

## Japanese Moray Eels of the Genus *Uropterygius*

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**Abstract** New records, new extralimital synonymies, and a key to the species of the Japanese moray eels, genus *Uropterygius* are presented. The valid Japanese species (in boldface) and their synonyms are: *U. bennettii* (Günther, 1870)=*U. okinawae* Jordan et Snyder, 1901; *Gymnomuraena brevicauda* Regan, 1903; *Scuticaria unicolor* Seale, 1917; and *U. sealei* Whitley, 1932; *U. micropterus* (Bleeker, 1852)=*U. tinkhami* Fowler, 1945; *U. macrocephalus* (Bleeker, 1865)=*Gymnomuraena nectura* Jordan et Gilbert, 1882; *Anarchias knighti* Jordan et Starks, 1906; and *U. reidi* Schultz, 1943; *U. marmoratus* (Lacepède, 1803); *U. concolor* Rüppell, 1837, and; *U. nagoensis* Hatooka, 1984. *Uropterygius macrocephalus* is recognized as a widespread trans-Pacific species, and comments are included concerning the distribution of muraenid and ophichthid eels.

The observation and capture by the fourth author of a breeding moray eel, *Uropterygius macrocephalus*, led us to examine the specimens and Japanese records of *Uropterygius*. We discovered that the Japanese literature records of *Uropterygius* are few and mostly based on incorrect identifications and invalid names. We have identified six species of Japanese *Uropterygius* and, in doing so, discovered that those species possess several unreported synonyms and are thus more wide-ranging than previously believed.

### Methods

All measurements are straight-line (point to point). Total length, trunk length, and tail length were read on a 300-mm ruler with 0.5-mm gradations and were recorded to the nearest 0.5 mm. All other measurements were made with dial calipers and were recorded to the nearest 0.1 mm. Head length was measured from the snout tip to the posterodorsal margin of the gill opening; trunk length was taken from the end of the head to mid-anus. Vertebrae (which include the last centrum) were counted from radiographs. Institutional abbreviations for specimens are listed in the Acknowledgments section of this paper.

### Artificial key to the Japanese species of *Uropterygius*

1a. Body coloration in life and in preservative uniform tan to gray.....2

- 1b. Body coloration in life and in preservative mottled, spotted, or reticulated.....3
- 2a. Anus in front of or approximately at mid-length; a small to medium length eel, not exceeding 35 cm.....*U. concolor*
- 2b. Anus in posterior third of length; a large species, often exceeding 50 cm.....*U. bennettii*
- 3a. Gill opening above middle of side; mouth large, jaw teeth nearly triserial.....*U. nagoensis*
- 3b. Gill opening on or below middle of side; mouth moderate, jaw teeth bi- or triserial.....4
- 4a. Jaw teeth triserial; body coloration cream to gray, overlain with numerous dark roundish spots.....*U. marmoratus*
- 4b. Jaw teeth biserial; body coloration either pale, and overlain dorsally with a fine reticulation, or dark, with dark brown or black blotches.....5
- 5a. Posterior nostril above or behind middle of eye, which lies over or beyond middle of gape; eye minute, less than half of snout; body coloration dark, with dark brown or black blotches over a brown background; a stout species, to 40 cm.....*U. macrocephalus*
- 5b. Posterior nostril over front of eye, which lies ahead of middle of gape; eye moderate, more than half of snout; body coloration pale to gray, overlain above midline with a reticulated network of fine brown lines;

a small species, to 30 cm. . *U. micropterus*

***Uropterygius concolor*** Rüppell

(Japanese name: Koge-utsubo)

*Uropterygius concolor* Rüppell, 1837: 83, pl. 20, fig. 4 (type locality, Red Sea)

**Diagnosis.** A small species of *Uropterygius*. Head 8.0–9.1, head and trunk 1.87–2.17, and depth 24–29 in length. Cephalic lateral line pore single or absent before gill opening. Teeth biserial in jaws, the inner row larger and fewer. Two large depressible intermaxillary teeth, followed by smaller, uniserial vomerines. Vertebrae 117–123. Color in alcohol uniform tan, brown or gray, tail tip pale.

**Etymology.** From the Latin *concolor*, uniformly colored.

**Range.** Red Sea, Indian Ocean, and western and central Pacific Ocean.

**Remarks.** *Uropterygius concolor* was first reported from Japan by Sakai and Sato (1982) and by Hatooka and Yoshino (1982). Their specimens were from the mangrove swamps at the edge of the Miyara River, Ishigaki Island, the Oura River, and the Teima River, Okinawa Island, and from the brackish water of the Atetsu River, Amami Island. Subsequent specimens have been collected by the second author from the Teima River (FAKU 51401–51403, 202–263 mm; FAKU 51404, 279 mm; FAKU 51406, 192 mm).

We identify these Japanese specimens as *U. concolor* with some hesitation in that they lack an obviously enlarged cephalic lateral line pore. The pore series continues onto the head but lacks the single pore which is possessed by Red Sea and western Pacific specimens. The first author has examined a radiograph of the lectotype and Rüppell's paratype (SMF 7422) but was unable to compare it to the Japanese specimens. They do not differ in body proportions, dentition or vertebrae. We are unable to satisfactorily explain the difference in head pore conditions, but suggest that it might reflect the difference in the habitat from which the Japanese specimens were collected. Red Sea and western Pacific specimens were primarily collected from shallow reef tops, lacking the sediment associated with mangrove habitats. A similar condition exists within the Ophichthidae wherein those species occupying mud and soft sediments exhibit a re-

duction in the size and number of head pores, presumably an adaptation to avoid clogging by the substrate (McCosker, 1977).

***Uropterygius bennettii*** (Günther)

(Japanese name: Kikai-utsubo)

*Gymnomuraena bennettii* Günther, 1870: 135 (type locality, Mauritius).

*Uropterygius okinawae* Jordan and Snyder, 1901: 886, fig. 22 (type locality, Okinawa).

*Gymnomuraena brevicauda* Regan, 1903: 414 (type locality, Mauritius).

*Scuticaria unicolor* Seale, 1917: 94 (type locality, Society Islands, Tahiti).

*Uropterygius sealei* Whitley, 1932: 330. A replacement name for *Uropterygius unicolor* (Seale), preoccupied.

**Diagnosis.** A large, elongate species of *Uropterygius*. Head 11.6–13.8, head and trunk 1.47–1.54, and depth 26–28 in length. A single cephalic lateral line pore before gill opening. Teeth biserial in jaws, the inner row larger, fewer, and depressible, and not extending as far back in the jaw. Two large intermaxillary fangs, separated by a gap from the uniserial row of stout vomerines. Vertebrae 175–178. Color in alcohol uniform yellowish brown to chocolate brown.

**Etymology.** Named in honor of Mr. Bennett, the Secretary of the Zoological Society of London.

**Range.** Hawaii to the Indian Ocean, including Japan, Indonesia, and Tahiti.

**Remarks.** This species is separable from all other *Uropterygius* on the basis of its coloration, body proportions, vertebral number, and its extraordinarily large adult size. It is very closely related to the wide-ranging *U. tigrinus* (Lesson) from which it is easily separable on the basis of its coloration. In that they appear to differ only in coloration (a specimen of *U. tigrinus* from Clarion had 172 vertebrae, cf. McCleneghan, 1976), the possibility exists that the brown form may be a rare color variant of the more common, spotted *U. tigrinus*. There is no evidence, however, of individuals which are intermediate in coloration, and living specimens of *U. tigrinus* kept for several years in the Steinhart Aquarium, San Francisco, have never appeared to change in coloration.

The first author has examined the holotype of *Uropterygius bennettii* and all of its synonyms. The 94 cm type (BMNH 1856.2.2.24.7) of *U.*

*bennettii* is dried and stuffed, but easily identifiable. We agree with Smith (1962) that *Gymnomuraena brevicauda*, also from Muaritus, is a synonym of *U. bennettii*. The types of *U. okinawae* (SU 6482) and *U. unicolor* (MCZ 9188) are also clearly synonyms of *U. bennettii*; the former has 175 total vertebrae (111 preanal) and the latter has 178. Franz's (1910) tentative identification of two specimens (8–12.5 cm) from Sagami Bay as “? *Uropterygius okinawae*” is based upon the misidentification of either *U. macrocephalus* or another species; we were unable to examine his specimens.

Within *Uropterygius*, *U. bennettii* and *U. tigrinus* form a distinct lineage that is worthy of at least subgeneric rank. The name *Scuticaria* is available and may be found, after a careful examination of all species within the genus *Uropterygius*, to deserve generic status.

***Uropterygius nagoensis* Hatooka**  
(Japanese name: Nago-kikai-utsubo)  
(Fig. 1A).

*Uropterygius nagoensis* Hatooka, 1984: 20, figs. 1–4  
(type locality, Nago, Okinawa Island).

**Diagnosis.** A large, elongate species of *Uropterygius*. Mouth large. Snout short. Gill opening above middle of body. Head 9.2, head and trunk 2.09, and depth 23 in length. Cephalic lateral line pore absent before gill opening. Teeth nearly triserial in jaws, the inner row larger, fewer, and depressible. Several large intermaxillary teeth, separated by a short gap from some vomerines. Vertebrae 140. Body yellowish or brownish with dark brownish obscure reticulation or vertical bars.

**Etymology.** Named after Nago, Okinawa Island, where the holotype was collected.

**Remarks.** *U. nagoensis* was described on the basis of a single specimen collected from Okinawa Island (Hatooka, 1984). This species is closely related to the tropical Pacific species, *U. supraforatus* (Regan) and *U. fuscoguttatus* Schultz in having the gill opening situated dorsally, but distinguished from them in its coloration, small mouth and short snout.

***Uropterygius marmoratus* (Lacepède)**  
(New Japanese name: Shizuku-kikai-utsubo)  
(Fig. 1B)

*Gymnomuraena marmorata* Lacepède, 1803: 648

(type locality, New Britain).

**Diagnosis.** A stout, moderate to large and elongate species of *Uropterygius*. Body cylindrical throughout most of its length; tail blunt and laterally compressed. Head 9.4–11.6, head and trunk 2.26–2.43, and depth 20–26 in length. A single cephalic lateral line pore before gill opening. Teeth triserial in jaws, the inner row larger, fewer, and depressible. Several large intermaxillary teeth, followed by a row of mostly uniserial vomerine teeth. Vertebrae 133–138. Body coloration grayish white to cream, overlain with numerous roundish brown and black spots about the size of the eye. Dorsally, the spots are larger, darker and more numerous than those on the ventral surface.

**Etymology.** From the Latin *marmoratus*, marbled.

**Range.** From the western Indian Ocean to the western and central Pacific Ocean, including Hawaii.

**Remarks.** This appears to be the first specimen of *U. marmoratus* correctly identified from Japan. As mentioned below, previous records are based upon misidentified specimens of *U. macrocephalus*. Our 298 mm specimen, IORD 76-72, was collected on 18 Jan. 1976 from the reef flat of Amitori Bay, Iriomote Island, Ryukyu Islands, by H. Kishimoto.

***Uropterygius macrocephalus* (Bleeker)**  
(Japanese name: Hoshi-kikai-utsubo)  
(Fig. 1C)

*Gymnomuraena macrocephalus* Bleeker, 1865: 54  
(type locality, Ambon, Indonesia).

*Gymnomuraena nectura* Jordan and Gilbert, 1882: 356 (type locality, Cabo San Lucas, Pacific Mexico).

*Anarchias knighti* Jordan and Starks, 1906: 205, in Jordan and Seale, 1906 (type locality, Samoa).

*Uropterygius reidi* Schultz, 1943: 32, pl. 5 (type locality, Samoa).

**Diagnosis.** A stout, moderate sized and moderately elongate species of *Uropterygius*. Tail blunt and noticeably laterally compressed. Head 6.8–7.6, head and trunk 2.06–2.32, and depth 16–27 in length. A single cephalic lateral line pore before gill opening. Teeth biserial in jaws, the inner row larger, fewer, and depressible, and extending as far back as the outer row. A large depressible intermaxillary fang, separated by a short gap from the uniserial row of small, stout vomerines. Vertebrae 105–116. Body



Fig. 1. Four species of Japanese *Uroterygius*. A, *Uroterygius nagoensis*, FAKU 51431, 713 mm, July 19, 1982, Okinawa Island; B, *Uroterygius marmoratus*, IORD 76-72, 298 mm, Jan. 18, 1976, Iriomote Island, Ryukyu Islands; C, *Uroterygius macrocephalus*, FAKU 51350, 125 mm, July 2, 1958, Amami Island; D, *Uroterygius micropterus*, FAKU 51379, 239 mm, Sept. 7, 1982, Iriomote Island, Ryukyu Islands.

coloration dark, with dark brown or black blotches heavily overlapping a brown background. Lower jaw pale and overall coloration

lighter in juvenile (less than 20 cm) specimens.

**Etymology.** From the Greek μακρός, long, and κεφαλή, head.

Table 1. Total vertebrae of *Uroterygius macrocephalus*.

Locality	N	Vertebrae	Range	Comment
Eastern Pacific				
Gulf of California	1	109	—	holotype of <i>G. nectura</i>
Gulf of California	4	107.5	106-109	McCleneghan (1976)
Gulf of California	2	108	107-109	SU 47844
Clipperton Is.	8	108.5	106-111	McCleneghan (1976) and SU 49742
Panama	1	105	—	SU 67499
Colombia	2	108	—	SU 67271
Galapagos Is.	1	108	—	CAS 2312
	19	$\bar{x}=108$	105-111	
Central and Western Pacific				
Ambon	1	114	—	holotype of <i>U. macrocephalus</i>
Samoa	1	106	—	cotype of <i>A. knighti</i>
Samoa	2	109.5	109-110	holotype and paratype of <i>U. reidi</i> .
Wake	2	112	111-113	CAS 41192 and CAS 41193
Palau	1	109	—	CAS 41191
Japan	13	111.5	109-116	BPBM 26554, FAKU 51350, FAKU 51374, FAKU 100230, and FAKU 108633-108641
	20	$\bar{x}=111.1$	109-116	

**Range.** Widespread in the eastern Pacific, central and western Pacific.

**Remarks.** Moyer and Zaiser (1982) observed the courtship behavior of four individuals of *U. macrocephalus* at Miyake-jima, on 29 July 1980. A specimen of an identical eel (BPBM 26554, 268 mm) was collected by them at the same site (at depth of 2.5 m, about 2 m from a concrete pier in a habitat of algal-covered lava boulders and coarse volcanic sand) on 20 Aug. 1980 and examined by the first author.

Our attempts to identify that specimen prompted the first author to examine the holotype of *U. macrocephalus* (BMNH 1867. 11.28.335, 236 mm) and the type specimens and numerous other specimens of the nominal species *U. necturus*, *U. knighti* and *U. reidi*. After that comparison, we have concluded that they are but a single species. Vertebral data is presented in Table 1. The literature concerning these species is confusing and worthy of comment.

Schultz (1953: 159) stated that *U. reidi* is close to eastern Pacific specimens of *U. necturus* but could be "distinguished by a slight difference in color pattern." In his key (p. 142), however, he was unable to separate *U. necturus* and *U. knighti*. Gosline (1958: 227) considered *U. reidi* to be synonymous with *U. knighti* and observed, as did we, that the entire range of colorations for each species could be found within a single collection. Gosline also suggested that Jordan and Evermann (1896), in describing the head pores of *U. necturus*, were actually dealing with a specimen of *Anarchias*. One of us (JEMc) reexamined the specimens and discovered that it was not the case.

Previous records of "*U. marmoratus* (Lacépède)" (Okada and Matsubara, 1938: 100, pl. 14 (4); Matsubara, 1955: 357, pl. 37 (131)) were apparently based on misidentifications of this species judging from the size and position of the eye shown in their figures, and the coloration described in their keys. *U. marmoratus* is a large, robust species which differs in coloration (random dots rather than blotches), dentition and vertebrae (McCosker and Randall, 1982; and this paper).

The recognition of *U. macrocephalus* as a trans-Pacific species (excluding the fauna of Easter Island) increases the total number of trans-Pacific eels to ten (cf. Rosenblatt et al.,

1972; McCosker and Rosenblatt, 1975). This phenomenon is interesting in that the muraenids far outnumber the ophichthids (ten to one) and must be related to differences in leptocephalus transport ability and/or the suitability of habitat in the Old and New World tropics. The biological answer to this problem may also lie with the comparative duration of larval life. Sampling and analysis of mid-Pacific leptocephali along the equatorial countercurrent may explain the importance of adult and juvenile habitat as compared to the ability or inability of larvae to make the trans-Pacific crossing.

*Uropterygius micropterus* (Bleeker)  
(Japanese name: Ami-kikai-utsubo)  
(Fig. 1D)

*Muraena micropterus* Bleeker, 1852: 298 (type locality, various Indonesian islands).

*Uropterygius tinkhami* Fowler, 1945: 59, figs. 1 and 2 (type locality, Saipan).

**Diagnosis.** A small, moderately elongate species of *Uropterygius*. Head 8.0–10.0, head and trunk 2.04–2.17, and depth 16–22 in length. A single cephalic lateral line pore before gill opening. Teeth biserial in jaws, the inner row larger and fewer. Two large depressible intermaxillary teeth, followed by small uniserial vomerines. Vertebrae 114–118. Color of lower surface of head and body white or pale gray, gray or gray-brown above, with an intricate web-like network of thin reticulated lines.

**Etymology.** From the Greek *μικρός*, small, and *πτερόν*, fin.

**Range.** Widely distributed from the central Pacific Ocean to the western Indian Ocean.

**Remarks.** While this paper was in preparation, Hatooka and Yoshino (1982: 96) presented the first record of *U. micropterus* on the basis of specimens from Sonai, Yonaguni Island, Ryukyu Islands and Kishimoto and Sasaki (1982: 30) reported the occurrence of this species from Iriomote Island, Ryukyu Islands.

We herein record additional Japanese specimens of *U. micropterus*. Through the kindness of Dr. Tominaga and Martha Zaiser, we have obtained specimens labeled "*Gymnomuraena marmorata*" from University of Tokyo. These specimens, and the sketchy data accompanying them, are: ZUMT 29625 and 29624,

232–236 mm, from Isen, Tokunoshima, 3 Sept. 1911, and ZUMT 29690, 192 mm, from Naze, Amami-Oshima, 31 Aug. 1910. ZUMT 29624 is a robust female, laden with mature eggs. F. B. Steiner collected a 176 mm specimen (CAS 27446) on 16 Feb. 1970, 1.6 km east of Toyohama-ko, Chita Hanto (near Nagoya). In the Yaeyama Islands which is located in the southern part of the Ryukyu Islands this species seems to be very common and additional specimens have been collected from there (FAKU 51379, 239 mm; FAKU 51410, 142 mm; FAKU 100289, 245 mm; FAKU 108632, 87 mm).

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日本産キカイウツボ属魚類 *Uropterygius* の再検討

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日本産キカイウツボ属魚類 *Uropterygius* の再検討を行った結果、コゲウツボ *U. concolor*, キカイウツボ *U. bennettii*, ナゴキカイウツボ *U. nagoensis*, シズクキカイウツボ (新称) *U. marmoratus*, ホシキカイウツボ *U. macrocephalus*, アミキカイウツボ *U. micropterus*, の 6 種の分布を確認し、あわせてその検索を掲げた。

これまでホシキカイウツボと称され報告されてきたキカイウツボ属の 1 種は *U. marmoratus* ではなく *U. macrocephalus* であり、従って *U. marmoratus* の記録は本邦初となる、また、*U. macrocephalus* の確認は本種の分布を太平洋全域に広げた。

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