islands. It is the fish currently identified as *Kuhlia marginata* (Cuvier), described from Java and presumed to be wide-ranging throughout much of Oceania, including Johnston Island. We examined the holotype of *Dules marginatus* in the Muséum National d'Histoire Naturelle in Paris (MNHN 9002, 93 mm SL, not the "syntypes" listed by Eschmeyer [1998:1019]; Cuvier described the species from a single specimen). The holotype has 13 pectoral rays, 41 lateral-line scales, and 7 + 17 gill rakers. None of these counts matches those of the fish of Pacific islands now identified as *Kuhlia marginata*. We first suspected that this new record of *Kuhlia* for Hawai'i represented an undescribed species, in spite of its broad distribution. We referred to the original description of *Kuhlia sandvicensis* (Steindachner, 1876) to make sure it applied to the common endemic Hawaiian species that has long held this name. To our dismay, we found that it fits the other species. The only available name for the endemic Hawaiian species of *Kuhlia* is *K. xenura* (Jordan & Gilbert, 1882), originally named *Xenichthys xenurus* and mistakenly placed in the Haemulidae. The questioned type locality of El Salvador is clearly in error.

Hombron and Jacquinot (1853) reported on fishes collected during Dumont d'Urville's voyage to the South Pole by the corvettes "Astrolabe" and "Zélée," 1837–1840. Among the species briefly described and without meristic data was *Dules marginata* Cuvier, illustrated as fig. 3 on Plate 3. Boulenger (1895:38) redescribed this fish as *Dules urvillii* and gave the locality as "Probably some Pacific Island." No type specimen is extant, and we cannot equate this description with any species of *Kuhlia* we know today. The strong black markings of the caudal fin suggest that it may have been one of the freshwater species of the genus. *Apogon aroubiensis* is another species described and illustrated in Hombron and Jacquinot that is regarded as unidentifiable (Randall and Lachner 1986).

We recognize 10 species of the genus *Kuhlia* from the islands of Oceania. Of these, only *K. mugil* and *K. rupestris* range to the western Indian Ocean. We provide here a key to the species of *Kuhlia* from the islands of Oceania, illustrations, and a diagnosis of each. Not included in our study are the nominal *K. boninensis* (Fowler) from the western Pacific, *K. caudovittata* (Lacépède) from Madagascar and Mauritius, *K. sauvagii* Regan from Madagascar, and *K. splendens* Regan from fresh water at Rodriguez and Mauritius.

MATERIALS AND METHODS

Specimens of *Kuhlia* have been examined at or obtained on loan from the Australian Museum, Sydney (AMS); Academy of Natural Sciences of Philadelphia (ANSP); the Natural History Museum, London (BMNH); Bernice P. Bishop Museum, Honolulu (BPBM); California Academy of Sciences, San Francisco (CAS); Hebrew University, Jerusalem (HUJ); Natural History Museum of Los Angeles County (LACM); Muséum National d'Histoire Naturelle, Paris (MNHN); Royal Ontario Museum, Toronto (ROM); and the National Museum of Natural History, Washington, D.C. (USNM).

Lengths given for specimens are standard length (SL), the straight-line distance from the median anterior point of upper lip to the base of the caudal fin (posterior end of the hypural plate). Head length is measured from the same anterior point to the most posterior end of the opercular membrane, and snout length from the same point to the fleshy edge of the orbit. Body depth is the greatest depth measured to the base of the dorsal spines; body width is the greatest width just posterior to the gill opening. Orbit diameter is the greatest fleshy diameter. The bony inter-

orbital width is measured over the center of the eye. Caudal-peduncle depth is the least depth, and caudal-peduncle length is measured horizontally from the rear base of the anal fin to the caudal-fin base. Lengths of fin spines and soft rays are taken from the tips to where they emerge from the basal scaly sheath (these lengths may be taken more accurately than ones to the extreme base of the spines and rays). Caudal concavity is the horizontal distance between verticals at the tips of the shortest and longest caudal rays.

Pectoral-ray counts include the short unbranched upper ray (but not the still smaller splintlike ray that is closely joined to it). Lateral-line scales are counted from the upper end of the gill opening to the base of the caudal fin (four to seven pored scales on the base of the caudal fin are not counted, but a pored scale overlapping the end of the hypural plate is included). Gill-raker counts include rudiments; the upper-limb count is given first, and the raker at the angle is contained in the lower-limb count. As noted by Schultz (1943:99) and Gosline (1955:472), the young of *Kuhlia* have fewer gill rakers than adults. This may be due to rudimentary rakers being more difficult to detect in juveniles rather than an actual increase in rakers with growth. Nevertheless, in this study, no gill-raker counts were recorded for specimens less than 70 mm SL.

Tables 1–3 present the meristic data of all 10 species. Proportional measurements were taken only on specimens 80 mm SL or larger. Body and fin proportions in the text are rounded to the nearest 0.05.

Genus *Kuhlia* Gill

Kuhlia Gill, 1861:48 (type species, *Perca ciliata* Cuvier in Cuvier and Valenciennes (after Kuhl and van Hasselt), 1828 = *Centropomus rupestris* Lacépède, 1802, by original designation).

Moronopsis Gill, 1864:82 (type species, *Dules marginatus* Cuvier in Cuvier and Valenciennes, 1829, by monotypy).

Herops De Vis, 1884:392 (type species, *Herops munda* De Vis, by monotypy).

Boulengerina Fowler, 1907:512 (type species, *Dules mato* Lesson, 1831; proposed as a subgenus; preoccupied by *Boulengerina* Dollo, 1886, in Reptilia).

Safole Jordan, 1912:655 (replacement name for *Boulengerina* Fowler).

DIAGNOSIS: Dorsal-fin rays X,9–13, the fin deeply notched; anal-fin rays III,10–13; pectoral-fin rays 13–15; pelvic rays I,5; lateral line complete, the pored scales 39–53; gill rakers long and slender, 7–13 + 16–30; branchiostegal rays 6; gill membranes not joined across isthmus; vertebrae 25; body moderately deep, the depth 2.55–3.1 in SL, and compressed; head moderately pointed, its length 3.0–3.6 in SL; mouth protractile, oblique with lower jaw projecting, and moderately large, the maxilla extending to below eye; supramaxilla not present; teeth villiform in jaws, on vomer, palatines, entopterygoids, and ectopterygoids; opercle with two spines; rounded corner and lower edge of preopercle finely serrate; edge of preorbital more coarsely serrate (serrae may be obsolete in large specimens); a few small serrae often present on edge of suborbital; scales ctenoid, present on cheek and opercle, none on interorbital, snout, or maxilla; dorsal and anal fins with a basal scaly sheath; no scaly pelvic-axillary process; caudal fin emarginate to deeply forked. Color silvery, a few species with small dark spots on body, the caudal fin often with black markings. One species reported to 400 mm total length, the remaining less than 320 mm.

REMARKS: *Platysome* was described by Liénard (1832) as a new genus, type species *Holocentrus caudavittata* Lacépède, hence an earlier name than *Kuhlia*. Scudder (1882:268) latinized it to *Platysoma*, but that name is preoccupied. Maugé in Daget et al. (1986) regarded *Platysome* as invalid. Eschmeyer (1998: 2080) wrote, "the type was not definitely referred and the description inadequate." In any case, the well-established *Kuhlia* can be conserved on the grounds that *Platysome* has not been used as a valid genus since it was proposed (International Code of Zoological Nomenclature 2000).

KEY TO THE SPECIES OF *Kuhlia* FROM THE ISLANDS OF OCEANIA (MICRONESIA, POLYNESIA, AND FIJI)

1a. Lateral-line scales 39–42; preorbital serrae 18–31 (except *rupestris*) 2
1b. Lateral-line scales 47–53; preorbital serrae 10–21 5

2a. Caudal fin emarginate, the caudal concavity 5.3–8.7 in head length; anal soft rays 10–11 (rarely 11); mouth large, the maxilla ending below posterior half of eye; edges of scales on body black or with a black bar or spot; juveniles with a large black spot in each lobe of caudal fin, and anteriorly in soft portion of dorsal fin, spreading to cover most of these fins in adults (East Africa to Samoa, in fresh water)..... *rupestris*
2b. Caudal fin forked, the caudal concavity 1.55–3.8 in head length; anal soft rays 11–13; mouth not as large, the maxilla ending below anterior half of eye (usually below anterior fourth); posterior border of caudal fin and outer anterior part of soft dorsal and anal fins broadly black 3

3a. Lower-limb gill rakers 16–19; total gill rakers 23–28; pectoral-fin rays 13 (western Pacific east to Caroline Islands, in fresh water) ..... *marginata*
3b. Lower-limb gill rakers 20–26; total gill rakers 30–35; pectoral-fin rays usually 14..... 4

4a. Lower-limb gill rakers 20–22; total gill rakers 28–32; caudal concavity 3.0–3.8 in head length (Society Islands, in fresh water)..... *malo*
4b. Lower-limb gill rakers 24–26; total gill rakers 33–35; caudal concavity 2.5–2.7 in head length (Samoa Islands, in fresh water)..... *salelea*

5a. Caudal fin with a median black stripe and two broad oblique black bands across each lobe; dorsal soft rays usually 10 (Indo-Pacific and tropical eastern Pacific)..... *mugil*
5b. Caudal fin without black bands as in 5a; dorsal soft rays usually 11 (rarely 10)..... 6

6a. Caudal fin with base and all of margins broadly black, the chevron-shaped central part pale (yellow in life); lateral-line scales 47–49; preorbital serrae 14–21 (Fiji, Vanuatu, New Caledonia, and Queensland in brackish and fresh water)..... *munda*
6b. Caudal fin not colored as in 6a; lateral-line scales 49–53; preorbital serrae 10–15 (marine)..... 7

7a. Caudal fin black with a large C-shaped white mark basally in each lobe, the lobe tips white; anal soft rays usually 12; lateral-line scales 51–53; upper-limb gill rakers 9–11; total gill rakers 34–38 (Phoenix Islands, Malden Island, and Marquesas Islands)..... *petiti*
7b. Caudal fin not colored as in 7a, the posterior border entirely blackish; anal soft rays usually 11; lateral-line scales 49–51 (modally 49 or 50); upper-limb gill rakers 9–13; total gill rakers 35–43 8

8a. Eye not very large, the orbit diameter 3.0–3.45 in head length; dorsal profile of head of adults straight; lower-limb gill rakers 27–30; total gill rakers 38–43; a dark reticular pattern dorsally on head in life (islands of central Pacific, including Hawai'i)..... *sandvicensis*
8b. Eye very large, the orbit diameter 2.55–2.95 in head length; dorsal profile of head of adults concave; lower-limb gill rakers 25–28; total gill rakers 35–39; no dark reticular pattern on head in life 9

9a. Pectoral-fin rays usually 15 (11 of 55 with 14); lateral-line scales usually 49 (22 of 55 with 50, one with 51); pelvic spine 2.2–2.5 in head length; second anal spine 86–98% length of third anal spine (Hawaiian Islands)..... *xenura*

FIGURE 1. *Kuhlia malo*, BPBM 11959, 128 mm SL, Moorea, Society Islands.

9b. Pectoral-fin rays 14 (one of 18 with 15); lateral-line scales usually 50 (4 of 19 with 49); pelvic spine 2.5–2.9 in head length; second anal spine 73–87% length of third anal-fin spine (Easter Island)..... *nutabunda*

Kuhlia malo (Valenciennes)
Figure 1; Tables 1–3

Dules malo Valenciennes in Cuvier and Valenciennes, 1831:475 (type locality, Matavai River, Tahiti).
Dules mato Lesson, 1831:223 (type locality, Matavai, Tahiti).
Dules leuciscus Jenyns, 1840:17 (type locality, Matavai River, Tahiti).
Kuhlia marginata (non Cuvier), Herre, 1936:145 (Papenoo River, Tahiti, and creek on Moorea).

DIAGNOSIS: Dorsal-fin rays X,11–12 (usually 11); anal-fin rays III,11–13 (usually 12); pectoral-fin rays 13–14 (usually 14); lateral-line scales 40–42; gill rakers 8–10 + 20–22; preorbital serrae 22–31; body depth 2.7–3.1 in SL; maxilla reaching to or beyond a vertical at front edge of pupil, but not beyond center of eye; caudal fin slightly forked, the caudal concavity 3.0–3.8 in head length. Color silvery with small, round, black spots dorsally on body; posterior edge and lobe tips of caudal fin broadly black, the upper and lower edges of lobes narrowly pale; pale central part of caudal fin with blackish streaks and elongate spots that parallel the rays. Largest specimen examined, 137 mm SL.

REMARKS: Fowler (1928:169) wrote that the first use of the name *Dules malo* was by

TABLE 1

Counts of Soft Fin Rays of Central Pacific Species of *Kuhlia*

	Dorsal Rays			Anal Rays				Pectoral Rays		
Species	10	11	12	10	11	12	13	13	14	15
malo		18	5		1	21	1	4	19	
marginata	3	35	1		27	12		27	12	
mugil	19	11		3	26	1		4	25	1
munda	1	18			19			3	16	
nutabunda		18		1	17				17	1
petiti	1	22	4		2	25		1	25	1
rupestris	3	19		20	2			4	18	
salelea		12			6	6			12	
sandvicensis		56	1		56	1		4	52	1
xenura		53	2	3	52				11	44

Cuvier in the second edition of *Règne Animal* (1829:147), adding that it is a nomen nudum; however, we do not find this name in our copy of the volume.

The Tahitian name for this fish is nato, hence the basis for Lesson's name *mato* and the emendation by Valenciennes to *malo*. Although the date of publication of Lesson is often given as 1830, Jordan and Jordan (1922:41) noted that Lesson quoted Cuvier and Valenciennes (1831) with the correct page; therefore, this part of Lesson's publication must have appeared after volume 7 of Cuvier and Valenciennes, and *Dules mato* Lesson is a junior synonym.

We have examined specimens of *Kuhlia malo* only from streams and rivers in Tahiti and Moorea. It should be expected to occur naturally in fresh water at other high islands of French Polynesia except the Marquesas.

The Division of Fish and Game of the State of Hawai'i decided to transport nato (*Kuhlia malo*) from Tahiti to the Hawaiian Islands aboard the National Marine Fisheries Service vessel *Hugh M. Smith* for introduction to freshwater habitats. For this privilege, the French Government asked that some nato be transported to and released in fresh water in the Marquesas. In 1958, 1868 fish were collected from a stream in Tautira, Tahiti, and placed in the saltwater bait tank on the vessel. Only 94 survived the trip to Nuku Hiva; 50 were planted in Taipi Vai. The remaining 44 died enroute to Hawai'i, which was fortunate (Randall 1960). Had the nato been successfully introduced, it would surely have had a deleterious effect on the native freshwater biota of Hawai'i.

Bryan and Herre (1903:129) erroneously recorded this fish from Marcus Island (= Minami Tori Shima) as *Kuhlia marginata*. This island has no surface fresh water, and it is far from the Society Islands, the only known locality for *K. malo*. The next species listed from Minami Tori Shima by Bryan and Herre, *Epinephelus spiniger* (= *E. irroratus*) is also an error; it is endemic to the Marquesas Islands. Because Alvin Seale's collections from the South Pacific in 1900–1903, which included specimens from Tahiti and the Marquesas (Seale 1906), would have been at the Bishop Museum at the same time as Bryan's collections, we believe that his specimens of these two fishes were mistakenly recorded as being from Minami Tori Shima.

MATERIAL EXAMINED: SOCIETY ISLANDS, Tahiti, ANSP 16008, 3: 48.5–87 mm; ANSP 105268, 77.5 mm; BPBM 1534, 137 mm; BPBM 2417, 128 mm (locality given as Marcus Island, but probably Tahiti); BPBM 3921, 2: 68–82 mm; BPBM 7202, 4: 73–80 mm. Moorea, BPBM 11959, 128 mm; BPBM 25754, 4: 99–132 mm; CAS 124712, 6: 19–111 mm.

FIGURE 2. *Kuhlia marginata*, BPBM 26618, 93 mm SL, Sulawesi, Indonesia.

Kuhlia marginata (Cuvier)
Figures 2, 3; Tables 1–3

Dules marginatus Cuvier in Cuvier and Valenciennes, 1829:116, pl. 52 (type locality, Java).
Dules maculatus Valenciennes in Cuvier and Valenciennes, 1831:475 (type locality, Sulawesi).
Dules papuensis Macleay, 1884:257 (type locality, Goldie River, Papua New Guinea).

DIAGNOSIS: Dorsal-fin rays X,10–12 (usually 11); anal-fin rays III,11 or 12 (usually 11); pectoral-fin rays 13 or 14 (usually 13); lateral-line scales 39–42; gill rakers 7–9 + 16–19; preorbital serrae 18–28; a few fine serrae may be present on suborbital; body depth 2.7–3.05 in SL; orbit diameter 2.75–3.3 in head length; maxilla extending to or slightly beyond a vertical at front edge of pupil; caudal fin forked, the caudal concavity 2.5–3.1 in head length. Silvery, usually with blackish spots posteriorly on dorsal part of body that tend to merge to form bands anteriorly (or the dark pigment is concentrated on scale margins); most of snout and tip of chin blackish; caudal fin pale with a black posterior margin that broadens on lobe tips, then a very broad submarginal pale zone, often preceded by a chevron-shaped blackish band or row of blackish spots parallel with posterior margin; base of caudal fin with small blackish spots; a narrow white margin on soft portion of dorsal and anal fins with a broad blackish submarginal zone anteriorly that narrows posteriorly (broader in dorsal fin than anal). Largest specimen examined, 179 mm SL, from the Solomon Islands.

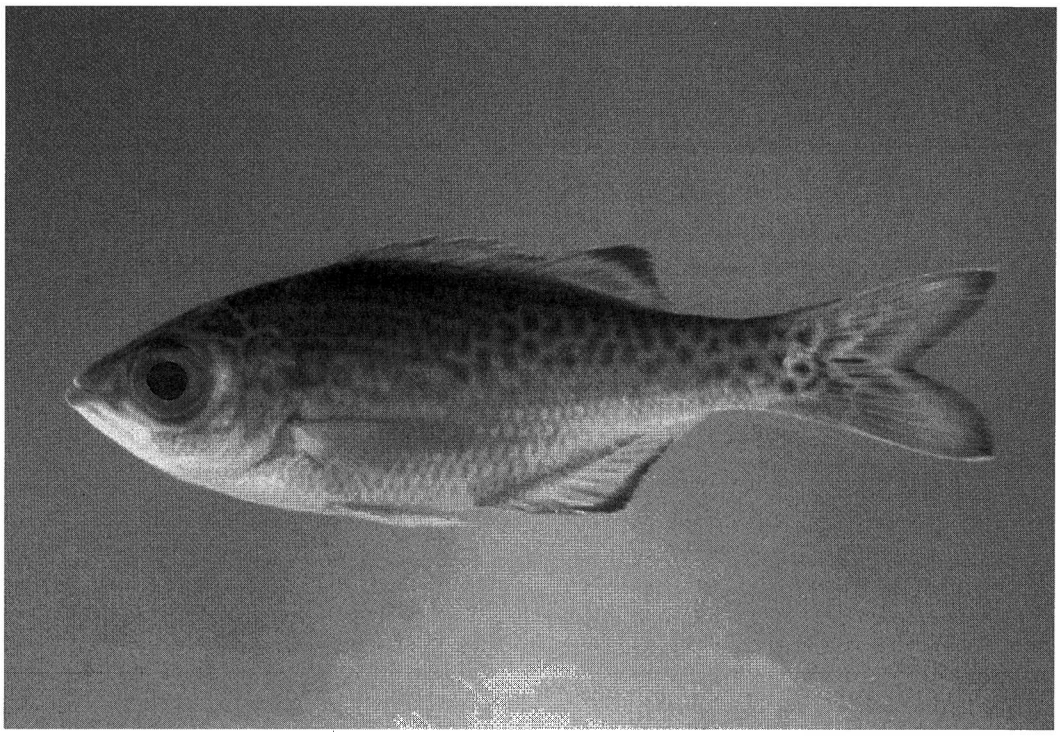

FIGURE 3. *Kuhlia marginata*, MNHN 1992-619, 96 mm SL, New Caledonia.

TABLE 2

Lateral-Line Scale Counts of Central Pacific Species of *Kuhlia*

	Lateral-Line Scales														
Species	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
malo		6	12	5											
marginata	5	18	12	4											
mugil											2	7	20	1	
munda									1	6	12				
nutabunda											4	15			
petiti													25	5	1
rupestris	6	9	7												
salelea		3	6	3											
sandvicensis											1	39	17		
xenura											32	22	1		

REMARKS: *Kuhlia marginata* is primarily a freshwater fish. The 101-mm specimen of CAS 125575 was collected from the Sepik River, Papua New Guinea, at Marienberg, which is 40 miles (64.5 km) from the sea. We do not know to what extent this species penetrates brackish or marine environments. The two specimens of CAS 210350, 99–105 mm, were taken at the mouth of the Kerawal River in New Britain, and the two of CAS 206602, 43–116 mm, were from a mangrove area in Palau.

No mention was made by Cuvier of dark spots on the body of the holotype, and none

was seen when we examined the specimen. J.E.R. obtained a market specimen at Manado, Sulawesi, that also lacked spots on the body (Figure 2). No morphological or meristic differences could be found between spotted and unspotted specimens. *Kuhlia rupestris* is known to be more silvery when taken from marine environments, so perhaps the presence or absence of spots on *K. marginata* is related to the habitat in which the fish is found.

The name *Kuhlia marginata* has been misapplied to other species, including *K. malo*, *K. salelea*, *K. munda*, *K. sandvicensis*, and *K. xenura*, perhaps because all share a black or blackish posterior margin on the caudal fin, though of various widths. Because of these misidentifications, some literature records of this species may be suspect. Masuda et al. (1984:142, pl. 127, fig. B) recorded the species from southern Japan. We have examined specimens from Taiwan, the Philippines, Indonesia, Papua New Guinea, Solomon Islands, Vanuatu, New Caledonia, Palau, and Kosrae, Caroline Islands. Ryan (1980:62) reported three species of *Kuhlia* in a checklist of the brackish and freshwater fishes of Fiji: *K. rupestris*, *K. bilunulata* (= *munda*), and *K. marginata*. Of the latter he wrote, "Recorded from Rewa River. I have collected several specimens from Wafbasqa village on the Wainisavulevu Creek. Up to 220 mm." The presence of *K. marginata* in Fiji is also confirmed by Johnson Seeto (pers. comm.).

MATERIAL EXAMINED: TAIWAN, Lanyu (Orchid Island), USNM 19125, 90 mm. INDONESIA, BMNH 32743, 107 mm. Sulawesi, MNHN 990, 138 mm (holotype of *Dules maculatus*); BPBM 26618, 93 mm. Java, MNHN 9002, 93 mm (holotype of *Dules marginata*). PHILIPPINES, Luzon, USNM 184755, 2: 70–76 mm. Palawan, USNM 184756, 2: 93–130 mm. PAPUA NEW GUINEA, Sepik River, Marienberg, CAS 125575, 101 mm. New Britain, CAS 210343, 2: 89–98 mm; CAS 210350, 2: 99–105 mm. PALAU, Arumonogui River, BPBM 9872, 128 m. Babelthuap, CAS 206602, 2: 43–116 mm; CAS 206617, 14: 59–73 mm; CAS 210212, 3: 52–102 mm; CAS 210345, 123 mm. SOLOMON ISLANDS, Bougainville, ROM 28721, 179 mm. VANUATU, Espiritu Santo, USNM 122849, 3: 20.5–48.5 mm. Erromango, USNM 360092, 2: 73–75 mm. NEW CALEDONIA, MNHN 1992-610, 15: 42–148 mm; MNHN 1992-616, 4: 86–123 mm. CAROLINE ISLANDS, Kosrae (Kusaie), USNM 163477, 80 mm; USNM 65886, 5: 76–112 mm; USNM 65887, 99 mm.

Kuhlia mugil (Forster)
Figures 4, 5; Tables 1–3

Sciaena mugil Forster in Bloch and Schneider, 1801:541 (type locality, Tahiti).
Dules taeniurus Cuvier in Cuvier and Valenciennes, 1829:114 (type locality, Java).
Perca argentea Bennett, 1830, pl. 22 (type locality, Sri Lanka) (homonym of *P. argentea* Linnaeus).
Dules Bennetti Bleeker, 1853:32 (type locality, Sri Lanka) (new name for *Perca argentea* Bennett).
Kuhlia arge Jordan & Bollman, 1890:159 (type locality, San Cristóbal, Galápagos Islands).
Dules taeniurus malpeloensis Fowler, 1944:301, fig. 176 (type locality, Malpelo Island, Colombia).

DIAGNOSIS: Dorsal-fin rays X,10–11 (usually 10); anal-fin rays III,10–12 (usually 11); pectoral-fin rays 13–15; lateral-line scales 49–52 (usually 51); gill rakers 9–11 + 24–27; preorbital serrae 11–14; body depth 2.75–3.05 in SL; caudal fin deeply forked, the caudal concavity 1.85–2.6 in head length. Silvery, the front of snout and chin blackish; caudal fin white with a median dark stripe and two broad oblique black bands across each lobe, the lobe tips white; a dusky band in outer part of soft portion of dorsal fin except for white tip of high anterior part. Juveniles of about 20–30 mm SL have the median and outer black bands in the caudal-fin lobes, but the middle band is represented only by a black spot basally in the outer part of each lobe. Largest specimen examined, 194 mm SL.

REMARKS: Most authors have used the name *Kuhlia taeniura* (Cuvier) for this species. Randall (1973:187) showed that the earliest name is *K. mugil* (Forster in Bloch and Schneider, 1801).

Kuhlia mugil is the most wide-ranging species of the genus, occurring from the Red

FIGURE 4. *Kuhlia mugil*, BPBM 7057, 175 mm SL, Minami Tori Shima (Marcus Island).

Sea and entire coast of East Africa to the eastern Pacific, where it ranges from Baja California to Colombia, including the Revillagigedo Islands, Clipperton Island, Isla del Coco, Galápagos Islands, and Malpelo Island. In the western Pacific it is distributed from southern Japan to central New South Wales and Lord Howe Island. It is absent from Easter Island, Pitcairn Islands, Marquesas Islands, and the Hawaiian Islands; the record from Johnston Island by Smith and Swain (1883:128), followed by Jordan and Evermann (1905:209, fig. 81), is a misidentification of *K. marginata* (= *sandvicensis*), as shown by Gosline (1955:451).

In the western Indian Ocean and the Red Sea *Kuhlia mugil* usually has 10 anal soft rays compared with 11 for Pacific specimens, and modally 49 instead of 51 lateral-line scales. Should further study demonstrate that the western Indian Ocean form is a distinct species, or if a subspecific name is needed, *K. sterneckii* Steindachner (1898), type locality Gulf of Aqaba, Red Sea, is available.

Kuhlia mugil typically occurs along exposed rocky shores. The young are common in tide pools, and adults are often seen in aggregations. Van der Elst (1981:184) reported that it is occasionally found in estuaries; however, Jordan and Seale (1906:255) wrote, "This species, unlike the others of the genus, never enters fresh water,..." Van der Elst stated that adults are mainly nocturnal and feed principally on planktonic crustaceans. Juveniles are seen throughout the year along the Natal coast, indicating year-around spawning.

MATERIAL EXAMINED: COLOMBIA, Malpelo Island, ANSP 70250, 116 mm (holotype of *Dules taeniurus malpeloensis*). GALÁ-

FIGURE 5. School of *Kuhlia mugil*, Enewetak Atoll, Marshall Islands.

PAGOS ISLANDS, San Cristóbal, USNM 41169, 2: 102–118 mm (syntypes of *Kuhlia arge*). Tower Island, CAS 37453, 113.5 mm. ISLA DEL COCO, LACM 22870, 111 mm; LACM 35473-2, 3: 50–65 mm. REVILLAGIGEDO ISLANDS, Clarion Island, LACM 23718, 9: 54–101 mm; USNM 59839, 4: 119–158 mm. Socorro Island, LACM W53-50, 8: 167–194 mm. CLIPPERTON ISLAND, LACM W59-296, 2: 137–140 mm. SOCIETY ISLANDS, Moorea, CAS 210198, 82 mm; CAS 210344, 4: 87–110 mm. RAPA, BPBM 17234, 3: 22–59 mm. AMERICAN SAMOA, Rose Atoll, BPBM 25903, 178 mm. WESTERN SAMOA, Upolu, BPBM 5953, 93 mm. TONGA, Tongatapu, BPBM 37992, 3: 20–30 mm. Vava'u, BPBM 38050, 27 mm; BPBM 28250, 23 mm. VANUATU, Efaté, BPBM 870, 109 mm; BPBM 1020, 159 mm; BPBM 10733, 8: 18–49 mm; BPBM 19737, 4: 21–24 mm. CORAL SEA, Chesterfield Islands, BPBM 33738, 136 mm. NORFOLK ISLAND, BPBM 34582, 118 mm. MINAMI TORI SHIMA (MARCUS ISLAND), BPBM 2416, 2: 45–51 mm; BPBM 7057, 175 mm; BPBM 8584, 6: 50–182 mm. CAROLINE ISLANDS, Puluwat Atoll, BPBM 24632, 2: 71–77 mm. Lamorek Island, BPBM 24621, 51 mm. PALAU, Augulpelu Reef, CAS 210348, 14: 89–110 mm. HELEN ISLAND (3° 52′N, 131° 49′E), BPBM 24621, 13: 22–86 mm. TAIWAN, BPBM 23199, 6: 23–41 mm; BPBM 23248, 46 mm. INDONESIA, Java, MNHN 166, 75.3 mm (holotype of *Dules taeniurus*). COCOS-KEELING ISLANDS, ANSP 131120-22, 14: 27.5–61 mm; ANSP 131169, 2: 40.5–44 mm. ANDAMAN SEA, Thailand, Similan Islands, BPBM 22808, 3: 73–85 mm. MASCARENE ISLANDS, Réunion, BPBM 20061, 4: 68–82 mm. MADAGASCAR, MNHN 32156, 96 mm. SOUTH AFRICA, Transkei, BPBM 36795, 30: 32–98 mm. OMAN, south coast, BPBM 36068, 7: 53–105 mm. RED SEA, Gulf

TABLE 3: Gill-Raker Counts of

	Upper-Limb Rakers							Lower-Limb Rakers[a]														
Species	7	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
malo		1	16	6								3	12	8								
marginata	18	17	1					2	11	17	6											
mugil			11	14	5											3	14	11	2			
munda			2	10	6										1	3	9	5				
nutabunda				5	12	1										2	8	6	2			
petiti			3	19	5											3	12	8	4			
rupestris	2	8	12						3	13	6											
salelea			4	5	3											7	4	1				
sandvicensis					15	30	8												8	21	19	5
xenura			3	26	19	1											2	25	17	5		

[a] Gill raker at angle included in lower-limb count.

of Aqaba, BPBM 35707, 152 mm; HUJ 3620, 3: 145–165 mm; HUJ 91119, 2: 72–78 mm; HUJ 17089, 4: 47–52 mm.

Kuhlia munda (De Vis)
Figure 6; Tables 1–3

Herops munda De Vis, 1884:392 (type locality, Cardwell, Queensland).
Dules humilis De Vis, 1884:396 (type locality, Queensland).
Kuhlia proxima Kendall & Goldsborough, 1911:282, pl. 3, fig. 2 (type locality, Fiji).
Kuhlia bilunulata Herre, 1935:404 (type locality, small river flowing into Suva Harbor, Viti Levu, Fiji); Herre, 1936:145, fig. 7.

DIAGNOSIS: Dorsal-fin rays X,10–11 (rarely 10); anal-fin rays III,11; pectoral-fin rays 13–14 (usually 14); lateral-line scales 47–49; gill rakers 9–11 + 23–26; preorbital serrae 14–21; body depth 2.55–2.85 in SL; orbit diameter 2.55–2.8 in head length; maxilla usually reaching to below anterior margin of pupil; caudal fin forked, the caudal concavity 2.5–3.0 in head length. Color silvery, the front of lips and upper half of snout blackish; caudal fin yellow with a very broad black posterior margin, the upper and lower margins narrowly black, but broadening toward base, often connecting across base of fin. Largest specimen examined, 134 mm SL.

REMARKS: All specimens for which there is information on habitat were taken from brackish or fresh water. Ryan (1980:62) identified specimens he collected in streams around Suva, Fiji, as *K. bilunulata;* he remarked on their having "brilliant yellow caudal fins." Johnson Seeto (pers. comm.) informed us that *K. munda* is typically found in brackish water in Fiji, in contrast to *K. rupestris* and *K. marginata* that occur in fresh water.

De Vis (1884) described *Herops munda* as a new genus and species of priacanthid fish from a single 5-inch (13-cm) specimen from Cardwell, Queensland. There was no mention of its being taken in fresh water or in the sea. In the same publication, four pages later, he described *Dules humilis* from one 4-inch (10-cm) specimen, giving only Queensland as the locality.

Kendall and Goldsborough (1911:283) differentiated their *Kuhlia proxima* from *Dules humilis* De Vis by its having a larger eye, shorter snout, and longer third anal-fin spine than *humilis.* They quoted De Vis, "In *D. humilis* the second anal spine is as long as and stronger than the third."

McCulloch (1929:167) placed *Dules humilis* in the synonymy of *Kuhlia munda.* He was followed by Paxton et al. (1989:540), who gave the range of *K. munda* in Australia as NE Queensland from Cape York to Cardwell (18° 16′ S).

Central Pacific Species of *Kuhlia*

	Total Gill Rakers																			
	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
malo						1	1	12	5	4											
marginata	2	7	12	10	4	1															
mugil												3	13	8	4	2					
munda												4	9	4	1						
nutabunda												2	2	6	6	2					
petiti												4	11	7	3	2					
rupestris			3	7	7	5															
salelea											3	3	6								
sandvicensis																4	10	18	11	7	3
xenura												1	3	13	18	12	2				

FIGURE 6. *Kuhlia munda*, ROM 51907, 72 mm, mangroves, Viti Levu, Fiji (R. Winterbottom).

McCulloch listed *Kuhlia proxima* as a synonym of *K. munda*. He was followed by Fowler (1949:49), who also relegated *K. bilunulata* to the synonymy of *K. munda*.

We obtained the following counts and measurements of a syntype of *Kuhlia munda* in the Australian Museum (AMS I.421, 105 mm SL) from Sally Reader: pectoral-fin rays 13 (14 on the other side); lateral-line scales 50; gill rakers 12 + 25; preorbital serrae 13;

FIGURE 7. *Kuhlia nutabunda*, BPBM 6626, 230 mm SL, Easter Island.

body depth 42 mm; head length 36 mm; snout length 7.25 mm; fleshy orbit diameter 14 mm; second anal spine 13.9 mm; and third anal spine 15.6 mm. Jeff Johnson of the Queensland Museum provided the following counts of the holotype of *Kuhlia humilis* (QM I.22, 85 mm SL): pectoral rays 14; lateral-line scales 49; gill rakers 11 + 25.

From these data; our examination of specimens from Fiji, New Caledonia, and Vanuatu that we had initially identified as *Kuhlia proxima;* and De Vis' color note for the caudal fin of both *munda* and *humilis*, "Caudal broadly dark-edged all around," we regard *K. proxima* as a probable synonym of *K. munda.*

MATERIAL EXAMINED: FIJI, BMNH 1855.8.16, 2: 71–74 mm. Viti Levu, CAS 124427, 12: 21–63 mm (paratypes of *Kuhlia bilunulata*); ROM 51906, 79.5 mm; ROM 51907, 3: 68–73 mm; USNM 65889, 95 mm (holotype of *K. proxima*); USNM 109857, 2: 26–38 mm; USNM 112736, 126 mm. Totoya, USNM 236690, 57 mm. NEW CALEDONIA, MNHN 1992-403, 4: 32–73 mm; MNHN 1992-408, 8: 34–54 mm. VANUATU, Erromango, USNM 360091, 2: 83–120 mm.

Kuhlia nutabunda Kendall & Radcliffe
Figures 7–9; Tables 1–3

Kuhlia nutabunda Kendall & Radcliffe, 1912:105, pl. 3, fig. 1 (type locality, Easter Island).

DIAGNOSIS: Dorsal-fin rays X,11; anal-fin rays III, 10–11 (rarely 10); pectoral-fin rays 14–15 (rarely 15); lateral-line scales 49–50 (usually 50); gill rakers 10–12 + 24–27; preorbital serrae 11–14 (obsolete in large specimens); body depth 2.7–3.1 in SL; dorsal profile of head of adults slightly to moderately concave; eye very large, the orbit diam-

FIGURE 8. *Kuhlia nutabunda*, BPBM 6625, 107 mm SL, Easter Island.

eter 2.55–2.95 in head length; second anal-fin spine 73–87% length of third spine; caudal fin deeply forked, the caudal concavity 1.7–2.2 in head length; pelvic-fin spine 2.5–2.9 in head length. Silvery, the fins dusky, the caudal fin with a narrow blackish posterior margin. Black margin of caudal fin more evident on juveniles than adults, and the upper and lower margins of the fin may be black as well. Largest specimen, 242 mm SL.

REMARKS: *Kuhlia nutabunda* is known only from Easter Island. Specimens were collected by J.E.R. and Gerald R. Allen in 1969 from along exposed rocky shore, in large tide pools, and over sand substratum near rocky shore in Anakena Bay. It was often seen in aggregations (Figure 9).

The species was described from the 115-mm holotype and 90 paratypes. The holotype and 53 of the paratypes were examined by us at the U.S. National Museum of Natural History. The remaining 37 paratypes were given to the Museum of Comparative Zoology of Harvard University.

This species is most similar to *Kuhlia sandvicensis*, sharing with it the large eyes, concave dorsal head profile, and caudal-fin color. It differs slightly in pectoral-fin ray, lateral-line scale, and gill-raker counts (see Tables 1–3), in having a shorter second anal-fin spine relative to the length of the third anal-fin spine, and in having shorter pelvic-fin spines.

MATERIAL EXAMINED: EASTER ISLAND, USNM 65550, 53: 24–95 mm (paratypes of *Kuhlia nutabunda*); USNM 65551, 115 mm (holotype of *K. nutabunda*); BMNH 1913.12:7.2, 162 mm; BPBM 6624, 13: 32–92 mm; BBPM 6625, 11: 32–113 mm; BPBM 6626, 21: 227.5–242 mm.

FIGURE 9. School of *Kuhlia nutabunda*, Easter Island.

Kuhlia petiti Schultz
Figures 10, 11; Tables 1–3

Dules taeniurus (non Cuvier) Fowler, 1938:70 (Nuku Hiva, Marquesas Islands).
Kuhlia petiti Schultz, 1943:102, fig. 7 (type locality, Hull Island, Phoenix Islands).
Dules taeniurus marquesensis Fowler, 1944:326, fig. 177 (type locality, Nuku Hiva, Marquesas Islands).

DIAGNOSIS: Dorsal-fin rays X,11–12 (usually 12); anal rays III,11–12 (usually 12); pectoral-fin rays 13–15 (rarely 13 or 15); lateral-line scales 51–53 (usually 51); gill rakers 9–11 + 24–27; preorbital serrae 11–20; body depth 2.6–3.1 in SL; maxilla ending beneath anterior third of eye; caudal fin forked, the caudal concavity 2.0–2.4 in head length. Silvery, the front of the snout and chin a little blackish; naked part of caudal fin black with a large, C-shaped, white marking basally in each lobe, the lobe tips white; outer part of anterior half of soft portion of dorsal fin broadly blackish (nearly half of first few rays and adjacent membranes blackish). Largest specimen examined, 201 mm SL.

REMARKS: *Kuhlia petiti* is known only from the Phoenix Islands, the Marquesas Islands (where it seems to be the only species of the genus), and Malden Island in the Line Islands. It might be expected at other southern Line Islands such as Starbuck, Vostok, Flint, and Caroline Atoll (recently renamed Millennium Island), and the northern Cook Islands. J.E.R. and John L. Earle encountered a school of about 100 adults along a rocky shore at Eiao in the northern Marquesas. One specimen was collected, and an underwater photograph was taken of part of the school (Figure 11).

The 17 specimens of BPBM 25524, 25–66 mm, were collected at Canton Atoll in the Phoenix Islands by nightlighting.

MATERIAL EXAMINED: PHOENIX ISLANDS, Hull Island, USNM 114986, 108 mm (holotype of *Kuhlia petiti*); USNM 114992, 20: 19–48 mm (paratypes of *K. petiti*). Enderbury Island, USNM 114988, 8: 49–60 mm (paratypes of *K. petiti;* three specimens of this lot

FIGURE 10. *Kuhlia petiti*, BPBM 12146, 136 mm SL, Ua Pou, Marquesas Islands.

given to Museum of Comparative Zoology of Harvard University); USNM 114991, 69: 20–116 mm. Canton Island, USNM 114987, 2: 68–84 mm (labeled as paratypes of *K. petiti*, but not listed by Schultz [1943]); USNM 114989, 3: 64–69 mm; USNM 114990, 18: 34–105 mm (paratypes of *K. petiti*); BPBM 25492, 201 mm; BPBM 25524, 17: 25–66 mm. LINE ISLANDS, Malden Island, BPBM 10488, 190 mm. MARQUESAS ISLANDS, Nuku Hiva, ANSP 70063, 51.5 mm (holotype of *Dules taeniurus marquesensis*); BPBM 10447, 2: 160–166 mm; BPBM 10458, 14: 68–157 mm; BPBM 12649, 2: 108–149 mm. Ua Pou, BPBM 12146, 6: 70–136 mm; BPBM 26349, 4: 65–101 mm. Eiao, BPBM 38517, 168 mm.

Kuhlia rupestris (Lacépède)
Figures 12, 13; Tables 1–3

Centropomus rupestris Lacépède, 1802:252, 273 (type locality, Réunion).

Perca ciliata Cuvier (ex Kuhl & van Hasselt) in Cuvier and Valenciennes, 1828:52 (type locality, Java).

Dules guamensis Valenciennes in Cuvier and Valenciennes, 1831:474 (type locality, Guam).

Dules vanicolensis Valenciennes in Cuvier and Valenciennes, 1831:478 (type locality, Vanicolo, Santa Cruz Islands).

Dules haswellii Macleay, 1881:359 (type locality, Rockingham Bay, Queensland).

Kuhlia rupestris hedleyi Ogilby, 1897:767 (type locality, New Caledonia).

Kuhlia caerulescens Regan, 1913:376, fig. 68 (type locality, Stirling Island, Solomon Islands).

DIAGNOSIS: Dorsal-fin rays X,10–11 (usually 11); anal-fin rays III,10–11 (usually 10); pectoral-fin rays 13–14 (usually 14); lateral-line scales 39–41; gill rakers 7–9 + 17–19; preorbital serrae 10–15 (obsolete on

FIGURE 11. School of *Kuhlia petiti*, Eiao, Marquesas Islands (J. L. Earle).

large specimens); body depth 2.6–3.0 in SL; mouth large for the genus, the maxilla reaching to below posterior half of eye; caudal fin emarginate, the lobes somewhat rounded, the caudal concavity 5.3–8.7 in head length. Silvery, the scales dorsally on body with black edges, those on side with a black bar or spot; juveniles with a broad black zone, edged above and below in white, in soft portion of dorsal fin, and each lobe of caudal fin with a large, white-edged black spot; black areas in these fins enlarge with growth until in adults most of these fins black (the caudal with upper and lower edges and corners whitish). Reported to 450 mm total length and a weight of 2.7 kg (Smith in Smith and Heemstra [1986:508]).

REMARKS: *Kuhlia rupestris* occurs in fresh and brackish water, but it is reported to venture into adjacent marine habitats. It is, however, primarily a freshwater fish. The two specimens of CAS 210346 were taken from the Malatgaw River in Palawan at an altitude of 800 feet (240 m). The species ranges from East Africa to American Samoa; in the western Pacific from the Ryukyu Islands south to Queensland and New Caledonia. The records from Hawai'i by Fowler (1938, 1940, 1949) are mistakes.

We place *Kuhlia caerulescens* Regan in the synonymy of *K. rupestris*. Regan gave the number of gill rakers on the lower limb of the first gill arch as 7. This is a probable printer's error for 17 (our count of the gill rakers of the holotype is 8 + 17).

MATERIAL EXAMINED: MAURITIUS, BPBM 20130, 180 mm. PHILIPPINES, Palawan, CAS 210346, 2: 137–147 mm. TAIWAN, USNM 191264, 6: 27–65 mm. PALAU, BPBM 9873, 154 mm. SOLOMON ISLANDS, Stirling Island, BMNH 1884.3.24.95, 242 mm (holotype of *Kuhlia caerulescens*). Guadalcanal, CAS 210191, 2: 41–48 mm; USNM uncat., 2: 39–48 mm. VANUATU, Erromango, USNM 360093, 62 mm. Malekula Island, CAS 125023, 3: 64–143 mm. MAR-

FIGURE 12. *Kuhlia rupestris*, BPBM 20130, 180 mm SL, Mauritius.

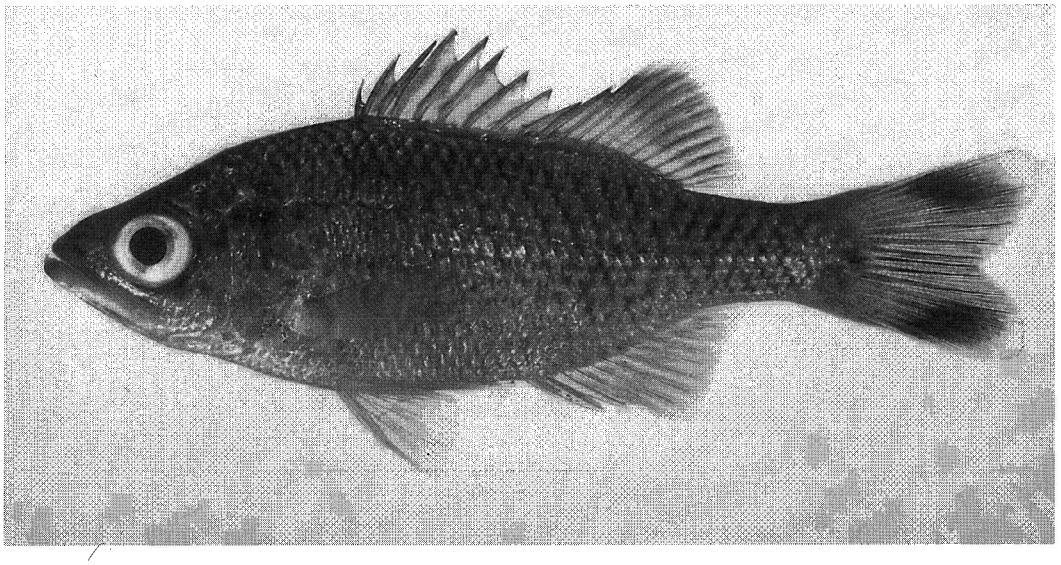

FIGURE 13. *Kuhlia rupestris*, USNM 360093, 62 mm SL, Erromango, Vanuatu (J. T. Williams).

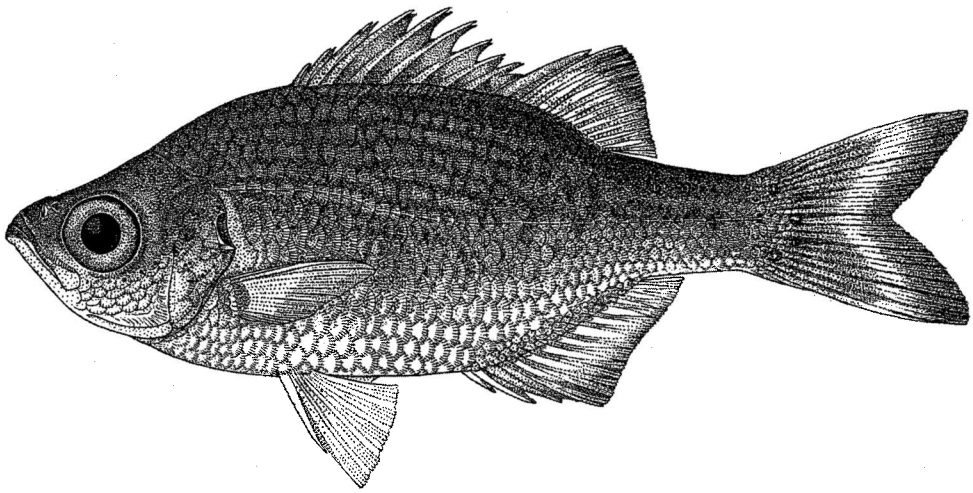

FIGURE 14. Holotype of *Kuhlia salelea*, USNM 114984, 95 mm SL, Tutuila, American Samoa (after Schultz [1943]).

IANA ISLANDS, Guam, MNHN 3060, 134 mm (syntype of *Dules guamensis*); BPBM 91, 145 mm; BPBM 92, 184 mm. Saipan, USNM 150026, 160 mm. CAROLINE ISLANDS, Pohnpei (Ponape), USNM 224342, 29: 33–149 mm. Kosrae (Kusaie), BPBM 28331, 12: 48–154 mm. FIJI, Viti Levu, CAS 5913, 54 mm. WESTERN SAMOA, Upolu, USNM 174740, 3: 28–228 mm.

Kuhlia salelea Schultz
Figure 14; Tables 1–3

Kuhlia salelea Schultz, 1943:100, fig. 6 (type locality, Tutuila, American Samoa).

DIAGNOSIS: Dorsal-fin rays X,11; anal-fin rays III,11–12; pectoral-fin rays 14; lateral-line scales 40–42; gill rakers 9–11 + 24–26; preorbital serrae 23–26; body depth 2.6–3.0 in SL; orbit diameter 2.9–3.2 in head length; maxilla extending to or slightly posterior to a vertical at anterior edge of pupil; caudal fin moderately forked, the caudal concavity 2.8–3.1 in head length. Color in alcohol brown, the edges of the scales dorsally on body dark brown, with small dark brown spots on about upper half of body; tip of lower jaw dark brown; caudal fin with a broad, dark brown posterior margin and narrow, pale upper and lower edges; soft portions of dorsal and anal fins with a dusky outer band, broad anteriorly and narrowing posteriorly, the ray tips pale. In life probably silvery, the dark markings black or blackish. Largest specimen examined, 114 mm.

REMARKS: *Kuhlia salelea* is currently known only from fresh water in Tutuila, American Samoa, and Upolu, Western Samoa. It was named from the native Samoan word for the species, *salele.*

This species is most similar to two other freshwater species, *K. marginata* from the western Pacific and *K. malo* from the Society Islands. It differs from both in its higher number of lower-limb gill rakers (Table 3).

MATERIAL EXAMINED: AMERICAN SAMOA, Tutuila, USNM 114984, 95 mm (holotype of *Kuhlia salelea*); USNM 114985, 32: 26–117 mm (paratypes of *K. salelea;* Schultz listed 37 specimens, but five were transferred to the Museum of Comparative Zoology of Harvard University). WESTERN SAMOA, Upolu, Apia, CAS 72, 114 mm; CAS 109027, 10: 17–88 mm; USNM 52276, 9: 23–94 mm (paratypes of *K. salelea*); USNM 126279, 3: 28–78 mm; BPBM 5152, 108 mm; BPBM 5370, 64 mm.

FIGURE 15. *Kuhlia sandvicensis*, BPBM 8956, 132 mm SL, Johnston Island.

Kuhlia sandvicensis (Steindachner)
Figures 15, 16; Tables 1–3

Moronopsis argenteus, var. *sandvicensis* Steindachner, 1876:205 (type locality, Hawaiian Islands).
Moronopsis sandvicensis Steindachner, 1887: 230, pl. 1, fig. 1 (Hawaiian Islands).
Kuhlia malo (non Valenciennes) Bryan & Herre, 1903:129 (Marcus Island = Minami Tori Shima).
Kuhlia malo (non Valenciennes) Jordan & Evermann (in part), 1905:207 (Hawaiian Islands).
Kuhlia sandvicensis Regan (in part), 1913:381 (Hawaiian Islands).
Dules sandvicensis Fowler, 1938:169 (Bora Bora).
Kuhlia sandvicensis Schultz, 1943:101 (Phoenix Islands).
Kuhlia sandvicensis Harry, 1953:82 (Raroia, Tuamotu Archipelago).
Kuhlia marginata (non Cuvier) Schultz in Schultz and Collaborators, 1953:327 (Marshall Islands).
Kuhlia marginata (non Cuvier) Gosline, 1955:471 (Johnston Island).
Kuhlia marginata (non Cuvier) Randall, 1955:79 (Nukunau, Gilbert Islands = Kiribati).
Kuhlia marginata (non Cuvier) Bagnis et al., 1972:270, figs. on pp. 270, 271 (Society Islands).
Kuhlia marginata (non Cuvier) Randall, 1999:12 (Pitcairn Islands).

DIAGNOSIS: Dorsal-fin rays X,11–12 (one of 57 specimens with 12); anal-fin rays III,11–12 (one of 57 with 12); pectoral-fin rays 13–15 (rarely 15); lateral-line scales 49–51 (usu-

ally 50, rarely 49); gill rakers 11–13 + 27–30; preorbital serrae 10–20; body depth 2.6–2.9 in SL; dorsal profile of head nearly straight; eye not very large, the orbit diameter 3.0–3.45 in head length; caudal fin strongly forked, the caudal concavity 1.45–1.7 in head length; third anal-fin spine slightly longer than second spine (second spine 88–95% length of third spine); pelvic-fin spine 2.3–2.9 in head length. Color silvery with a coarse silver and black reticulum dorsally on head in life; posterior edge of caudal fin blackish. Largest specimen examined, 214 mm SL, from Wake Island.

REMARKS: Günther (1873:24) was the first to record a species of *Kuhlia* from the Hawaiian Islands, identifying it as *Dules marginatus* Cuvier, and noting the Hawaiian name as "Haholehole." He also listed the species from Indonesia, Fiji, Marshall Islands, Gilbert Islands, and Society Islands.

Steindachner (1876) briefly described *sandvicensis* as a variety of *Moronopsis argentea* (Bennett, 1830), now known as a synonym of *Kuhlia mugil.* Steindachner (1887) elevated *sandvicensis* to a species, described it more fully, and provided a very good drawing. He gave the total length of his type specimens as 26–28 cm but did not indicate how many he examined, nor was any designated as a holotype.

Boulenger (1895:40) correctly placed the Hawaiian species in *Kuhlia*, but used the specific name *malo* and put Steindachner's *sandvicensis* in synonymy. He was followed in the use of the name *Kuhlia malo* by Fowler (1900), Steindachner (1901), Jenkins (1903), Snyder (1904), Jordan and Evermann (1905), and Jordan and Jordan (1922).

In a revision of *Kuhlia*, Regan (1913:381) resurrected the name *K. sandvicensis* and listed specimens from the Hawaiian Islands and Tahiti.

Gosline (1955:471) showed that *Kuhlia sandvicensis* is endemic to the Hawaiian Islands; he recorded specimens from throughout the archipelago.

When only one endemic species of *Kuhlia* was known from the Hawaiian Islands, there was no question that the correct name was *K. sandvicensis.* With the recent discovery that there are two species in the Hawaiian Islands, Steindachner's description and illustration were carefully analyzed. Unfortunately he did not give the number of pectoral-fin rays or a count of the gill rakers, but he did give the count of lateral-line scales as 51 plus 5 extending onto the base of the caudal fin. As shown in Table 2, this count strongly favors the species that ranges to many other islands besides those of Hawai'i. The drawing shows a nearly straight dorsal profile of the head (actually the part from the interorbital to the dorsal fin origin is slightly convex). A specimen of the endemic Hawaiian species of this size would have a slightly concave profile. The eye size of 3 in the head length also slightly favors the wide-ranging species. There is therefore little doubt from these characters that the name *Kuhlia sandvicensis* can no longer be used for the endemic Hawaiian species.

Ernst Mikschi, curator of fishes of the Naturhistorische Museum in Vienna, was asked to check the syntypes of *Moronopsis sandvicensis* for confirmation of the lateral-line scale count and to make counts of pectoral-fin rays and gill rakers. He reported that only one specimen, NMW 42484, is on the shelf as a syntype, but it is too large to have been one of Steindachner's types. He searched for the missing syntypes but was unable to find them. He added that this does not mean they are lost because an estimated 40% of the NMW fish collection is uncataloged.

This species has been misidentified most recently as *K. marginata.* As noted above, *K. marginata* is a freshwater species from the western Pacific. Fowler (1928:169) recorded many specimens of *Kuhlia marginata* from the Hawaiian Islands, as well as other localities, but the meristic data he provided, such as lateral-line scales 38–47, indicate that his specimens could not be from Hawai'i.

Initially there seemed to be no available name for the endemic Hawaiian species of *Kuhlia* that has long been misidentified as *sandvicensis;* however, as is explained in the next species treatment, *Kuhlia xenura* (Jordan & Gilbert) is based on two specimens of this species, overlooked because of an erroneous type locality of El Salvador, Central America.

Judging from the meristic data, general morphology, and caudal-fin coloration, *K.*

FIGURE 16. *Kuhlia sandvicensis*, Maui, Hawaiian Islands.

sandvicensis is most similar to the endemic Easter Island *K. nutabunda* and the endemic Hawaiian *K. xenura*. It differs from both in its smaller eye, straighter dorsal head profile, higher gill-raker counts, and the reticular color pattern dorsally on the head. In addition, it differs from *xenura* in the strongly modal count of 14 pectoral-fin rays versus 15 for *xenura*.

Gosline (1955) compared Hawaiian specimens that he identified as *K. sandvicensis* (now *K. xenura*), and specimens of *K. marginata* (now *K. sandvicensis*), noting that the latter has a lower average pectoral-ray count and a higher gill-raker count. He examined specimens of what he called *K. marginata* from Johnston Island, Line Islands, Phoenix Islands, northern Cook Islands, Wake Island, and Minami Tori Shima (Marcus Island), and he accepted the record by Schultz in Schultz and Collaborators (1953:324) from the Marshall Islands. He had no specimens of *marginata* from the Hawaiian Islands; however, we now know from a comment made by Tester and Takata (1953:7), in their report on a study of the biology of this species, that their material included both species. They wrote, "In some of the small aholehole, the top of the head is whitish with black reticulations...." It is also clear from the description of *Kuhlia malo* by Jordan and Evermann (1905:207) that they had specimens of both Hawaiian species of the genus.

We can add the Pitcairn Islands, Tuamotu Archipelago, Society Islands, Rapa, and Kiribati to the localities for this species given by Gosline. Meristic data for this species for Tables 1–3 were taken from all available specimens except juveniles; no differences were noted in counts between Hawaiian specimens and those from other localities.

Two adult specimens from Wake Island, BPBM 3929, 172–212 mm, are perplexing in having 14 pectoral-fin rays, 50–51 lateral-line scales, and 12 + 28 gill rakers, hence the counts for *sandvicensis*, but the largest specimen has an unusually large eye for the species, 2.8 in the head length, and the smallest an eye size that is marginal for the species, 3.0 in the head. Four other specimens from Wake, CAS 150071, 3: 41–97 mm, and CAS 212859, 214 mm SL, are typical in all respects to *sandvicensis*, including an eye diameter 3.3 in the head length for the large specimen. More specimens should be obtained from Wake Island.

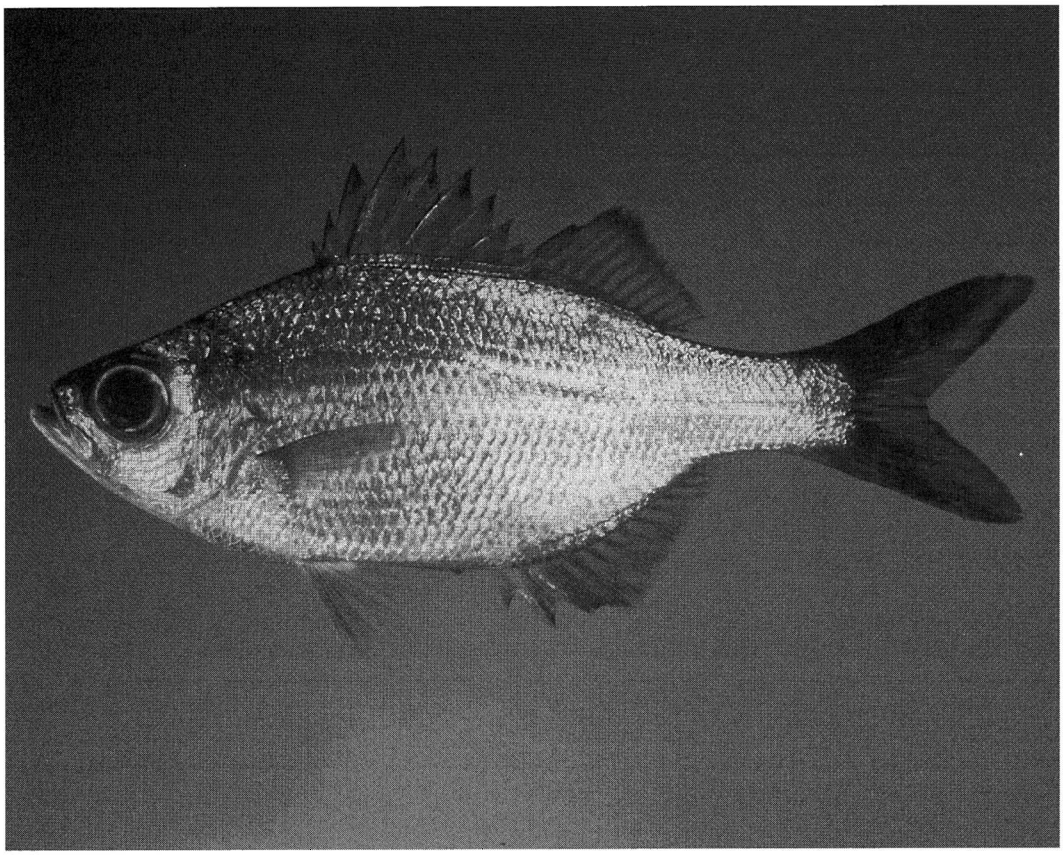

FIGURE 17. *Kuhlia xenura*, BPBM 11533, 121 mm, O'ahu, Hawaiian Islands.

MATERIAL EXAMINED: HAWAIIAN ISLANDS, Hawai'i, Puakō Bay, USNM 55128, 134 mm. Kalapana, AMS I.40256-001, 171 mm; ANSP 177868, 186.5 mm; BMNH 2000.5.8.1, 183 mm; BPBM 38712, 187 mm; CAS 212862, 157 mm; LACM 54291-1, 182.5 mm; MNHN 2000-1060, 187.5 mm; ROM 72244, 190 mm; USNM 361238, 183.5 mm. O'ahu, BPBM 37390, 4: 28–97.5 mm; CAS 213279, 14: 44–133 mm. JOHNSTON ISLAND, BPBM 3928, 110 mm; BPBM 3930, 33 mm; BPBM 8956, 132 mm. PITCAIRN ISLANDS, Ducie Atoll, BPBM 12250, 2: 159–161 mm; BPBM 17125, 2: 200–202 mm. Henderson Island, BPBM 17063, 3: 25–159 mm. Pitcairn Island, BPBM 16737, 8: 109–165 mm. TUAMOTU ARCHIPELAGO, Rangiroa Atoll, BPBM 10253, 7: 49–81 mm. RAPA, BPBM 12881, 23: 43–98.5 mm. Marotiri (Ilots de Bass), BPBM 10354, 3: 97.5–115 mm. SOCIETY ISLANDS, Tahiti, BMNH 73.4.3.65, 167 mm. COOK ISLANDS, Mangaia, CAS 210189, 4: 24.5–52 mm. LINE ISLANDS, Malden Island, BPBM 38724, 212 mm. Tabuaeran (Fanning Island), BPBM 10904, 198 mm. PHOENIX ISLANDS, Hull Island, USNM 11500, 3: 24–114 mm. WAKE ISLAND, CAS 150071, 3: 41–97 mm; CAS 212859, 214 mm. MINAMI TORI SHIMA (MARCUS ISLAND), BPBM 7058–7060, 12: 49–198 mm.

Kuhlia xenura (Jordan & Gilbert)
Figures 17–19; Tables 1–3

Dules marginatus (non Cuvier) Günther (in part), 1873:24 (Hawaiian Islands).
Xenichthys xenurus Jordan & Gilbert,

1882:454 (questioned type locality, San Salvador, El Salvador).

Kuhlia malo (non Valenciennes) Boulenger (in part), 1895:41 (Hawaiian Islands).

Kuhlia malo (non Valenciennes) Steindachner, 1901:483 (Laysan and Honolulu).

Kuhlia malo (non Valenciennes) Jordan & Evermann (in part), 1905:207 (Hawaiian Islands).

Kuhlia sandvicensis (non Steindachner) Regan (in part), 1913:381 (Hawaiian Islands).

Kuhlia sandvicensis (non Steindachner) Gosline, 1955:471 (Hawaiian Islands).

Kuhlia sandvicensis (non Steindachner) Gosline & Brock, 1960:159 (Hawaiian Islands).

Kuhlia sandvicensis (non Steindachner) Randall, 1985:16, fig. 32 (Hawaiian Islands).

DIAGNOSIS: Dorsal-fin rays X,11–12 (rarely 12); anal-fin rays III,10–11 (rarely 10); pectoral-fin rays 14–15 (usually 15); lateral-line scales 49–51 (usually 49, rarely 51); gill rakers 9–12 + 25–28; preorbital serrae 11–18; body depth 2.3–2.7 in SL; dorsal profile of head of adults slightly concave; eye large, 2.6–2.95 in head length; second anal spine 86–98% length of third spine; pelvic spine 2.2–2.5 in head length; caudal fin deeply forked, the caudal concavity 1.8–2.0 in head length. Silvery, the caudal fin dusky to dark gray with a narrow black posterior margin and often a pale submarginal band. Largest specimen examined, 222 mm SL, from Laysan.

REMARKS: The recent discovery of a second species of *Kuhlia* from the Hawaiian Islands prompted us to look at Steindachner's description of *sandvicensis* more closely. Regrettably, it strongly favors the species that is the least common in Hawai'i and ranges well beyond the Hawaiian Islands. The only other available name for the endemic Hawaiian species of *Kuhlia* is *K. xenura* (Jordan & Gilbert, 1882).

Jordan and Evermann (1896:1015) reclassified the haemulid fish *Xenichthys xenurus* Jordan & Gilbert, "supposed to come from San Salvador," as *Kuhlia xenura*. They wrote, "known from two specimens in the U.S. National Museum, bearing the label 'San Salvador. J. M. Dow.' But it is possible that they were brought by Dr. Stimpson from China and *Kuhlia xenura* may not be an American fish at all." Jeffrey T. Williams examined the two syntypes of *Kuhlia xenura*, USNM 4356, 122–132 mm SL, for us. He counted 15–15 pectoral-fin rays for one specimen and 15–14 for the other, 49 lateral-line scales for each, and 11 + 26 and 11 + 27 gill rakers. The endemic Hawaiian species of *Kuhlia* is the only species with modally 15 pectoral rays, modally 49 lateral-line scales, and the only one with primary counts of 26 and 27 lower-limb gill rakers (see Tables 1–3). The largest syntype was sent to us on loan; we here designate it the lectotype. We conclude that the two syntypes of *K. xenura* are the Hawaiian endemic species long misidentified as *K. sandvicensis*.

Kuhlia xenura is a common inshore fish in Hawai'i that is often seen in schools (Figure 19). Tester and Takata (1953) prepared an extensive report on its biology (as *K. sandvicensis*) because it seemed to have potential as a tuna baitfish. They noted that small fish are found in fresh water, brackish habitats, and shallow water along the seashore. Those from fresh water feed mostly on algae, insects, planktonic crustaceans, and foraminifera, whereas those from brackish or salt water eat crustaceans (principally copepods and amphipods), insects, mollusk larvae, algae, spiders, and annelids. Intermediate-size fish (75–150 mm TL) are found in deeper water at the base of exposed cliffs, large tide pools, or in rivers or ponds. They eat mainly crustacean larvae, especially the larger stages of crabs and stomatopods, but also small quantities of insects and algae. Large fish (greater than 150 mm TL) from surf-pounded cliffs, in the caverns of outer reefs, and other exposed localities feed mainly on crustaceans (77.6% of the stomach contents, mostly crab larvae but also stomatopod larvae and amphipods) and polychaete worms (13.3% of the stomach contents). Tester and Takata failed to mention that this species is primarily nocturnal, at least as adults. This was pointed out by Gosline and Brock (1960:159) and Hobson (1974:948).

Tester and Takata noted that spawning takes place throughout the year, but mainly

FIGURE 18. *Kuhlia xenura*, Maui, Hawaiian Islands.

from December to June. There is no evidence of spawning in fresh or brackish water. Young fish first appear inshore at a total length of about 25 mm, "presumably some two months after hatching." The fish grow to about 100 mm by the end of the first year, and 150–175 mm by the end of the second. Maturity is attained at a total length of 175–200 mm.

It should be noted, as mentioned in the Remarks for *Kuhlia sandvicensis*, that Tester and Takata were unaware that there are two species of *Kuhlia* in the Hawaiian Islands. It is clear from their statement that some small individuals had a reticular pattern on the head that *K. sandvicensis* was among their specimens for the study of *K. xenura*.

MATERIAL EXAMINED: HAWAIIAN ISLANDS, ANSP 22922, 2: 59–64 mm; CAS 212860, 3: 142–155 mm; USNM 4356, 132 mm (lectotype of *Xenichthys xenurus* Jordan & Gilbert; erroneus type locality, USNM 109433, 25: 21–100 mm. Hawai'i, ANSP 27991, 61 mm; BPBM 28723, 54: 32–174 mm. Maui, BPBM 33458, 201 mm. O'ahu, BPBM 11533, 3: 100–121 mm; BPBM 37388, 73 mm; BPBM 37389, 107 mm; CAS 132013, 6: 85–130 mm; CAS 32013, 6: 82–128 mm. Laysan, BPBM 3923, 2: 155–157 mm; BPBM 3924, 222 mm; BPBM 3931, 7: 15–146 mm; BPBM 5287, 3: 80–128.5 mm. Lisiansky, BPBM 3932, 5: 99–121 mm. Midway, BPBM 10475, 3: 144–155 mm; BPBM 25461, 7: 82–130 mm; BPBM 25475, 55: 38–97 mm; BPBM 25516, 13: 25–103 mm.

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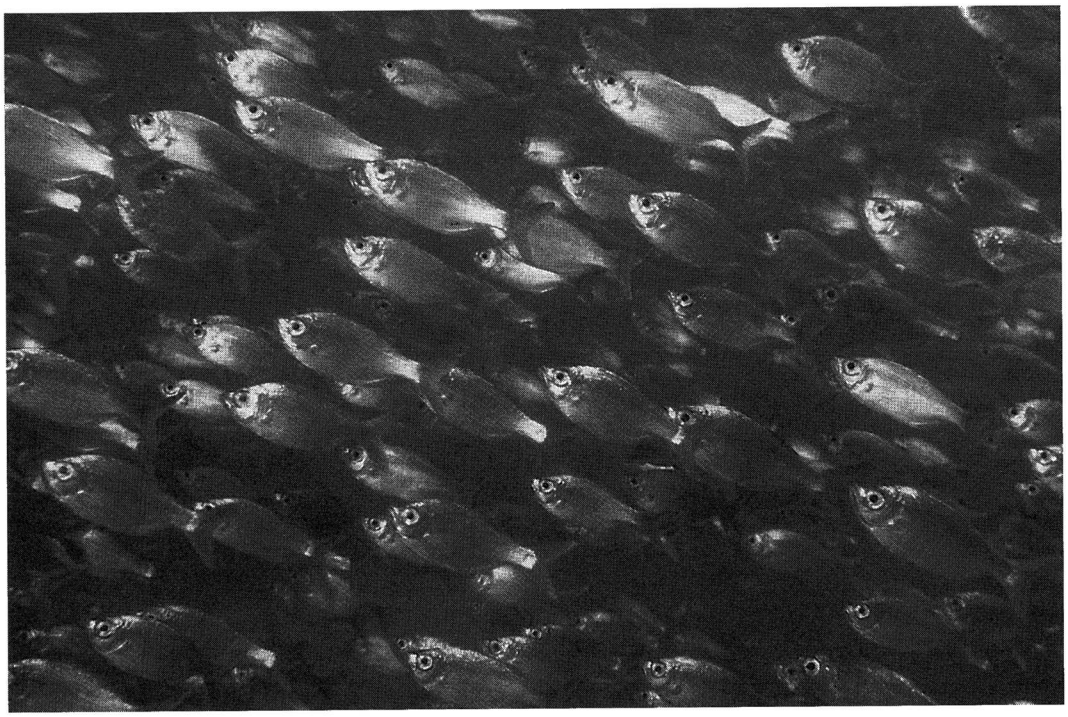

FIGURE 19. School of *Kuhlia xenura*, Maui, Hawaiian Islands.

delphia for data on the holotype of *Kuhlia boninensis* and the loan of specimens; Mark McGrouther and Sally Reader of the Australian Museum for the loan of the holotype of *Kuhlia munda;* Ernst Mikschi of the Naturhistorische Museum in Vienna for the information that Steindachner's syntypes of *Kuhlia sandvicensis* could not be located; Johnson Seeto of the University of the South Pacific for information on the freshwater species of *Kuhlia* in Fiji; Bernard Seret, Martine Desoutter, and Patrice Pruvost of the Muséum National d'Histoire Naturelle in Paris for data on specimens and the loan of material; David G. Smith, Jeffrey T. Williams, and Lisa Palmer of the National Museum of Natural History for information, the loan of specimens, and (from Williams) color photographs; Darrell Takaoka for alerting us to the presence of a second species of *Kuhlia* in Hawaiian waters; and Richard Winterbottom of the Royal Ontario Museum for a loan of specimens of *K. munda* from Fiji and providing color photographs. Arnold Y. Suzumoto helped with curatorial matters, and Loreen R. O'Hara took radiographs.

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