

Checklist of marine fishes of the Zunan Islands, located between the Izu and Ogasawara (Bonin) islands, Japan, with zoogeographical comments

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ABSTRACT: The Zunan Islands are located 360–650 km south of Tokyo, and consist of four uninhabited volcanoes: the Bayonnaise Rocks, the Smith Rocks, Torishima Island and the Sofugan Rock. Although all of the elements of the Zunan Islands are tiny islets and rocks, they form a series of stepping stones for shallow water fishes between the Izu Islands in the north and the Ogasawara (Bonin) Islands in the south. We report here the first comprehensive survey of marine fishes in the Zunan Islands. A total of 139 species of fishes (88 genera of 46 families in 11 orders) were recorded on the basis of specimens and/or underwater photographs. Although our survey showed that the fish fauna of the Zunan Islands was more similar to that of the Ogasawara than that of the Izu islands, most of the species from the Zunan Islands occurred in all three island groups.

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INTRODUCTION

The Zunan Islands are located 360–650 km south of Tokyo, Japan, between the Izu Islands and the Ogasawara (Bonin) Islands on the Izu-Ogasawara Arc (Figure 1A). The Zunan Islands comprise four uninhabited volcanoes as follows: the Bayonnaise Rocks (31°53'16" N, 139°55'5" E), the Smith Rocks (31°26'22" N, 140°3'2" E), Torishima Island (30°29'1" N, 140°18'10" E) and the Sofugan Rock (29°47'36" N, 140°20'32" E) (Figures 1A and 2).

The Zunan and Ogasawara islands have never been connected to the Asian Continent and major islands of Japan, providing these islands with oceanic environments (Fujioka and Sakamoto 1999) and distinctive fish faunas. The Kuroshio Current, one of the world's major ocean currents, runs along the south coast of the major islands of Japan including Honshu (the largest island of Japan), frequently changing courses northwardly and southwardly between the Izu and Zunan islands (Figure 1B; data from the Hydrographic and Oceanographic Department, Japan Coast Guard) and transporting tropical fishes from the south to these islands (Senou *et al.* 2006; Kuriwa *et al.* 2014). Senou *et al.* (2006) showed that the fish faunas of the Ogasawara Islands, Izu Islands and the south coast of central Honshu were similar to one another, strongly suggesting a stepping stone role (see "stepping stone model" of population structure in Kimura and Weiss 1964) of the Izu Islands in terms of fish fauna between the Ogasawara Islands and Honshu. Although the fish faunas of the Izu Islands and the Ogasawara Islands have been well studied by previous authors such as Randall *et al.* (1997), Senou *et al.* (2002) and Senou *et al.* (2006), fishes

of the Zunan Islands have never been surveyed except for a taxonomic study on groupers (Katayama, 1957). A small expedition to the Zunan Islands was conducted by us to fill-in gaps in the fish fauna and to determine whether the fish fauna is similar to that of the Izu Islands or the Ogasawara Islands.

MATERIALS AND METHODS

Study Area and Collecting Methods

We undertook the first comprehensive survey of marine fishes of the Zunan Islands during the periods 18–22 July 2010 and 25–27 July 2012. The survey in 2010 covered all areas of the Zunan Islands, and that of 2012 covered only the Bayonnaise and Smith Rocks. Specimens were collected by spear, hook and line, long line, fish trap and hand net. All specimens are deposited in the Department of Zoology of National Museum of Nature and Science (NSMT). All musculature tissues of voucher specimens for DNA analysis are deposited in the DNA-Tissue Collection of NSMT (See Appendix 1). Underwater photographs of fishes and photographs of voucher specimens are registered in the Image Database of Fishes of the Kanagawa Prefectural Museum of Natural History, Japan (KPM). All images of recorded fishes are available through FishPix: <http://fishpix.kahaku.go.jp/fishimage-e>.

Collection data of fishes were derived from voucher specimens and/or underwater photographs (see Appendix 1). The systematic arrangements of families follow Nelson (2006) and scientific names generally follow Nakabo (2013). Species and genera in families are arranged in alphabetical order. The maps with submarine topographies were drawn

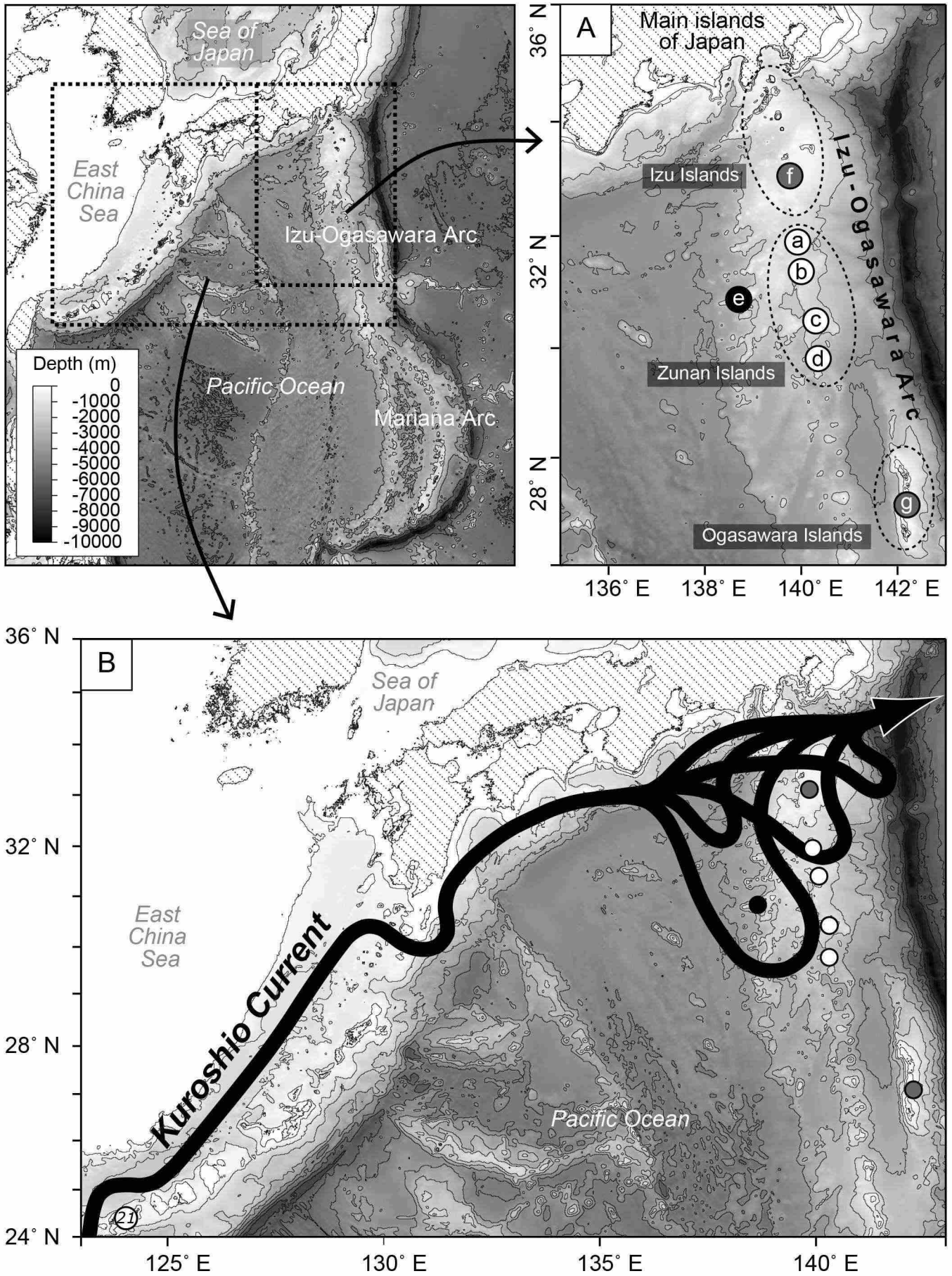


FIGURE 1. Map of the Zunan Islands on the Izu-Ogasawara Arc, Japan. (A) map of the Izu, Zunan and Ogasawara islands, and the Hoei Seamount; a) the Bayonnaise Rocks; b) the Smith Rocks; c) Torishima Island; d) the Sofugan Rock; e) the Hoei Seamount; f) Hachijo-jima Island; (B) fluctuation route of the Kuroshio Current along the coast of Japan.

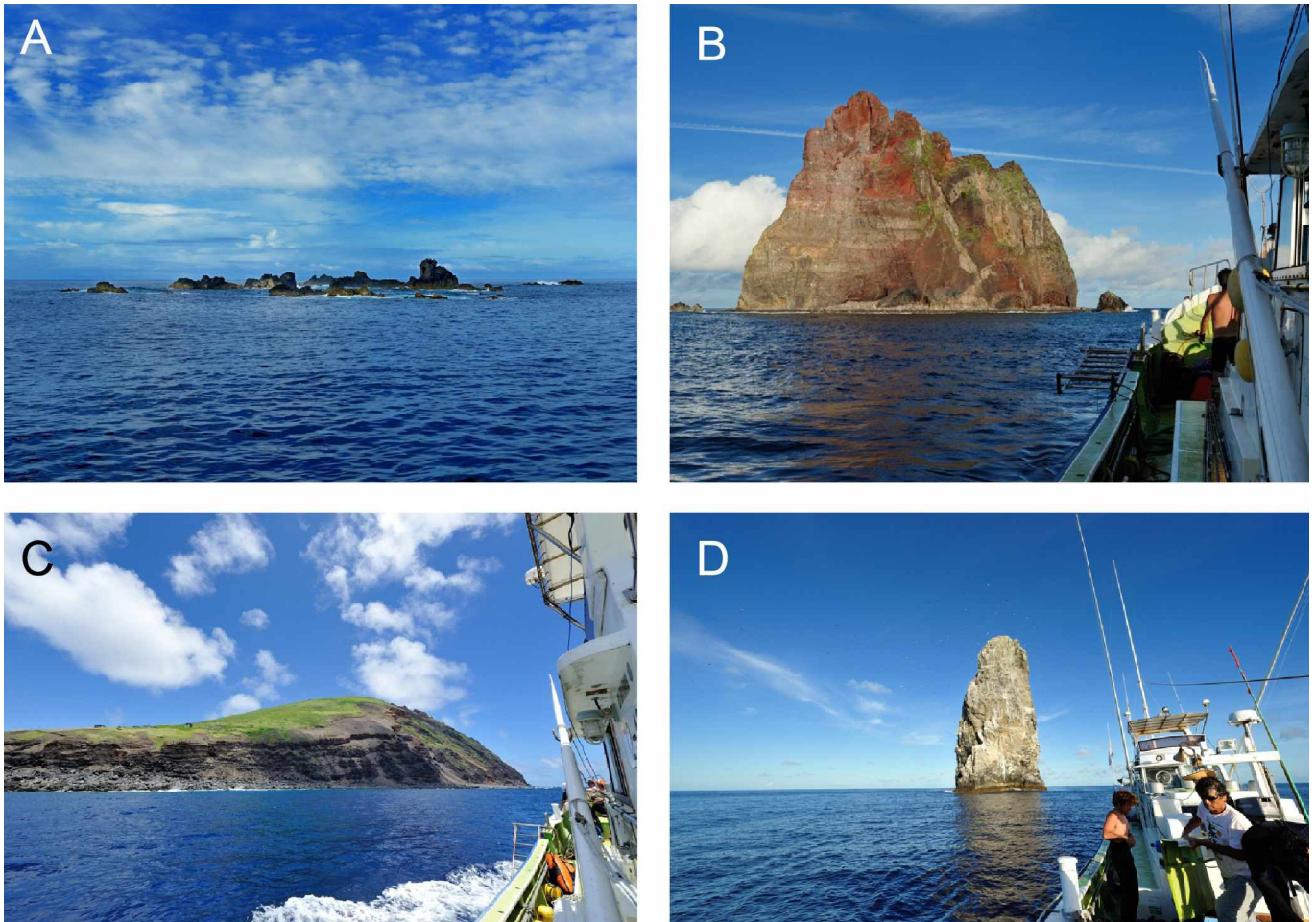


FIGURE 2. Views of the Zunan Islands. (A) the Bayonnaise Rocks; (B) the Smith Rocks; (C) Torishima Island; (D) the Sofugan Rock.

by the Generic Mapping Tools (GMT) ver. 4.5.7 (University of Hawaii: <http://gmt.soest.hawaii.edu/>). All geological data of the islands referred to is from the Database of the Quaternary Volcanoes in Japan by the National Institute of Advanced Industrial Science and Technology, Japan (https://gbank.gsj.jp/volcano/index_e.htm).

Specimens of the following 11 species collected previously from the Zunan Islands are deposited in NSMT and were used in this study: holotypes of *Cephalopholis igarashiensis* and *Epinephelus truncatus* (Katayama, 1957) collected from the Smith Rocks on 10 September 1953 and Torishima Island on 10 March 1954, respectively; *Winteria telescopa* and *Canthigaster inframacula* collected by the RV *Soyo-maru* of the National Research Institute of Fisheries Science from the area between the Smith Rocks and Torishima Island (31°10'4" N, 141°44' E) on 20 June 1973, and the area between Torishima Island and the Sofugan Rock (30°29' N, 140°18' E) on 20 July 1979, respectively; *Galeus nipponensis*, *Zenopsis nebulosa*, *Plectranthias kamii*, *Banjos banjos*, *Eumegistus illustris*, *Bodianus oxycephalus* and *Ariomma luridum* collected by the FV *Taiyo-maru* at the Hoi Seamount (30°52'30" N, 138°43'36" E; Figure 1A) on 9–12 September 2002.

Notes on Collection Sites

The Bayonnaise Rocks (Figure 2A), the northernmost element of the Zunan Islands, are composed of rocks lying over the western rim of the submarine Myojinsyo Caldera, 7×10 km in diameter and its bottom at *ca.* 900–1,000 m

depth. The highest part of the Bayonnaise Rocks reaches 11 m above the sea surface. The Smith Rocks (Figure 2B) are composed of rocks lying over the southern rim of the submarine Smith Caldera, 6.6×8.3 km in diameter and its bottom at *ca.* 800–900 m depth. The highest part of the Smith Rocks reaches 136 m above the sea surface. Torishima Island (Figure 2C) lies over the southern rim of the submarine Torishima Caldera, 4 km in diameter and its bottom at *ca.* 660 m depth. The highest part of Torishima Island reaches 394 m above the sea surface. Since several endangered species of albatrosses and murrelets, such as *Pheoebastria albatrus*, *Diomedea nigripes* and *Synthliboramphus wumizusume*, breed on Torishima Island, and the island was designated as the Wildlife Refuge by the Ministry of the Environment, Japan. The Sofugan Rock (Figure 2D), the southernmost element of the Zunan Islands, is stratovolcano pinnacle, 28 km in diameter and 2.2 km in height. The highest part of the Sofugan Rock reaches 99 m above the sea surface. The coastal areas of the Bayonnaise Rocks, the Smith Rocks and Torishima Island are occupied by sandy and/or rocky bottoms with a few corals. However, the Sofugan Rock stands alone as a column and its sides fall steeply down to the bottom.

RESULTS

A total of 139 species of fishes belonging to 88 genera of 46 families in 11 orders were recorded on the basis of collected specimens, underwater photographs

and previously deposited specimens in NSMT (Table 1; Figures 4–17). Three unidentified species (Figures 4C, 4E and 17F) were included in the total. Figure 3 shows a comparison of the fish fauna of the Zunan Islands with the Izu and Ogasawara islands (Randall *et al.* 1997; Senou *et al.* 2002; Nakabo 2013). About 85.3% of the 136 species recorded from the Zunan Islands, excluding above three unidentified species, occurred in all three island groups. About 0.7% of species occurring in the Zunan Islands were reported in the Izu Islands and 8.1% in the Ogasawara Islands. The remaining 5.9% of species were recorded only in the Zunan Islands.

DISCUSSION

High similarity of the recorded number of species among the Izu, Zunan and Ogasawara islands (Figure 3) suggests that there is dispersal and/or migration of fishes among the three islands groups. This also indicates that the Zunan Islands are stepping stones between the other two island groups. On the other hand, the fish fauna of the Zunan Islands is more similar to that of the Ogasawara Islands than the Izu Islands (Figure 3). This is also well recognized from the observed number of inhabitants of several fish species. For example, *Goniistius zonatus* (Figure 13B) is very rare in the Zunan and Ogasawara islands, but abundant in the Izu Islands. A closely related species, *G. zebra* (Figure 13A), on the other hand, is abundant in the former two islands and very rare in the latter. Likewise, *Kyphosus vaigiensis* (only recorded from an underwater photograph; KPM-NR 78292) is very rare in the Zunan and Ogasawara islands, but abundant in the Izu Islands, and its closely related species *K. pacificus* (Figures 9I–K) (*K. bigibbus* in Randall *et al.* 1997 and *K. sp.* in Senou *et al.* 2002) shows an opposite pattern of abundance.

Taxonomic Notes

1) unidentified species, *Carcharhinus* sp. (Figure 4C): three specimens of this species were collected in the Bayonnaise Rocks and Torishima Island. Although this species is similar to *C. falciformis* in overall body appearance and meristic counts, shape of the first dorsal fin and an inner margin of the second dorsal fin are different. More specimens are needed to clarify its taxonomic status.

2) *Gymnothorax meleagris* (Figure 4D): this specimen has a regenerated-caudal fin. Although there are conflicts about taxonomic status of the three species, *G. meleagris*, *G. eurostus* and *G. chlorostigma*, among moray eel specialists (Hatooka 2002, 2013; Smith 2012), we follow Hatooka (2002, 2013) to apply the name *G. meleagris* to this specimen.

3) unidentified species, *Gymnothorax* sp. (Figure 4E): underwater photographs of this species were taken at the Smith Rocks but the specimen was not collected. This species is similar to *G. breedeni* in overall body appearance, but does not have a clear black band from the eye to the rear end of mouth. This species is probably an undescribed species.

4) *Luzonichthys taeniatus* (Figure 6I): an underwater photograph of this species was taken at the Smith Rocks but the specimen was not collected. Since this species has not yet been recorded from Japan, collecting specimens of and careful identification are required.



FIGURE 3. Percentage of fish fauna of the Zunan Islands shared with Hachijo-jima Island of the Izu Islands (Senou *et al.* 2002; Nakabo 2013) and the Ogasawara Islands (Randall *et al.* 1997; Nakabo 2013). Green, red, blue and orange bars represent percentage of species occurring in both Hachijo-jima Island and the Zunan Islands, that in the Zunan Islands only, that in both the Zunan and Ogasawara islands, and that in all three islands, respectively.

5) *Chaetodon auripes* (Figures 10C–D): this specimen has an anomalous number of dorsal spines (XIII).

6) Hybrid individual between *Oplegnathus fasciatus* and *O. punctatus* (Figure 12D): an underwater photograph of this specimen was taken at the Bayonnaise Rocks, but the specimen was not collected.

7) *Chromis analis* (Figure 13C): an underwater photograph of this species was taken at the Smith Rocks but the specimen was not collected. Since *C. albicauda* was misidentified in Japan as *C. analis* (Iwatsubo and Motomura 2010), the distribution of this species in Japanese waters is not well known.

8) *Minysynchiropus kiyoeae* (Figure 14F): this specimen was regurgitated from the mouth of *Bodianus perditio* (Figure 13H) collected in Torishima Island.

9) *Abalistes* sp. (Figure 17F): this juvenile specimen was regurgitated from the mouth of *Epinephelus fasciatus* (NSMT-P 108762) collected in the Smith Rocks. This species is identified as a species of *Abalistes* because it has two dark blotches on the base of the soft dorsal fin. Although the two species of *Abalistes*, *A. filamentosus* and *A. stellatus*, can be distinguished from each other by the caudal fin shape of adults, larvae of the two species are difficult to identify to the species level.

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AUTHORS' CONTRIBUTION STATEMENT: KK played a major role in implementing the expedition to the Zunan Islands and drafted the manuscript. HA and SNC helped to collect fish samples. SK took underwater photographs of fishes. HS identified the species from underwater photographs. KM helped to draft and edit the manuscript. All authors read and approved the final version of the manuscript.

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APPENDIX 1. Voucher specimens and underwater photographs. Deposited number of (S) voucher specimen (NSMT-P); (T) musculature tissue (NSMT-DNA); (PS) photograph of voucher specimen (KPM-NR); and (U) underwater photograph (KPM-NR). NSMT, National Museum of Nature and Science; KPM, Kanagawa Prefectural Museum of Natural History.

Carcharhiniformes, Scyliorhinidae–*Galeus nipponensis*: (S) NSMT-P 64807; (PS) KPM-NR 144588. **Carcharhinidae**–*Carcharhinus galapagensis*: (S) NSMT-P 103419, 103421, 103424–103428, 108817–108820; (T) NSMT-DNA 18737, 18739, 18742–18746, 61391–61394; (PS) KPM-NR 144589; (U) KPM-NR 78265, 78298–78302, 78319. *Carcharhinus* sp.: (S) NSMT-P 103420, 103422, 103423; (T) NSMT-DNA 18738, 18740, 18741; (PS) KPM-NR 144590. *Triacodon obesus*: (U) KPM-NR 78326. **Anguilliformes, Muraenidae**–*Gymnothorax isingteena*: (U) KPM-NR 78275. *Gymnothorax meleagris*: (S) NSMT-P 103287; (T) NSMT-DNA 18608; (PS) KPM-NR 144591. *Gymnothorax* sp.: (U) KPM-NR 78303–78306. **Argentiniformes, Opisthoproctidae**–*Winteria telescopa*: (S) NSMT-P 18952; (PS) KPM-NR 144592. **Mugiliformes, Mugilidae**–*Crenimugil cranilabis*: (S) NSMT-P 103439; (T) NSMT-DNA 18757; (PS) KPM-NR 144593. **Beloniformes, Exocoetidae**–*Exocoetus monocirrhus*: (S) NSMT-P 103087; (T) NSMT-DNA 18408; (PS) KPM-NR 144594. *Hirundichthys speculiger*: (S) NSMT-P 103365; (T) NSMT-DNA 18683; (PS) KPM-NR 144595. **Belonidae**–*Platybelone argalus platyura*: (S) NSMT-P 108845, 108846; (T) NSMT-DNA 61419, 61420; (PS) KPM-NR 144596. **Beryciformes, Holocentridae**–*Myripristis berndti*: (S) NSMT-P 103091, 103160, 103284; (T) NSMT-DNA 18412, 18481, 18605; (PS) KPM-NR 144597, 144598; (U) KPM-NR 78243, 78244, 78297. *Myripristis chryseris*: (S) NSMT-P 103088–103090; (T) NSMT-DNA 18409–18411; (PS) KPM-NR 144599, 144600. *Myripristis vittata*: (U) KPM-NR 78296. *Sargocentron spiniferum*: (S) NSMT-P 103142; (T) NSMT-DNA 18463; (PS) KPM-NR 144601. **Zeiformes, Zeidae**–*Zenopsis*

nebulosa: (S) NSMT-P 64810; (PS) KPM-NR 144602. **Gasterosteiformes, Aulostomidae**–*Aulostomus chinensis*: (S) NSMT-P 103399; (T) NSMT-DNA 18717; (PS) KPM-NR 144603. **Fistulariidae**–*Fistularia commersonii*: (S) NSMT-P 103297, 103298; (T) NSMT-DNA 18618, 18619; (PS) KPM-NR 144604. **Perciformes, Serranidae**–*Cephalopholis igarashiensis*: (S) NSMT-P 18655; (PS) KPM-NR 144605. *Cephalopholis miniata*: (S) NSMT-P 103095, 103110, 103182, 103281–103283, 108831; (T) NSMT-DNA 18416, 18431, 18503, 18602–18604, 61405; (PS) KPM-NR 144606, 144607; (U) KPM-NR 78336. *Cephalopholis sonnerati*: (S) NSMT-P 103280; (T) NSMT-DNA 18601; (PS) KPM-NR 144608. *Cephalopholis urodeta*: (S) NSMT-P 108838; (T) NSMT-DNA 61412; (PS) KPM-NR 144609. *Epinephelus fasciatus*: (S) NSMT-P 103199–103277, 103307–103361, 103388–103396, 108761–108770, 108805–108812; (T) NSMT-DNA 18520–18598, 18625–18679, 18706–18714, 61335–61344, 61379–61386; (PS) KPM-NR 144610–144649; (U) KPM-NR 78240–78242, 78311. *Epinephelus hexagonatus*: (S) NSMT-P 103121; (T) NSMT-DNA 18442; (PS) KPM-NR 144650. *Epinephelus retouti*: (S) NSMT-P 18222, 103168, 103169; (T) NSMT-DNA 18489, 18490; (PS) KPM-NR 144651, 144652. *Epinephelus tauvina*: (S) NSMT-P 103119, 103290; (T) NSMT-DNA 18440, 18611; (PS) KPM-NR 144653. *Luzonichthys taeniatus*: (U) KPM-NR 78307. *Plectranthias kamii*: (S) NSMT-P 64813; (PS) KPM-NR 144654. *Pseudanthias dispar*: (U) KPM-NR 78308, 78309. *Pseudanthias squamipinnis*: (U) KPM-NR 78310, 78337. *Variola louti*: (S) NSMT-P 103416; (T) NSMT-DNA 18734; (PS) KPM-NR 144655. **Banjosiidae**–*Banjios banjos*: (S) NSMT-P 64811; (PS) KPM-NR 144656. **Priacanthidae**–*Priacanthus hamrur*: (U) KPM-NR 78278. **Coryphaenidae**–*Coryphaena hippurus*: (S) NSMT-P 108829; (T) NSMT-DNA 61403; (PS) KPM-NR 144657. **Carangidae**–*Carangoides orthogrammus*: (S) NSMT-P 103108, 103113, 103114, 103374; (T) NSMT-DNA 18429, 18434, 18435, 18692; (PS) KPM-NR 144658. *Caranx ignobilis*: (S) NSMT-P 103383, 103413; (T) NSMT-DNA 18701, 18731; (PS) KPM-NR 144659, 144660. *Caranx lugubris*: (S) NSMT-P 103099, 103115, 103188, 103373, 103380, 103408–103410, 103414, 103445, 108849; (T) NSMT-DNA 18420, 18436, 18509, 18691, 18698, 18726–18728, 18732, 18763, 61423; (PS) KPM-NR 144661; (U) KPM-NR 78258, 78259, 78314–78316. *Caranx melampygus*: (S) NSMT-P 103301, 103431, 103432; (T) NSMT-DNA 18622, 18749, 18750; (PS) KPM-NR 144662; (U) KPM-NR 78256, 78257, 78317. *Caranx sexfasciatus*: (S) NSMT-P 103387, 103429, 103430, 108832; (T) NSMT-DNA 18705, 18747, 18748, 61406; (PS) KPM-NR 144663; (U) KPM-NR 78262–78264, 78318. *Elagatis bipinnulata*: (S) NSMT-P 103386, 103447, 103448, 108816; (T) NSMT-DNA 18704, 18765, 18766, 61390; (PS) KPM-NR 144664; (U) KPM-NR 78270, 78322. *Seriola rivoliana*: (S) NSMT-P 103170, 103433–103435, 108815; (T) NSMT-DNA 18491, 18751–18753, 61389; (PS) KPM-NR 144665–144668; (U) KPM-NR 78260. *Trachinotus baillonii*: (S) NSMT-P 103187; (T) NSMT-DNA 18508; (PS) KPM-NR 144669. **Bramidae**–*Eumegistus illustris*: (S) NSMT-P 64809; (PS) KPM-NR 144670. **Lutjanidae**–*Aphareus furca*: (U) KPM-NR 78312. *Aprion virescens*: (S) NSMT-P 103299; (T) NSMT-DNA 18620; (PS) KPM-NR 144671; (U) KPM-NR 78239. *Lutjanus bohar*: (S) NSMT-P 108848; (T) NSMT-DNA 61422; (PS) KPM-NR 144672. *Lutjanus gibbus*: (S) NSMT-P 103096; (T) NSMT-DNA 18417; (PS) KPM-NR 144673. *Lutjanus kasmira*: (S) NSMT-P 103130, 103161, 103285; (T) NSMT-DNA 18451, 18482, 18606; (PS) KPM-NR 144674. *Lutjanus stellatus*: (S) NSMT-P 103100, 103289, 103292, 103293, 103296, 103411, 103415, 103440, 108826; (T) NSMT-DNA 18421, 18610, 18613, 18614, 18617, 18729, 18733, 18758, 61400; (PS) KPM-NR 144675–144676. *Macolor macularis*: (U) KPM-NR 78283. *Macolor niger*: (S) NSMT-P 103300; (T) NSMT-DNA 18621; (PS) KPM-NR 144677. *Paracaesio xanthura*: (S) NSMT-P 103120; (T) NSMT-DNA 18441; (PS) KPM-NR 144678. **Caesionidae**–*Caesio teres*: (U) KPM-NR 78250. **Haemulidae**–*Plectorhinchus picus*: (S) NSMT-P 103303; (T) NSMT-DNA 18624; (PS) KPM-NR 144679; (U) KPM-NR 78245. *Plectorhinchus vittatus*: (S) NSMT-P 108836; (T) NSMT-DNA 61410; (PS) KPM-NR 144680. **Lethrinidae**–*Gnathodentex aureolineatus*: (S) NSMT-P 103131, 108840, 108841; (T) NSMT-DNA 18452, 61414, 61415; (PS) KPM-NR 144681, 144682; (U) KPM-NR 78255, 78276, 78281. *Gymnocranius euanus*: (S) NSMT-P 103401, 103402; (T) NSMT-DNA 18719, 18720; (PS) KPM-NR 144683. **Mullidae**–*Mulloidichthys vanicolensis*: (S) NSMT-P 103132, 103189; (T) NSMT-DNA 18453, 18510; (PS) KPM-NR 144684, 144685. *Parupeneus ciliatus*: (S) NSMT-P 103186; (T) NSMT-DNA 18507; (PS) KPM-NR 144686; (U) KPM-NR 78254, 78280. *Parupeneus multifasciatus*: (S) NSMT-P 103125; (T) NSMT-DNA 18446; (PS) KPM-NR 144687; (U) KPM-NR 78251. **Kyphosidae**–*Girella mezinga*: (S) NSMT-P 103107, 103184; (T) NSMT-DNA 18428, 18505; (PS) KPM-NR 144688. *Girella punctata*: (S) NSMT-P 103375; (T) NSMT-DNA 18693; (PS) KPM-NR 144689. *Kyphosus pacificus*: (S) NSMT-P 103101, 103104, 103105, 103171–103176, 103372, 103378, 103397, 103449, 108843, 108844; (T) NSMT-DNA 18422, 18425, 18426, 18492–18497, 18690, 18696, 18715, 18767, 61417, 61418; (PS) KPM-NR 144690–144694; (U) KPM-NR 78285–78291, 78338. *Kyphosus vaigiensis*: (U) KPM-NR 78292. **Chaetodontidae**–*Chaetodon auriga*: (S) NSMT-P 103368; (T) NSMT-DNA 18686; (PS) KPM-NR 144695; (U) KPM-NR 78273. *Chaetodon auripes*: (S) NSMT-P 103111,

103181, 103363; (T) NSMT-DNA 18432, 18502, 18681; (PS) KPM-NR 144696, 144697; (U) KPM-NR 78253. *Chaetodon daedalma*: (S) NSMT-P 103144–103156, 103190–103197, 103367; (T) NSMT-DNA 18465–18477, 18511–18518, 18685; (PS) KPM-NR 144698–144700; (U) KPM-NR 78294. *Chaetodon lunula*: (S) NSMT-P 103106, 103133; (T) NSMT-DNA 18427, 18454; (PS) KPM-NR 144701. *Chaetodon speculum*: NSMT-P 103157, 103364; (T) NSMT-DNA 18478, 18682; (PS) KPM-NR 144702. *Forcipiger flavissimus*: (U) KPM-NR 78279. *Hemitaenichthys polylepis*: (S) NSMT-P 103143; (T) NSMT-DNA 18464; (PS) KPM-NR 144703. *Heniochus acuminatus*: (S) NSMT-P 103158, 103371; (T) NSMT-DNA 18479, 18689; (PS) KPM-NR 144704. *Heniochus monoceros*: (S) NSMT-P 108834; (T) NSMT-DNA 61408; (PS) KPM-NR 144705; (U) KPM-NR 78252. **Pomacanthidae**–*Apolemichthys trimaculatus*: (U) KPM-NR 78267. *Centropyge interrupta*: (S) NSMT-P 103159, 108842; (T) NSMT-DNA 18480, 61416; (PS) KPM-NR 144706, 144707; (U) KPM-NR 78335. *Genicanthus melanospilos*: (U) KPM-NR 78333. *Genicanthus semifasciatus*: (U) KPM-NR 78323. *Pomacanthus imperator*: (S) NSMT-P 103369; (T) NSMT-DNA 18687; (PS) KPM-NR 144708; (U) KPM-NR 78268, 78269. *Pomacanthus semirculatus*: (S) NSMT-P 103294; (T) NSMT-DNA 18615; (PS) KPM-NR 144709; (U) KPM-NR 78266. **Pentaceroptidae**–*Evisitias acutirostris*: (S) NSMT-P 103116, 108835; (T) NSMT-DNA 18437, 61409; (PS) KPM-NR 144710, 144711; (U) KPM-NR 782671. **Kuhliidae**–*Kuhlia mugil*: (S) NSMT-P 103092, 103286; (T) NSMT-DNA 18413, 18607; (PS) KPM-NR 144712, 144713. **Oplegnathidae**–*Oplegnathus fasciatus*: (S) NSMT-P 103137, 103138, 103162–103164, 103198, 103379, 103437, 110930; (T) NSMT-DNA 18458, 18459, 18483–18485, 18519, 18697, 18755, 61441; (PS) KPM-NR 144714–144717. *Oplegnathus punctatus*: (S) NSMT-P 103139–103141, 103376, 103377, 103400, 103407, 103438, 103446, 108827, 108828; (T) NSMT-DNA 18460–18462, 18694, 18695, 18718, 18725, 18756, 18764, 61401, 61402; (PS) KPM-NR 144718–144720; (U) KPM-NR 78246, 78247. *Oplegnathus fasciatus* × *Oplegnathus punctatus*: (U) KPM-NR 78248. **Cirrhitidae**–*Cirrhitus pinnulatus*: (S) NSMT-P 103093, 103094; (T) NSMT-DNA 18414, 18415; (PS) KPM-NR 144721. *Paracirrhites arcatus*: (U) KPM-NR 78293, 78331. *Paracirrhites forsteri*: (U) KPM-NR 78330. **Cheilodactylidae**–*Goniistius zebra*: (S) NSMT-P 108839; (T) NSMT-DNA 61413; (PS) KPM-NR 144722; (U) KPM-NR 78284. *Goniistius zonatus*: (S) NSMT-P 103185; (T) NSMT-DNA 18506; (PS) KPM-NR 144723. **Pomacanthidae**–*Chromis analis*: (U) KPM-NR 78327. *Chromis chrysurus*: (U) KPM-NR 78282. *Chromis onumai*: (U) KPM-NR 78334. **Labridae**–*Anampses caeruleopunctatus*: (S) NSMT-P 103097; (T) NSMT-DNA 18418; (PS) KPM-NR 144724. *Bodianus bilunulatus*: (S) NSMT-P 103098, 103103, 103136, 103167; (T) NSMT-DNA 18419, 18424, 18457, 18488; (PS) KPM-NR 144725, 144726; (U) KPM-NR 78261. *Bodianus oxycephalus*: (S) NSMT-P 64812; (PS) KPM-NR 144727. *Bodianus perditio*: (S) NSMT-P 103122, 103404; (T) NSMT-DNA 18443, 18722; (PS) KPM-NR 144728. *Coris aygula*: (S) NSMT-P 103291, 103382, 108850; (T) NSMT-DNA 18612, 18700, 61424; (PS) KPM-NR 144729. *Hologymnosus doliatus*: (U) KPM-NR 78321. *Pseudolabrus eoethinus*: (U) KPM-NR 78325. *Thalassoma lutescens*: (S) NSMT-P 108837; (T) NSMT-DNA 61411; (PS) KPM-NR 144730. **Scaridae**–*Calotomus japonicus*: (S) NSMT-P 108833; (T) NSMT-DNA 61407; (PS) KPM-NR 144731. *Scarus*

forsteni: (S) NSMT-P 103112, 103403, 110929; (T) NSMT-DNA 18433, 18721, 61440; (PS) KPM-NR 144732, 144733. *Scarus ghobban*: (S) NSMT-P 103295; (T) NSMT-DNA 18616; (PS) KPM-NR 144734. **Blenniidae**–*Alticus saliens*: (S) NSMT-P 103304 (*N* = 3); (PS) KPM-NR 144735. **Callionymidae**–*Minysynchiropus kiyooe*: (S) NSMT-P 103305; (PS) KPM-NR 144736. **Ephippidae**–*Platax teira*: (S) NSMT-P 103302; (T) NSMT-DNA 18623; (PS) KPM-NR 144737. **Zanclidae**–*Zanclus cornutus*: (S) NSMT-P 103118, 103362; (T) NSMT-DNA 18439, 18680; (PS) KPM-NR 144738. **Acanthuridae**–*Acanthurus dussumieri*: (S) NSMT-P 108847; (T) NSMT-DNA 61421; (PS) KPM-NR 144739. *Acanthurus leucopareius*: (S) NSMT-P 103128, 103178, 103278; (T) NSMT-DNA 18449, 18499, 18599; (PS) KPM-NR 144740. *Acanthurus olivaceus*: (S) NSMT-P 103129, 103398; (T) NSMT-DNA 18450, 18716; (PS) KPM-NR 144741. *Naso annulatus*: (U) KPM-NR 78328, 78329. *Naso lopezi*: (U) KPM-NR 78272, 78320. *Naso maculatus*: (S) NSMT-P 103417; (T) NSMT-DNA 18735; (PS) KPM-NR 144742. *Naso tonganus*: (U) KPM-NR 78274. *Naso unicornis*: (S) NSMT-P 103117; (T) NSMT-DNA 18438; (PS) KPM-NR 144743. *Prionurus scalprum*: (S) NSMT-P 103436; (T) NSMT-DNA 18754; (PS) KPM-NR 144744. *Zebrosoma veliferum*: (S) NSMT-P 103102; (T) NSMT-DNA 18423; (PS) KPM-NR 144745. **Sphyraenidae**–*Sphyraena barracuda*: (S) NSMT-P 103385; (T) NSMT-DNA 18703; (PS) KPM-NR 144746. *Sphyraena helleri*: (S) NSMT-P 103279; (T) NSMT-DNA 18600; (PS) KPM-NR 144747. **Scombridae**–*Acanthocybium solandri*: (S) NSMT-P 103418; (T) NSMT-DNA 18736; (PS) KPM-NR 144748. *Gymnosarda unicolor*: (S) NSMT-P 103384; (T) NSMT-DNA 18702; (PS) KPM-NR 144749; (U) KPM-NR 78249, 78313. *Katsuwonus pelamis*: (S) NSMT-P 103288, 103412, 108824, 108825; (T) NSMT-DNA 18609, 18730, 61398, 61399; (PS) KPM-NR 144750, 144751. *Thunnus albacores*: (S) NSMT-P 108830; (T) NSMT-DNA 61404; (PS) KPM-NR 144752. **Ariommatidae**–*Ariomma luridum*: (S) NSMT-P 64808 (*N* = 2); (PS) KPM-NR 144753. **Pleuronectiformes**, **Bothidae**–*Bothus mancus*: (S) NSMT-P 103123; (T) NSMT-DNA 18444; (PS) KPM-NR 144754. **Tetraodontiformes**, **Balistidae**–*Balistoides conspicillum*: (S) NSMT-P 103126, 103165; (T) NSMT-DNA 18447, 18486; (PS) KPM-NR 144755, 144756. *Rhinecanthus rectangulus*: (S) NSMT-P 103166; (T) NSMT-DNA 18487; (PS) KPM-NR 144757. *Sufflamen bursa*: (U) KPM-NR 78332. *Sufflamen chrysopteron*: (S) NSMT-P 103109; (T) NSMT-DNA 18430; (PS) KPM-NR 144758. *Sufflamen fraenatum*: (S) NSMT-P 103127, 103183, 103366, 103381, 103405, 103406, 103443, 110928; (T) NSMT-DNA 18448, 18504, 18684, 18699, 18723, 18724, 18761, 61439; (PS) KPM-NR 144759, 144760. *Xanthichthys caeruleolineatus*: (S) NSMT-P 103441; (T) NSMT-DNA 18759; (PS) KPM-NR 144761. *Xanthichthys mento*: (S) NSMT-P 103179, 103370, 103442; (T) NSMT-DNA 18500, 18688, 18760; (PS) KPM-NR 144762–144764; (U) KPM-NR 78324. *Abalistes* sp.: (S) NSMT-P 108813; (T) NSMT-DNA 61387; (PS) KPM-NR 144765. **Monacanthidae**–*Aluterus scriptus*: (S) NSMT-P 103124, 103134, 103444; (T) NSMT-DNA 18445, 18455, 18762; (PS) KPM-NR 144766, 144767. *Cantherhines dumerilii*: (U) KPM-NR 78277. **Ostraciidae**–*Ostracion immaculatus*: (S) NSMT-P 103180; (T) NSMT-DNA 18501; (PS) KPM-NR 144768. **Tetraodontidae**–*Arothron hispidus*: (S) NSMT-P 103177; (T) NSMT-DNA 18498; (PS) KPM-NR 144769. *Canthigaster inframacula*: (S) NSMT-P 22288; (PS) KPM-NR 144770.

TABLE 1. Checklist of marine fishes of the Zunan Islands including records from the Izu and Ogasawara islands (Randall *et al.* 1997; Senou *et al.* 2002; Nakabo 2013). Collection locality: B, Bayonnaise Rocks; SM, Smith Rocks; T, Torishima Island; SG, Sofugan Rock; H, Hoei Seamont; bw/SM-T, Between the Smith Rocks and Torishima Island; bw/T-SG, Between Torishima Island and the Sofugan Rock. Occurrence Record: IZU, Izu Islands; OGA, Ogasawara Islands; Asterisk (*), recorded only in the Zunan Islands.

TAXON	NUMBER OF VOUCHER		COLLECTION LOCALITY	FIGURE	OCCURRENCE RECORD
	SPECIMENS	UNDERWATER PHOTOGRAPHS			
Carcharhiniformes					
Scyliorhinidae					
<i>Galeus nipponensis</i> Nakaya, 1975	1	0	H	FIGURE 4A	*
Carcharhinidae					
<i>Carcharhinus galapagensis</i> (Snodgrass & Heller, 1905)	11	7	B, SM, T	FIGURE 4B	IZU, OGA
<i>Carcharhinus</i> sp.	3	0	B, T	FIGURE 4C	
<i>Triaenodon obesus</i> Rüppell, 1837	0	1	SR		OGA
Anguilliformes					
Muraenidae					
<i>Gymnothorax isingteena</i> (Richardson, 1845)	0	1	B		IZU, OGA
<i>Gymnothorax meleagris</i> (Shaw, 1795)	1	0	T	FIGURE 4D	IZU, OGA
<i>Gymnothorax</i> sp.	0	4	SM	FIGURE 4E	
Argentiniiformes					
Opisthoproctidae					
<i>Winteria telescopa</i> (Brauer, 1901)	1	0	bw/SM-T	FIGURE 4F	OGA

TABLE 1. Continued.

TAXON	NUMBER OF VOUCHER		COLLECTION LOCALITY	FIGURE	OCCURRENCE RECORD
	SPECIMENS	UNDERWATER PHOTOGRAPHS			
Mugiliformes					
Mugilidae					
<i>Crenimugil crenilabis</i> (Forsskål, 1775)	1	0	T	FIGURE 4G	IZU, OGA
Beloniformes					
Exocoetidae					
<i>Exocoetus monocirrhus</i> (Richardson, 1846)	1	0	B	FIGURE 4H	IZU, OGA
<i>Hirundichthys speculiger</i> (Valenciennes, 1847)	1	0	B	FIGURE 4I	IZU, OGA
Belonidae					
<i>Platybelone argalus platyura</i> (Bennett, 1832)	2	0	B	FIGURE 4J	IZU, OGA
Beryciformes					
Holocentridae					
<i>Myripristis berndti</i> Jordan & Evermann, 1903	3	3	B, T, SG	FIGURE 4K	OGA
<i>Myripristis chryseres</i> Jordan & Evermann, 1903	3	0	SG	FIGURE 5A	IZU, OGA
<i>Myripristis murdjan</i> (Forsskål, 1775)	0	1	B		OGA
<i>Myripristis vittata</i> (Valenciennes, 1831)	0	1	B		IZU, OGA
<i>Sargocentron spiniferum</i> (Forsskål, 1775)	1	0	SG	FIGURE 5B	IZU, OGA
Zeiformes					
Zeidae					
<i>Zenopsis nebulosa</i> (Temminck & Schlegel, 1846)	1	0	H	FIGURE 5C	IZU, OGA
Gasterosteiformes					
Aulostomidae					
<i>Aulostomus chinensis</i> (Linnaeus, 1766)	1	0	SG	FIGURE 5D	IZU, OGA
Fistulariidae					
<i>Fistularia commersonii</i> Rüppell, 1838	2	0	T	FIGURE 5E	IZU, OGA
Perciformes					
Serranidae					
<i>Cephalopholis igarashiensis</i> Katayama, 1957	1	0	SM	FIGURE 5F	OGA
<i>Cephalopholis miniata</i> (Forsskål, 1775)	7	1	B, SM, T, SG	FIGURE 5G–H	IZU, OGA
<i>Cephalopholis sonnerati</i> (Valenciennes, 1828)	1	0	T	FIGURE 5I	IZU, OGA
<i>Cephalopholis urodeta</i> (Forster, 1801)	1	0	SM	FIGURE 6A	IZU, OGA
<i>Epinephelus fasciatus</i> (Forsskål, 1775)	161	4	B, SM, T, SG	FIGURE 6B–D	IZU, OGA
<i>Epinephelus hexagonatus</i> (Forster, 1801)	1	0	T	FIGURE 6E	IZU, OGA
<i>Epinephelus retouti</i> (Bleeker, 1868)	3	0	SM, T	FIGURE 6F–G	OGA
<i>Epinephelus tauvina</i> (Forsskål, 1775)	2	0	B, T	FIGURE 6H	IZU, OGA
<i>Luzonichthys taeniatus</i> Randall & McCosker, 1992	0	1	SM	FIGURE 6I	*
<i>Plectranthias kamii</i> Randall, 1980	1	0	H	FIGURE 6J	OGA
<i>Pseudanthias dispar</i> (Herre, 1955)	0	2	SM		*
<i>Pseudanthias squamipinnis</i> (Peters, 1855)	0	2	SM		IZU, OGA
<i>Variola louti</i> (Forsskål, 1775)	1	0	T	FIGURE 6K	IZU, OGA
Banjosidae					
<i>Banjos banjos</i> (Richardson, 1846)	1	0	H	FIGURE 7A	*
Priacanthidae					
<i>Priacanthus hamrur</i> (Forsskål, 1775)	0	1	B		IZU, OGA
Coryphaenidae					
<i>Coryphaena hippurus</i> Linnaeus, 1758	1	0	SM	FIGURE 7B	IZU, OGA
Carangidae					
<i>Carangoides orthogrammus</i> (Jordan & Gilbert, 1882)	5	0	T	FIGURE 7C	IZU, OGA
<i>Caranx ignobilis</i> (Forsskål, 1775)	2	0	B, T	FIGURE 7D–E	IZU, OGA
<i>Caranx lugubris</i> Poey, 1860	11	5	B, SM, T, SG	FIGURE 7F	IZU, OGA
<i>Caranx melampygus</i> Cuvier, 1833	3	3	B, SM, T	FIGURE 7G	IZU, OGA
<i>Caranx sexfasciatus</i> Quoy & Gaimard, 1825	4	4	B, SM, T	FIGURE 7H	IZU, OGA
<i>Elagatis bipinnulata</i> (Quoy & Gaimard, 1825)	4	2	B, SM, SG	FIGURE 7I	IZU, OGA
<i>Seriola rivoliana</i> Valenciennes, 1833	5	1	B, SM, SG	FIGURE 7J	IZU, OGA
<i>Trachinotus baillonii</i> (Lacepède, 1801)	1	0	T	FIGURE 8A	IZU, OGA
Bramidae					
<i>Eumegistus illustris</i> Jordan & Jordan, 1922	1	0	H	FIGURE 8B	OGA
Lutjanidae					
<i>Aphareus furca</i> (Lacepède, 1801)	0	1	SM		IZU, OGA
<i>Aprion virescens</i> Valenciennes, 1830	1	1	B, T	FIGURE 8C	IZU, OGA
<i>Lutjanus bohar</i> (Forsskål, 1775)	1	0	SM	FIGURE 8D	IZU, OGA
<i>Lutjanus gibbus</i> (Forsskål, 1775)	1	0	T	FIGURE 8E	IZU, OGA
<i>Lutjanus kasmira</i> (Forsskål, 1775)	3	0	B, T	FIGURE 8F	IZU, OGA
<i>Lutjanus stellatus</i> Akazaki, 1983	9	0	SM, T	FIGURE 8G	IZU, OGA

TABLE 1. Continued.

TAXON	NUMBER OF VOUCHER		COLLECTION LOCALITY	FIGURE	OCCURRENCE RECORD
	SPECIMENS	UNDERWATER PHOTOGRAPHS			
<i>Macolor macularis</i> Fowler, 1931	0	1	B		OGA
<i>Macolor niger</i> (Forsskål, 1775)	1	0	T	FIGURE 8H	IZU, OGA
<i>Paracaesio xanthura</i> (Bleeker, 1869)	1	0	T	FIGURE 8I	IZU, OGA
Caesionidae					
<i>Caesio teres</i> Seale, 1906	0	1	B		IZU, OGA
Haemulidae					
<i>Plectorhinchus picus</i> (Cuvier, 1828)	1	1	B, T	FIGURE 8J	IZU, OGA
<i>Plectorhinchus vittatus</i> (Linnaeus, 1758)	1	0	B	FIGURE 9A	IZU, OGA
Lethrinidae					
<i>Gnathodentex aureolineatus</i> (Lacepède, 1801)	3	3	B, T	FIGURE 9B	IZU, OGA
<i>Gymnocranius euanus</i> (Günther, 1879)	2	0	B	FIGURE 9C	OGA
Mullidae					
<i>Mulloidichthys vanicolensis</i> (Valenciennes, 1831)	2	0	T	FIGURE 9D	IZU, OGA
<i>Parupeneus ciliatus</i> (Lacepède, 1802)	1	2	B, T	FIGURE 9E	IZU, OGA
<i>Parupeneus multifasciatus</i> (Quoy & Gaimard, 1825)	1	1	B, T	FIGURE 9F	IZU, OGA
Kyphosidae					
<i>Girella mezinga</i> Jordan & Starks, 1907	2	0	T	FIGURE 9G	IZU, OGA
<i>Girella punctata</i> Gray, 1835	1	0	T	FIGURE 9H	IZU, OGA
<i>Kyphosus pacificus</i> Sakai & Nakabo, 2004	15	8	B, SM, T, SG	FIGURE 9I–K	IZU, OGA
<i>Kyphosus vaigiensis</i> (Quoy & Gaimard, 1825)	0	1	B		IZU, OGA
Chaetodontidae					
<i>Chaetodon auriga</i> Forsskål, 1775	1	1	B, SM	FIGURE 10A	IZU, OGA
<i>Chaetodon auripes</i> Jordan & Snyder, 1901	3	1	B, T	FIGURE 10B–D	IZU, OGA
<i>Chaetodon daedalma</i> Jordan & Fowler, 1902	22	1	B, SM, T, SG	FIGURE 10E	IZU, OGA
<i>Chaetodon lunula</i> (Lacepède, 1802)	2	0	T	FIGURE 10F	IZU, OGA
<i>Chaetodon speculum</i> Cuvier, 1831	2	0	T	FIGURE 10G	IZU, OGA
<i>Forcipiger flaccissimus</i> Jordan & McGregor, 1898	0	1	B		IZU, OGA
<i>Hemitaenichthys polylepis</i> (Bleeker, 1857)	1	0	SG	FIGURE 10H	IZU, OGA
<i>Heniochus acuminatus</i> (Linnaeus, 1758)	2	0	SM, T	FIGURE 11A	IZU, OGA
<i>Heniochus monoceros</i> Cuvier, 1831	1	1	B	FIGURE 11B	IZU, OGA
Pomacanthidae					
<i>Apolemichthys trimaculatus</i> Cuvier, 1831	0	1	B		IZU, OGA
<i>Centropyge interrupta</i> (Tanaka, 1918)	2	1	B, SM, SG	FIGURE 11C	IZU, OGA
<i>Genicanthus melanospilos</i> (Bleeker, 1857)	0	1	SM		IZU, OGA
<i>Genicanthus semifasciatus</i> (Kamohara, 1934)	0	1	SM		IZU, OGA
<i>Pomacanthus imperator</i> (Bloch, 1787)	1	2	B, SM	FIGURE 11D	IZU, OGA
<i>Pomacanthus semicirculatus</i> (Cuvier, 1831)	1	1	B	FIGURE 11E	IZU, OGA
Pentacerotidae					
<i>Evistias acutirostris</i> (Temminck & Schlegel, 1844)	2	1	B, SM	FIGURE 11F	IZU, OGA
Kuhliidae					
<i>Kuhlia mugil</i> (Forster, 1801)	2	0	B	FIGURE 11G	IZU, OGA
Oplegnathidae					
<i>Oplegnathus fasciatus</i> (Temminck & Schlegel, 1844)	9	0	SM, T	FIGURE 12A–C	IZU, OGA
<i>Oplegnathus punctatus</i> (Temminck & Schlegel, 1844)	11	2	B, SM, T	FIGURE 12E–G	IZU, OGA
<i>Oplegnathus fasciatus</i> × <i>O. punctatus</i>	0	1	B	FIGURE 12D	
Cirrhitidae					
<i>Cirrhitus pinnulatus</i> (Forster, 1801)	2	0	B	FIGURE 12H	IZU, OGA
<i>Paracirrhites arcatus</i> (Cuvier, 1829)	0	2	B, SM		IZU, OGA
<i>Paracirrhites forsteri</i> (Schneider, 1801)	0	1	SM		IZU, OGA
Cheilodactylidae					
<i>Goniistius zebra</i> (Döderlein, 1883)	1	1	B, SM	FIGURE 13A	IZU, OGA
<i>Goniistius zonatus</i> (Cuvier, 1830)	1	0	T	FIGURE 13B	IZU, OGA
Pomacanthidae					
<i>Chromis analis</i> (Cuvier, 1830)	0	1	SM	FIGURE 13C	*
<i>Chromis chrysurus</i> (Bliss, 1883)	0	1	B		IZU, OGA
<i>Chromis onumai</i> Senou & Kudo, 2007	0	1	SM		IZU
Labridae					
<i>Anampses caeruleopunctatus</i> Rüppell, 1829	1	0	T	FIGURE 13D	IZU, OGA
<i>Bodianus bilunulatus</i> (Lacepède, 1801)	4	1	B, T	FIGURE 13E–F	IZU, OGA
<i>Bodianus oxycephalus</i> (Bleeker, 1862)	1	0	H	FIGURE 13G	IZU, OGA
<i>Bodianus perditio</i> (Quoy & Gaimard, 1834)	2	0	B, T	FIGURE 13H	IZU, OGA
<i>Coris aygula</i> Lacepède, 1801	3	0	B, SM, T	FIGURE 13I	IZU, OGA
<i>Hologymnosus doliatus</i> (Lacepède, 1801)	0	1	SM		IZU, OGA



TABLE 1. Continued.

TAXON	NUMBER OF VOUCHER		COLLECTION LOCALITY	FIGURE	OCCURRENCE RECORD
	SPECIMENS	UNDERWATER PHOTOGRAPHS			
<i>Pseudolabrus eoethinus</i> (Richardson, 1846)	0	1	SM		IZU, OGA
<i>Thalassoma lutescens</i> (Lay & Bennett, 1839)	1	0	SM	FIGURE 13J	IZU, OGA
Scaridae					
<i>Calotomus japonicus</i> (Valenciennes, 1840)	1	0	B	FIGURE 14A	IZU, OGA
<i>Scarus forsteni</i> (Bleeker, 1861)	3	0	B, T	FIGURE 14B–C	IZU, OGA
<i>Scarus ghobban</i> Forsskål, 1775	1	0	SG	FIGURE 14D	IZU, OGA
Blenniidae					
<i>Alticus saliens</i> (Lacepède, 1800)	3	0	T	FIGURE 14E	IZU, OGA
Callionymidae					
<i>Minysynchiropus kiyooae</i> (Fricke & Zaiser, 1983)	1	0	T	FIGURE 14F	IZU, OGA
Ephippidae					
<i>Platax teira</i> (Forsskål, 1775)	1	0	T	FIGURE 14G	IZU, OGA
Zanclidae					
<i>Zanclus cornutus</i> (Linnaeus, 1758)	2	0	SM, T	FIGURE 14H	IZU, OGA
Acanthuridae					
<i>Acanthurus dussumieri</i> Valenciennes, 1835	1	0	SM	FIGURE 14I	IZU, OGA
<i>Acanthurus leucopareius</i> (Jenkins, 1903)	3	0	T	FIGURE 15A	IZU, OGA
<i>Acanthurus olivaceus</i> Bloch & Schneider, 1801	2	0	T	FIGURE 15B	IZU, OGA
<i>Naso annulatus</i> (Quoy & Gaimard, 1825)	0	2	SM		IZU, OGA
<i>Naso lopezi</i> Herre, 1927	0	2	B, SM		OGA
<i>Naso maculatus</i> Randall & Struhsaker, 1981	1	0	T	FIGURE 15C	IZU, OGA
<i>Naso tonganus</i> (Valenciennes, 1835)	0	1	B		*
<i>Naso unicornis</i> (Forsskål, 1775)	1	0	SM	FIGURE 15D	IZU, OGA
<i>Prionurus scalprum</i> Valenciennes, 1835	1	0	SM	FIGURE 15E	IZU, OGA
<i>Zebрасoma veliferum</i> (Bloch, 1795)	1	0	B	FIGURE 15F	IZU, OGA
Sphyracidae					
<i>Sphyracna barracuda</i> (Edwards, 1771)	1	0	SG	FIGURE 15G	IZU, OGA
<i>Sphyracna helleri</i> Jenkins, 1901	1	0	T	FIGURE 15H	IZU, OGA
Scombridae					
<i>Acanthocybium solandri</i> (Cuvier, 1832)	1	0	SG	FIGURE 16A	IZU, OGA
<i>Gymnosarda unicolor</i> (Rüppell, 1836)	1	2	B, SM, SG	FIGURE 16B	IZU, OGA
<i>Katsuwonus pelamis</i> (Linnaeus, 1758)	4	0	B, SM, T	FIGURE 16C	IZU, OGA
<i>Thunnus albacares</i> (Bonnaterre, 1788)	1	0	SM	FIGURE 16D	IZU, OGA
Ariommatidae					
<i>Ariomma luridum</i> Jordan & Snyder, 1904	2	0	H	FIGURE 16E	*
Pleuronectiformes					
Bothidae					
<i>Bothus mancus</i> (Broussonet, 1782)	1	0	T	FIGURE 16F	IZU, OGA
Tetraodontiformes					
Balistidae					
<i>Balistoides conspicillum</i> (Bloch & Schneider, 1801)	2	0	T	FIGURE 16G	IZU, OGA
<i>Rhinecanthus rectangulus</i> (Bloch & Schneider, 1801)	1	0	T	FIGURE 16H	IZU, OGA
<i>Sufflamen bursa</i> (Bloch & Schneider, 1801)	0	1	SM		IZU, OGA
<i>Sufflamen chrysopterum</i> (Bloch & Schneider, 1801)	1	0	T	FIGURE 16I	IZU, OGA
<i>Sufflamen fraenatum</i> (Latreille, 1804)	8	0	B, T, SG	FIGURE 17A–B	IZU, OGA
<i>Xanthichthys caeruleolineatus</i> Randall, Matsuura & Zama, 1987	1	0	SG	FIGURE 17C	IZU, OGA
<i>Xanthichthys mento</i> (Jordan & Gilbert, 1882)	3	1	SM, T, SG	FIGURE 17D–E	IZU, OGA
<i>Abalistes</i> sp.	1	0	SM	FIGURE 17F	
Monacanthidae					
<i>Aluterus scriptus</i> (Osbeck, 1765)	3	0	T, SG	FIGURE 17G	IZU, OGA
<i>Cantherhines dumerilii</i> (Hollard, 1854)	0	1	B		IZU, OGA
Ostraciidae					
<i>Ostracion immaculatus</i> Temminck & Schlegel, 1850	1	0	T	FIGURE 17H	IZU, OGA
Tetraodontidae					
<i>Arothron hispidus</i> (Linnaeus, 1758)	1	0	T	FIGURE 17I	IZU, OGA
<i>Canthigaster inframacula</i> Allen & Randall, 1977	1	0	bw/T-SG	FIGURE 17J	*
Total	431	100	—	—	—

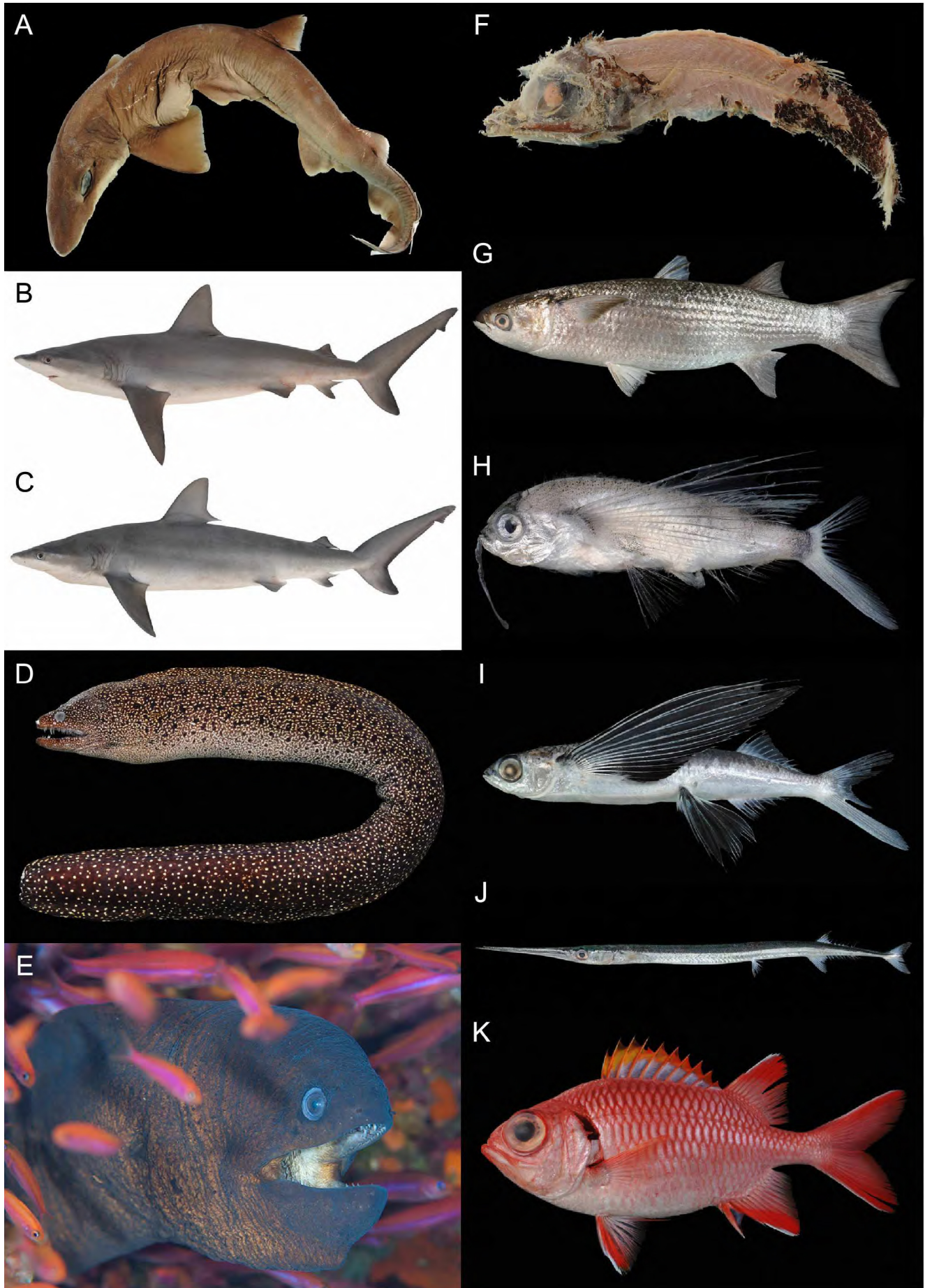


FIGURE 4. (A) *Galeus nipponensis*, NSMT-P 64807, 623.0 mm TL, preserved specimen; (B) *Carcharhinus galapagensis*, NSMT-P 103419, 957.2 mm TL; (C) *Carcharhinus* sp., NSMT-P 103420, 855.3 mm TL; (D) *Gymnothorax meleagris*, NSMT-P 103287, 472.7 mm TL; (E) *Gymnothorax* sp., KPM-NR 78303; (F) *Winteria telescopa*, NSMT-P 18952, 114.0 mm SL, preserved specimen; (G) *Crenimugil crenilabis*, NSMT-P 103439, 467.1 mm SL; (H) *Exocoetus monociihus*, NSMT-P 103087, 40.4 mm SL; (I) *Hirundichthys speculiger*, NSMT-P 103365, 123.1 mm SL; (J) *Platybelone argalus platyura*, NSMT-P 108845, 438.6 mm SL; (K) *Myripristis berndti*, NSMT-P 103284, 191.4 mm SL.

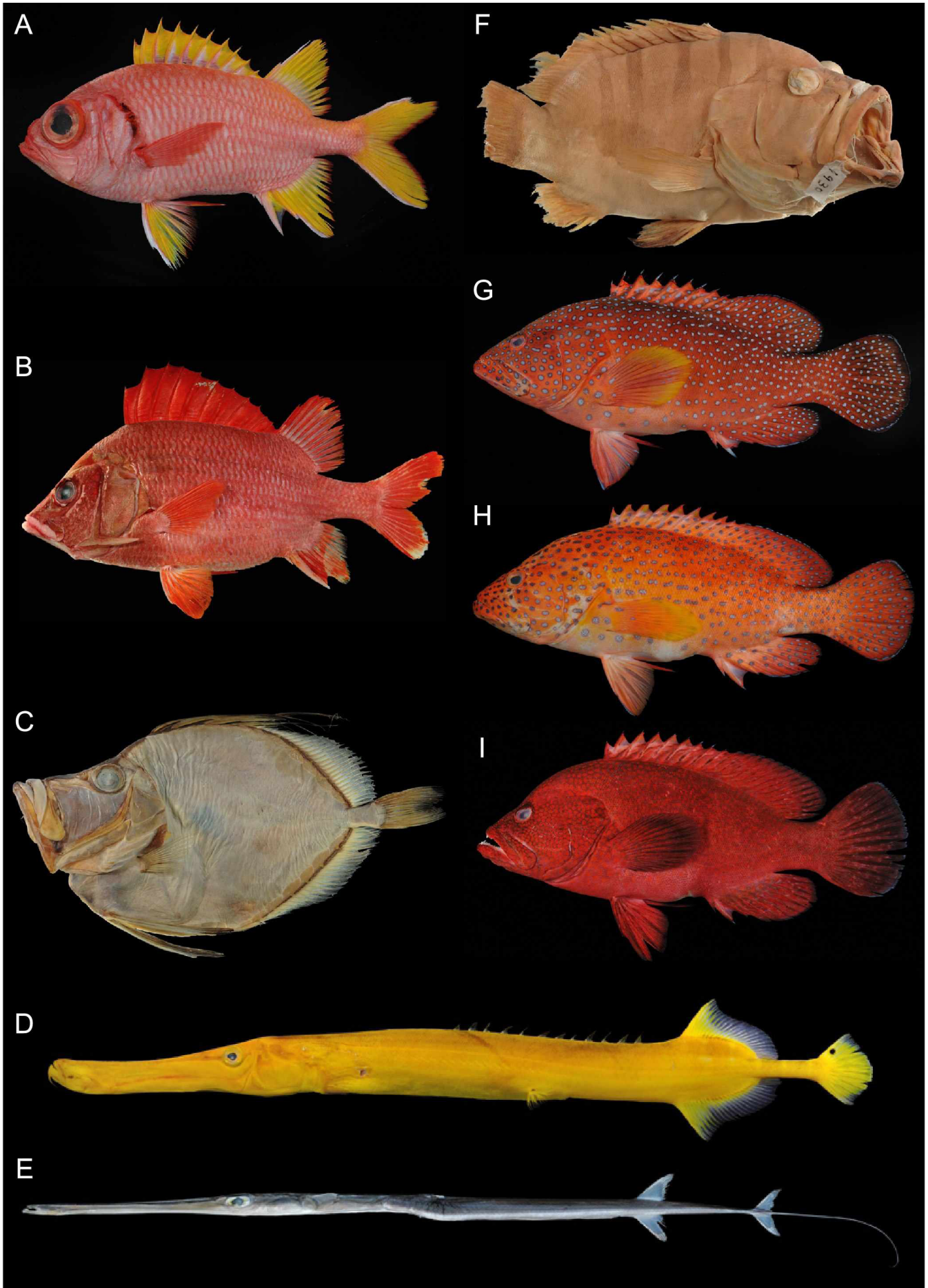


FIGURE 5. (A) *Myripristis chryseres*, NSMT-P 103088, 196.8 mm SL; (B) *Sargocentron spiniferum*, NSMT-P 103142, 333.9 mm SL; (C) *Zenopsis nebulosa*, NSMT-P 64810, 347.7 mm SL, preserved specimen; (D) *Aulostomus chinensis*, NSMT-P 103399, 533.1 mm SL; (E) *Fistularia commersonii*, NSMT-P 103298, 675.2 mm SL; (F) *Cephalopholis igarashiensis*, NSMT-P 18655, 283.0 mm SL, holotype, preserved specimen; (G) *Cephalopholis miniata*, NSMT-P 103110), 260.3 mm SL; (H) *Cephalopholis miniata*, NSMT-P 103095, 233.5 mm SL, color variation; (I) *Cephalopholis sonnerati*, NSMT-P 103280, 219.0 mm SL.

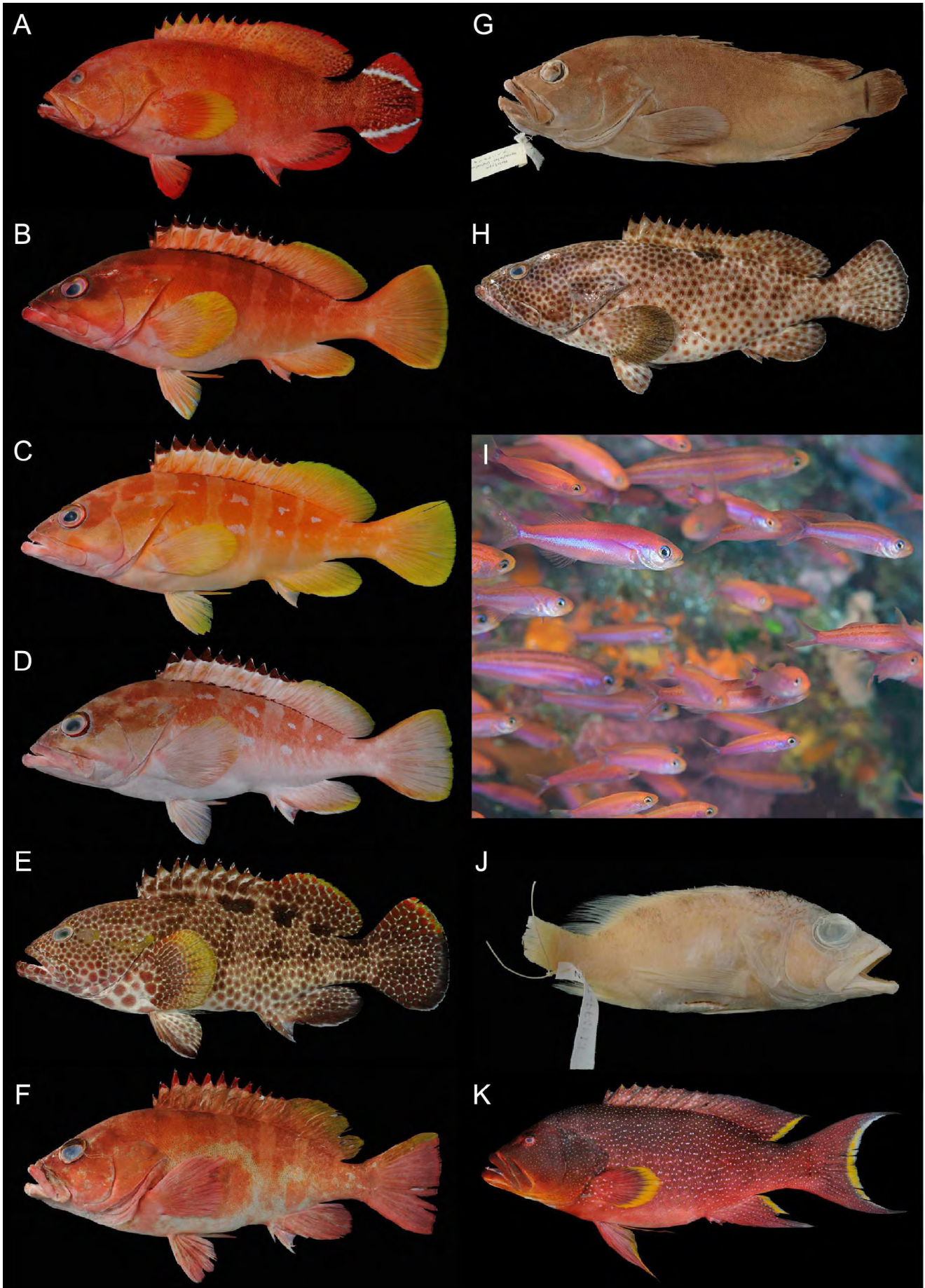


FIGURE 6. (A) *Cephalopholis urodeta*, NSMT-P 108838, 154.7 mm SL; (B) *Epinephelus fasciatus*, NSMT-P 103263, 246.8 mm SL, reddish coloration; (C) *Epinephelus fasciatus*, NSMT-P 103388, 249.0 mm SL, orange-yellowish coloration; (D) *Epinephelus fasciatus*, NSMT-P 103307, 272.3 mm SL, red-whitish coloration; (E) *Epinephelus hexagonatus*, NSMT-P 103121, 207.2 mm SL; (F) *Epinephelus retouti*, NSMT-P 103169, 330.7 mm SL; (G) *Epinephelus retouti*, NSMT-P 18222, 320.0 mm SL, holotype of *E. truncatus* (synonym of *E. retouti*), preserved specimen; (H) *Epinephelus tauvina*, NSMT-P 103119, 409.3 mm SL; (I) *Luzonichthys taeniatus*, KPM-NR 78307; (J) *Plectranthias kamii*, NSMT-P 64813, 152.7 mm SL; (K) *Variola louti*, NSMT-P 103416, 525.3 mm SL.

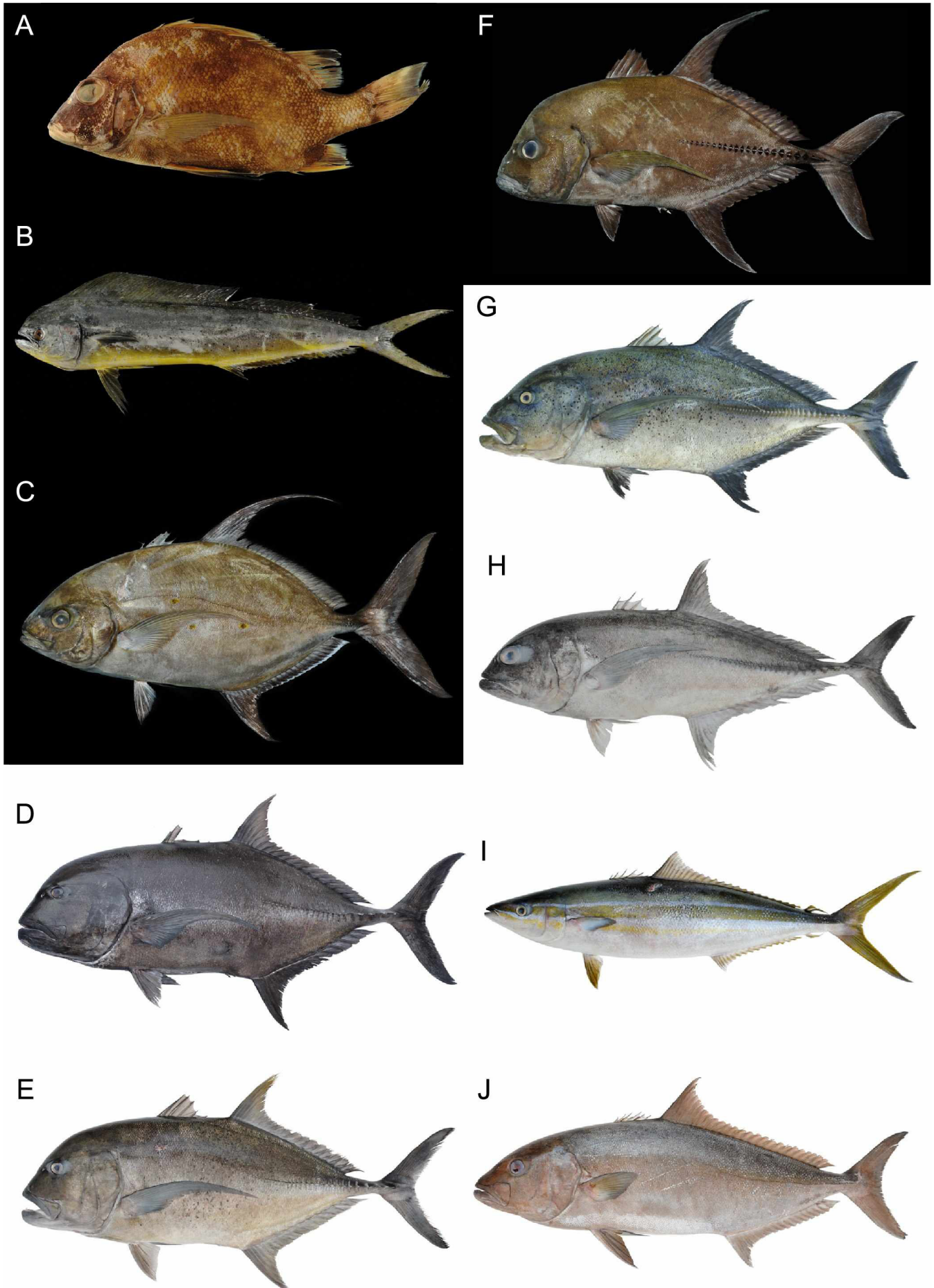


FIGURE 7. (A) *Banjos banjos*, NSMT-P 64811, 332.1 mm SL, preserved specimen; (B) *Coryphaena hippurus*, NSMT-P 108829, 886.8 mm SL; (C) *Carangoides orthogrammus*, NSMT-P 103108, 284.0 mm SL; (D) *Caranx ignobilis*, NSMT-P 103383, 1093.0 mm SL, male; (E) *Caranx ignobilis*, NSMT-P 103413, 790.1 mm SL, female; (F) *Caranx lugubris*, NSMT-P 103099, 350.9 mm SL; (G) *Caranx melampygus*, NSMT-P 103301, 569.0 mm SL; (H) *Caranx sexfasciatus*, NSMT-P 103387, 699.2 mm SL, female; (I) *Elagatis bipinnulata*, NSMT-P 103386, 600.5 mm SL; (J) *Seliora rivoliana*, NSMT-P 103433, 1013.4 mm SL.

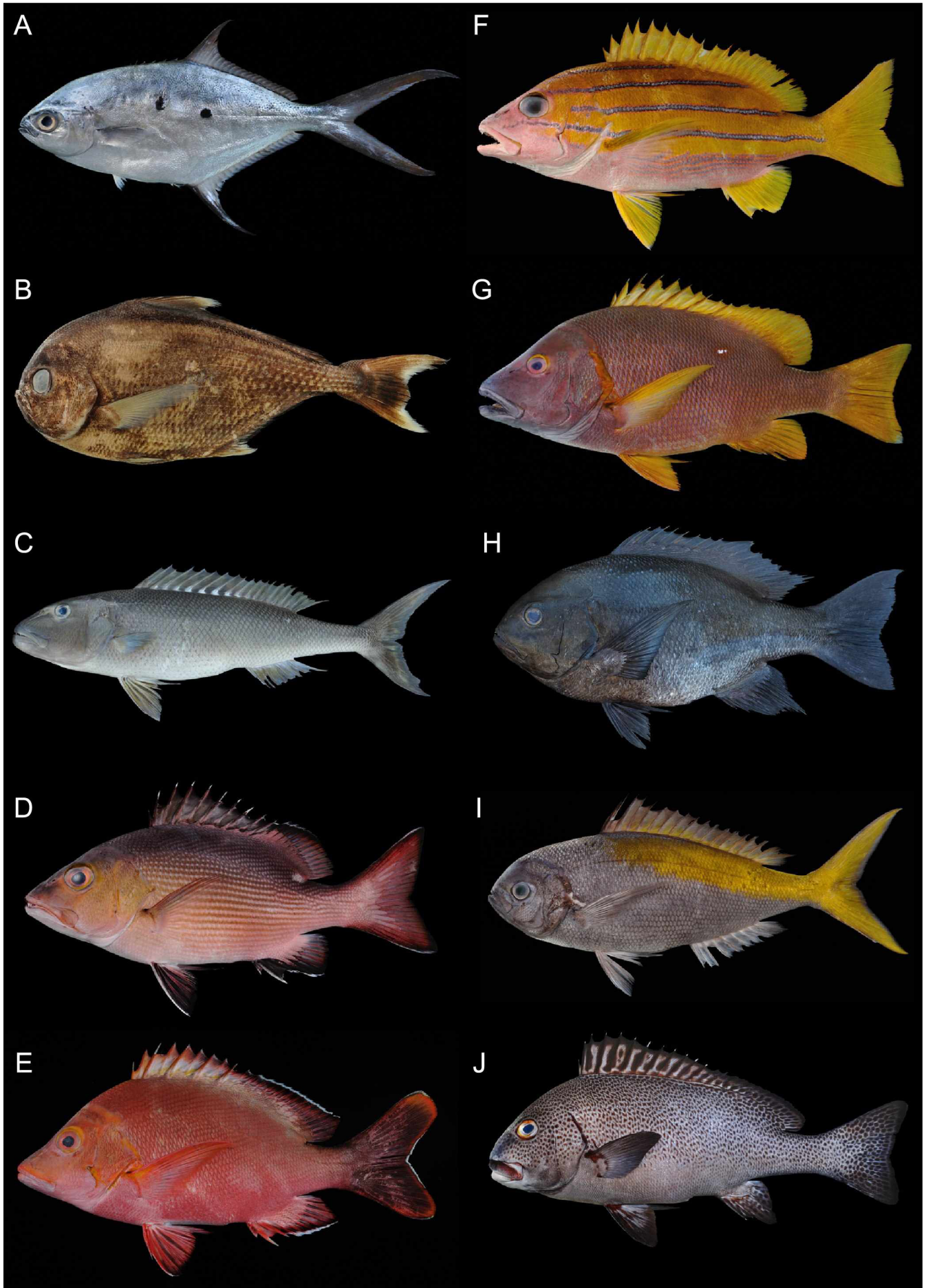


FIGURE 8. (A) *Trachinotus bailloni*, NSMT-P 103187, 327.0 mm SL; (B) *Eumegistus illustris*, NSMT-P 64809, 385.9 mm SL, preserved specimen; (C) *Aprion virescens*, NSMT-P 103299, 598.4 mm SL; (D) *Lutjanus bohar*, NSMT-P 108848, 177.5 mm SL; (E) *Lutjanus gibbus*, NSMT-P 103096, 239.8 mm SL; (F) *Lutjanus kasmira*, NSMT-P 103130, 234.9 mm SL; (G) *Lutjanus stellatus*, NSMT-P 103289, 418.8 mm SL; (H) *Macolor niger*, NSMT-P 103300, 446.4 mm SL; (I) *Paracaesio xanthura*, NSMT-P 103120, 339.8 mm SL; (J) *Plectorhinchus picus*, NSMT-P 103303, 436.7 mm SL.

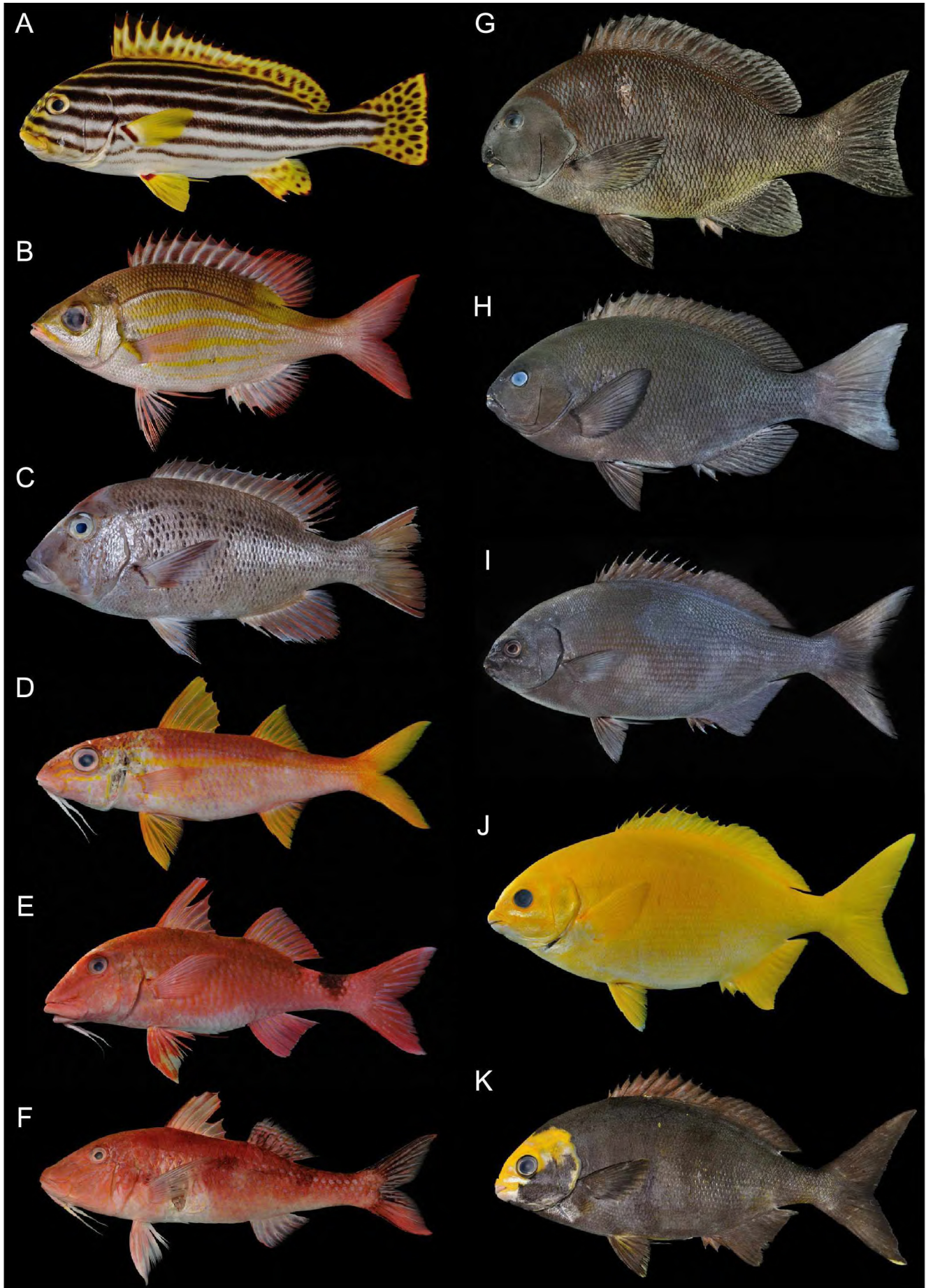


FIGURE 9. (A) *Plectorhinchus vittatus*, NSMT-P 108836, 297.7 mm SL; (B) *Gnathodentex aureolineatus*, NSMT-P 108841, 180.4 mm SL; (C) *Gymnocranius euanus*, NSMT-P 103401, 448.4 mm SL; (D) *Mulloidichthys vanicolensis*, NSMT-P 103189, 210.8 mm SL; (E) *Parupeneus ciliatus*, NSMT-P 103186, 300.8 mm SL; (F) *Parupeneus multifasciatus*, NSMT-P 103125, 259.3 mm SL; (G) *Girella mezina*, NSMT-P 103107, 332.9 mm SL; (H) *Girella punctata*, NSMT-P 103375, 297.2 mm SL; (I) *Kyphosus pacificus*, NSMT-P 103171, 246.9 mm SL, grayish coloration; (J) *Kyphosus pacificus*, NSMT-P 103397, 302.7 mm SL, yellowish coloration; (K) *Kyphosus pacificus*, NSMT-P 108844, 258.3 mm SL, partially yellowish coloration.

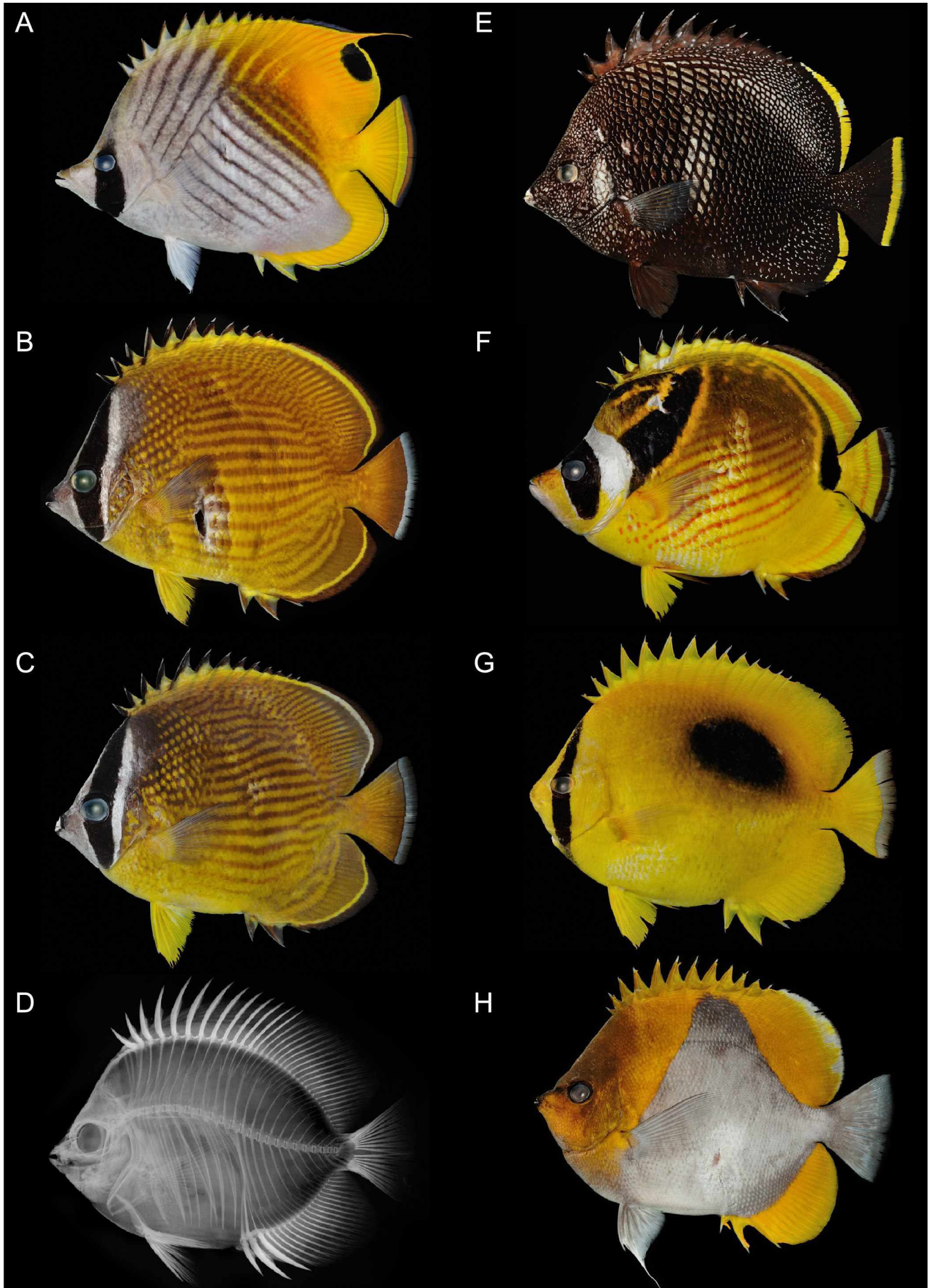


FIGURE 10. (A) *Chaetodon auriga*, NSMT-P 103368, 155.2 mm SL; (B) *Chaetodon auripes*, NSMT-P 103111, 141.1 mm SL; (C) *Chaetodon auripes*, NSMT-P 103181, 131.5 mm SL, anomaly number of dorsal spines (D XIII); (D) soft X-ray of *Chaetodon auripes*, NSMT-P 103181; (E) *Chaetodon daedalma*, NSMT-P 103145, 134.2 mm SL; (F) *Chaetodon lunula*, NSMT-P 103106, 177.4 mm SL; (G) *Chaetodon speculum*, NSMT-P 103157, 136.4 mm SL; (H) *Hemitaurichthys polylepis*, NSMT-P 103143, 131.6 mm SL.

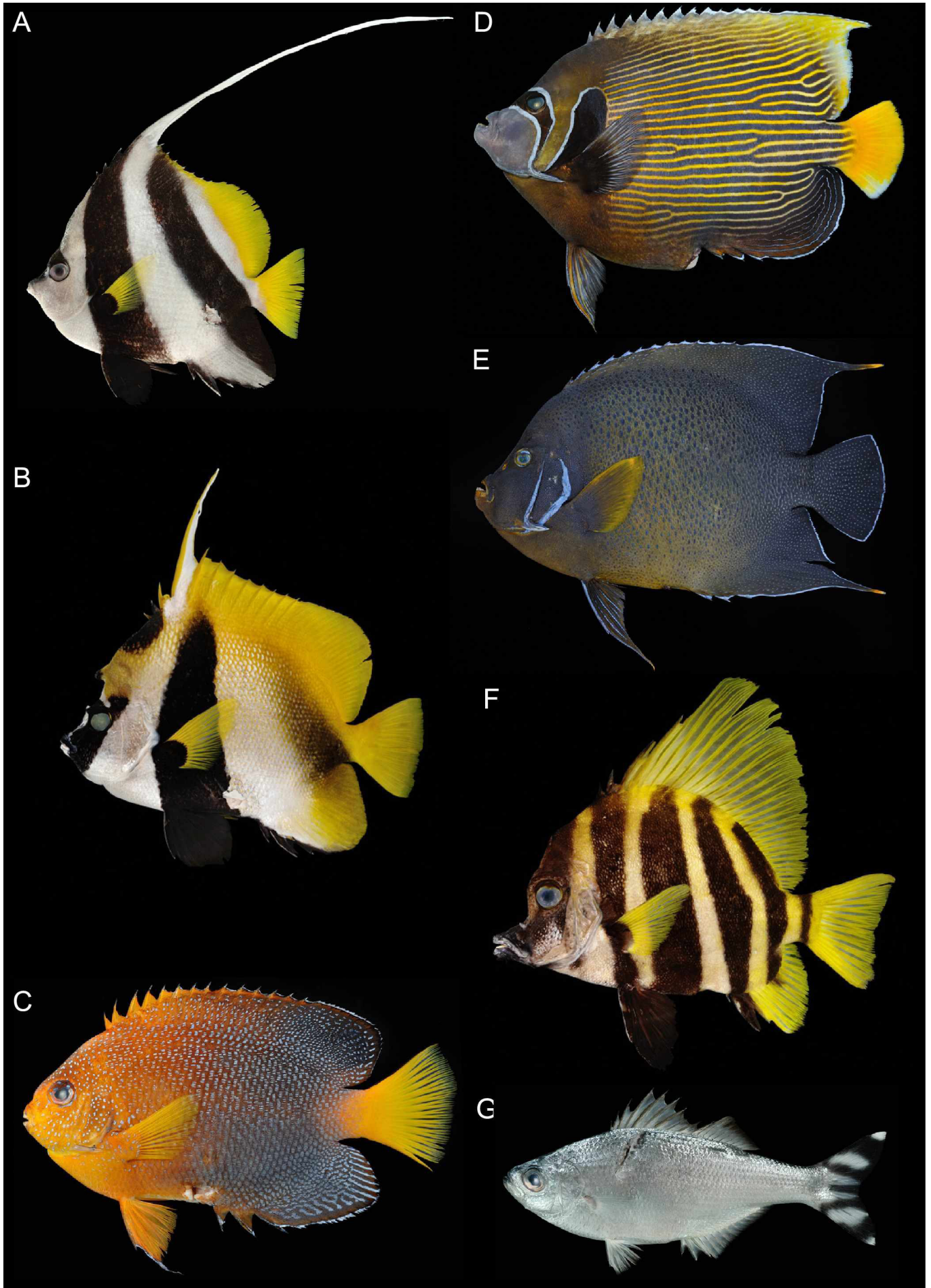


FIGURE 11. (A) *Heniochus acuminatus*, NSMT-P 103158, 162.8 mm SL; (B) *Heniochus monoceros*, NSMT-P 108834, 225.4 mm SL; (C) *Centropyge interrupta*, NSMT-P 103159, 105.2 mm SL; (D) *Pomacanthus imperator*, NSMT-P 103369, 266.8 mm SL; (E) *Pomacanthus semicirculatus*, NSMT-P 103294, 346.6 mm SL; (F) *Evisτίας acutirostris*, NSMT-P 108835, 261.8 mm SL; (G) *Kuhlia mugil*, NSMT-P 103286, 224.9 mm SL.

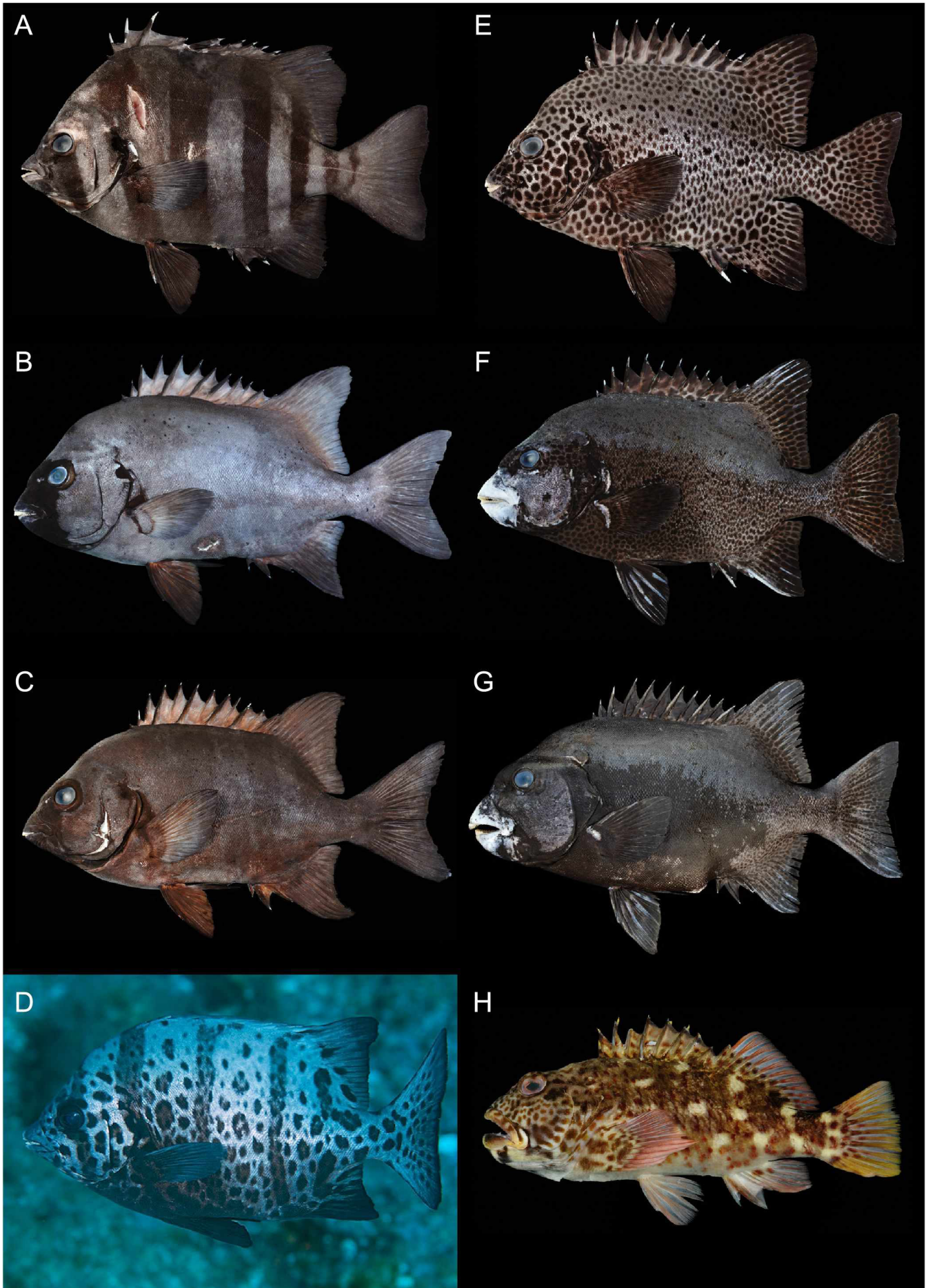


FIGURE 12. (A) *Oplegnathus fasciatus*, NSMT-P 103138, 193.7 mm SL, young; (B) *Oplegnathus fasciatus*, NSMT-P 103379, 365.2 mm SL, adult male; (C) *Oplegnathus fasciatus*, NSMT-P 103137, 331.2 mm SL, adult female; (D) Hybrid individual between *Oplegnathus fasciatus* and *O. punctatus*, KPM-NR 78248; (E) *Oplegnathus punctatus*, NSMT-P 103139, 227.5 mm SL, young; (F) *Oplegnathus punctatus*, NSMT-P 103407, 355.5 mm SL, adult; (G) *Oplegnathus punctatus*, NSMT-P 103400, 468.5 mm SL, older adult; (H) *Cirrhitus pinnulatus*, NSMT-P 103093, 177.2 mm SL.

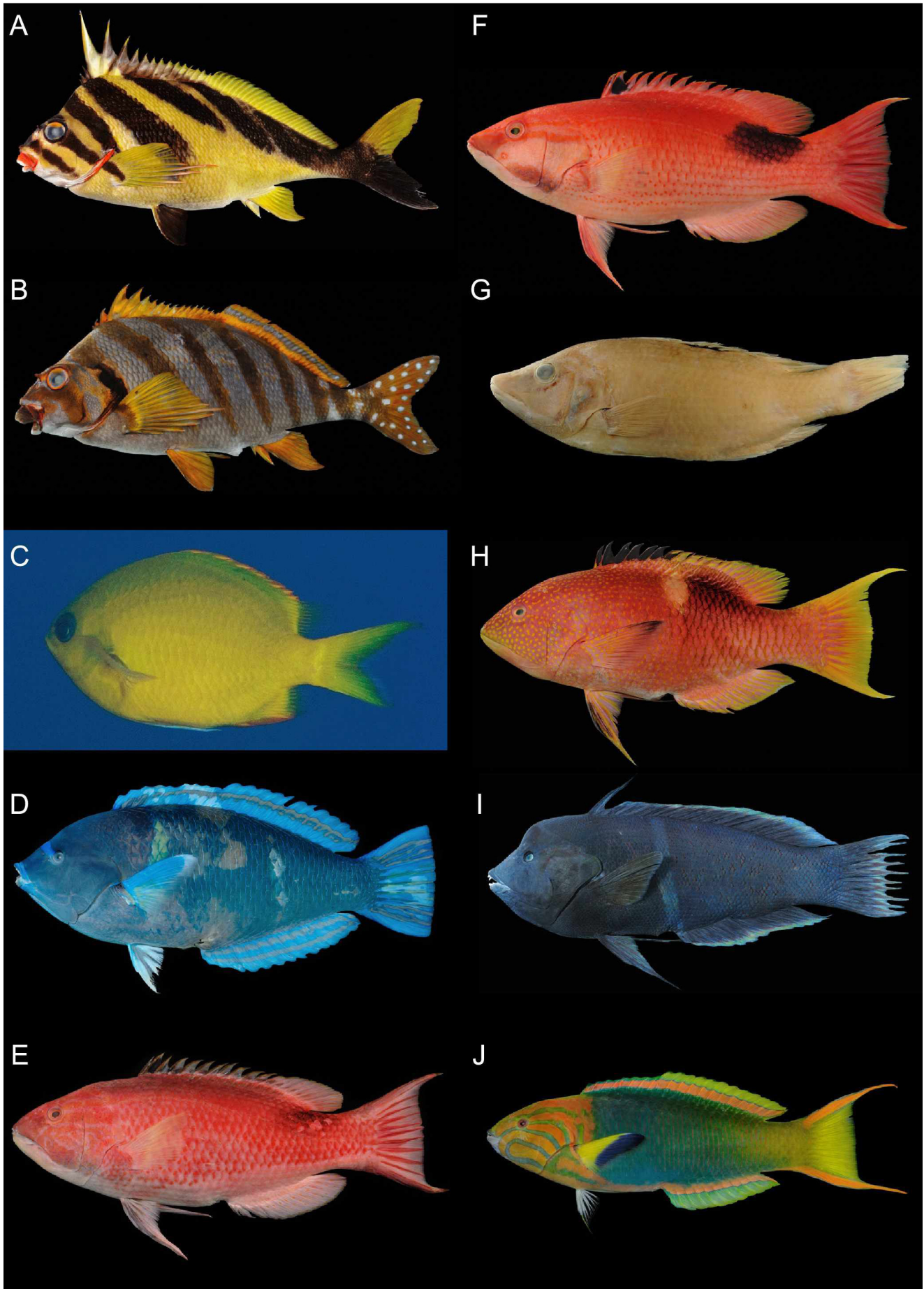


FIGURE 13. (A) *Goniistius zebra*, NSMT-P 108839, 299.5 mm SL; (B) *Goniistius zonatus*, NSMT-P 103185, 331.8 mm SL; (C) *Chromis analis*, KPM-NR 78327; (D) *Anampses caeruleopunctatus*, NSMT-P 103097, 285.5 mm SL, terminal male; (E) *Bodianus bilunulatus*, NSMT-P 103103, 291.1 mm SL, terminal male; (F) *Bodianus biunulatus*, NSMT-P 103167, 267.7 mm SL, initial phase; (G) *Bodianus oxycephalus*, NSMT-P 64812, 334.5 mm SL, preserved specimen; (H) *Bodianus perditio*, NSMT-P 103122, 330.6 mm SL; (I) *Coris aygula*, NSMT-P 103291, 398.5 mm SL, terminal male; (J) *Thalassoma lutescens*, NSMT-P 108837, 174.3 mm SL, terminal male.

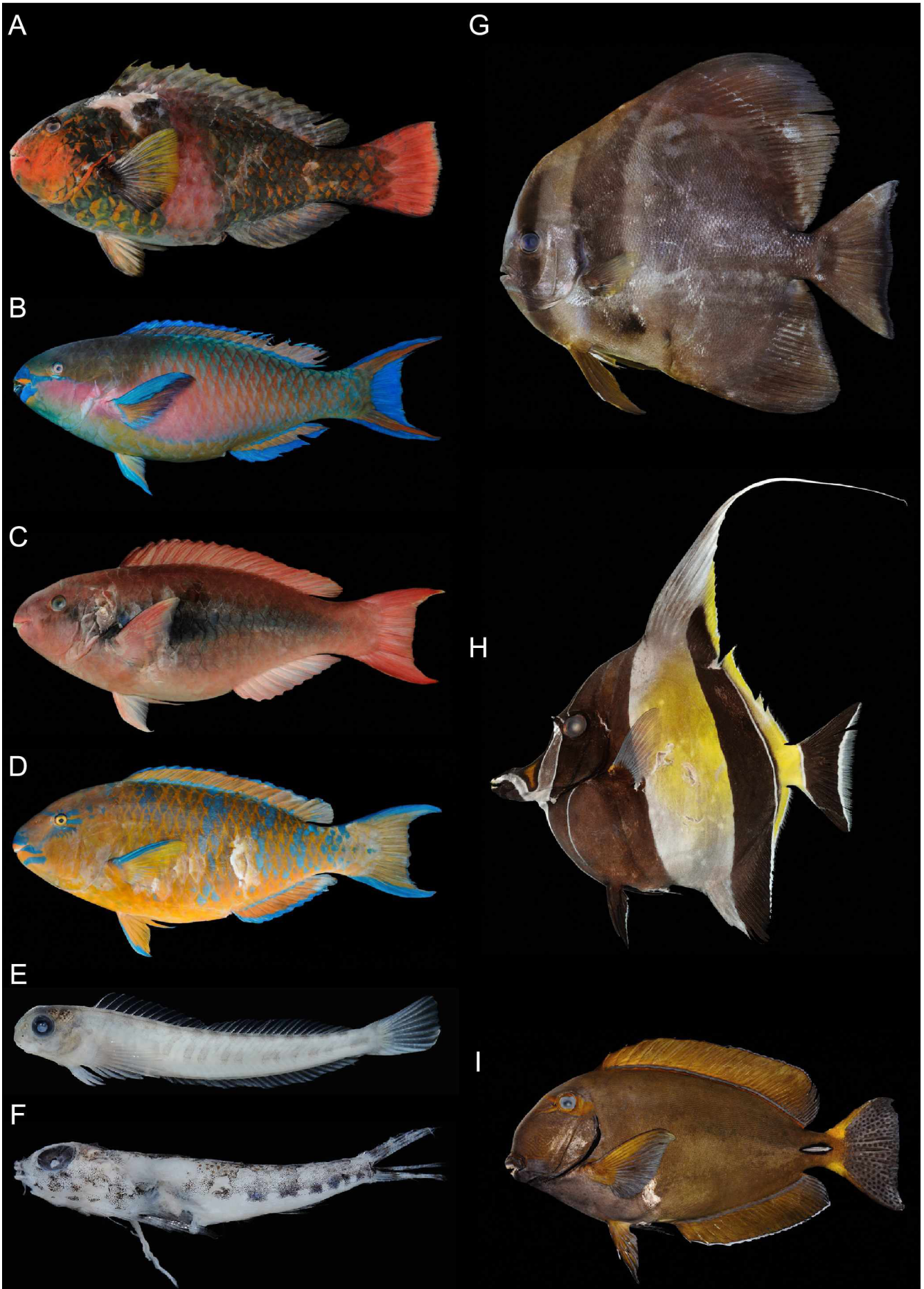


Figure 14. (A) *Calotomus japonicus*, NSMT-P 108833, 282.1 mm SL; (B) *Scarus forsteni*, NSMT-P 103403, 397.5 mm SL, terminal male; (C) *Scarus forsteni*, NSMT-P 103112, 315.5 mm SL, initial phase; (D) *Scarus ghobban*, NSMT-P 103295, 503.7 mm SL, initial phase; (E) *Alticus saliens*, NSMT-P 103304, 18.7 mm SL; (F) *Minysynchiropus kiyooae*, NSMT-P 103305, 17.1 mm SL, female; (G) *Platax teira*, NSMT-P 103302, 262.3 mm SL; (H) *Zanclus cornutus*, NSMT-P 103118, 156.8 mm SL; (I) *Acanthurus dussumieri*, NSMT-P 108847, 363.1 mm SL.

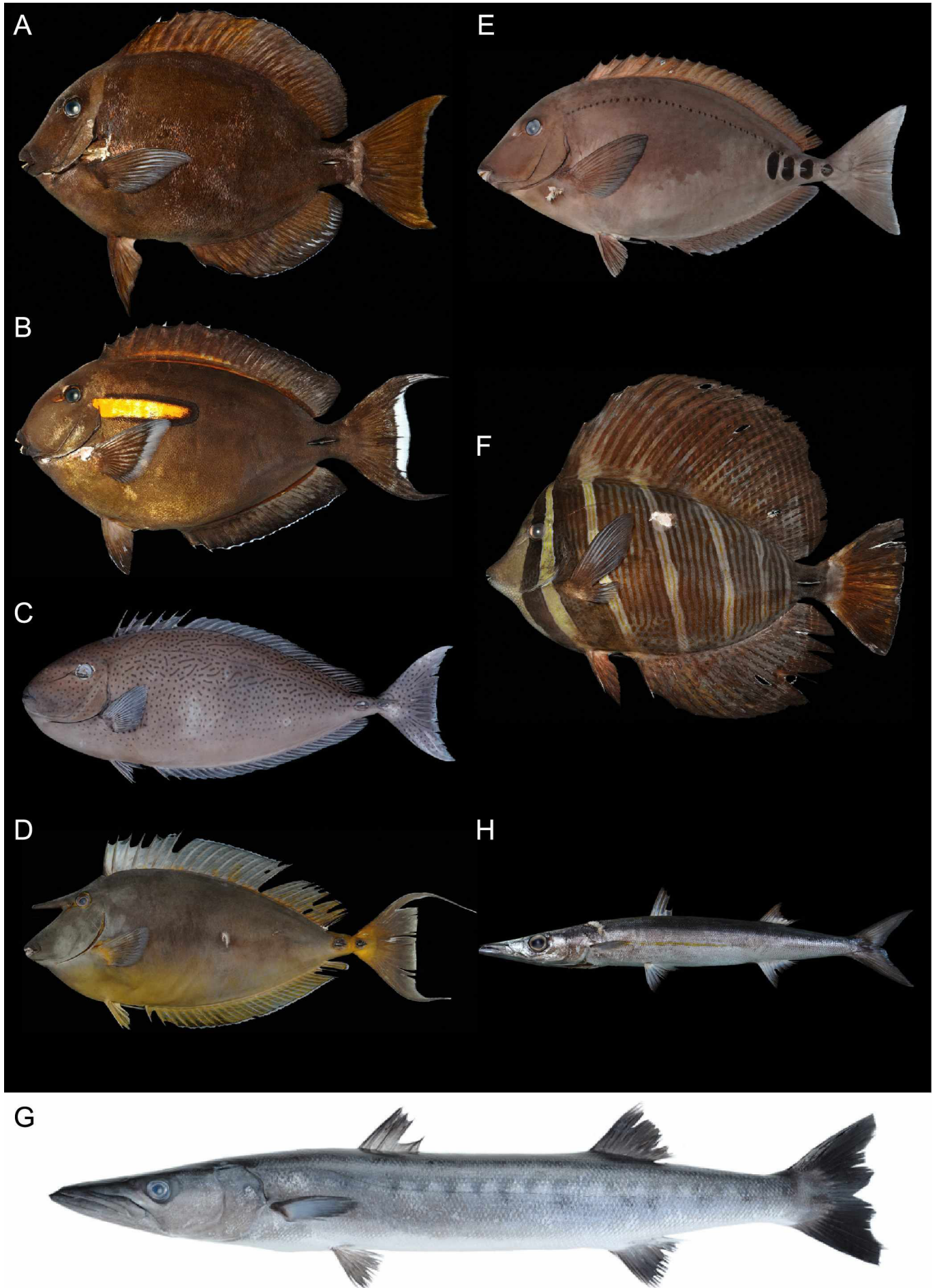


FIGURE 15. (A) *Acanthurus leucopareius*, NSMT-P 103128, 228.3 mm SL; (B) *Acanthurus olivaceus*, NSMT-P 103129, 234.5 mm SL; (C) *Naso maculatus*, NSMT-P 103417, 553.6 mm SL; (D) *Naso unicornis*, NSMT-P 103117, 352.6 mm SL; (E) *Prionurus scalprum*, NSMT-P 103436, 411.9 mm SL; (F) *Zebrasoma veliferum*, NSMT-P 103102, 222.8 mm SL; (G) *Sphyraena barracuda*, NSMT-P 103385, 819.3 mm SL; (H) *Sphyraena helleri*, NSMT-P 103279, 459.7 mm SL.

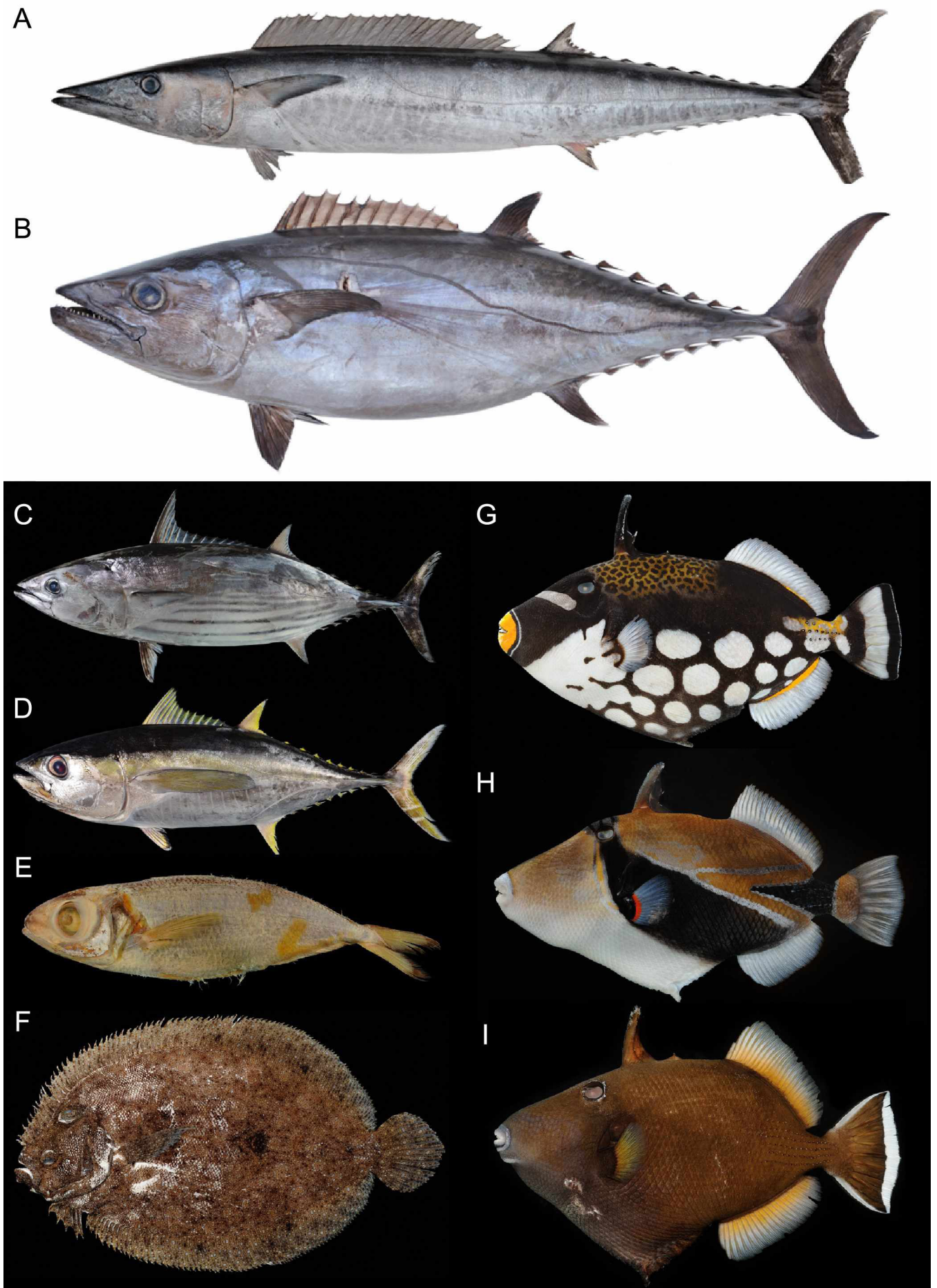


FIGURE 16. (A) *Acanthocybium solandri*, NSMT-P 103418, 1034.1 mm SL; (B) *Gymnosarda unicolor*, NSMT-P 103384, 885.4 mm SL, male; (C) *Katsuwonus pelamis*, NSMT-P 103412, 484.3 mm SL; (D) *Thunnus albacares*, NSMT-P 108830, 481.9 mm SL; (E) *Ariomma luridum*, NSMT-P 64808, 262.7 mm SL, preserved specimen; (F) *Bothus mancus*, NSMT-P 103123, 263.7 mm SL, female; (G) *Balistoides conspicillum*, NSMT-P 103165, 244.0 mm SL; (H) *Rhinecanthus rectangulus*, NSMT-P 103166, 180.9 mm SL; (I) *Sufflamen chrysopterum*, NSMT-P 103109, 148.9 mm SL.

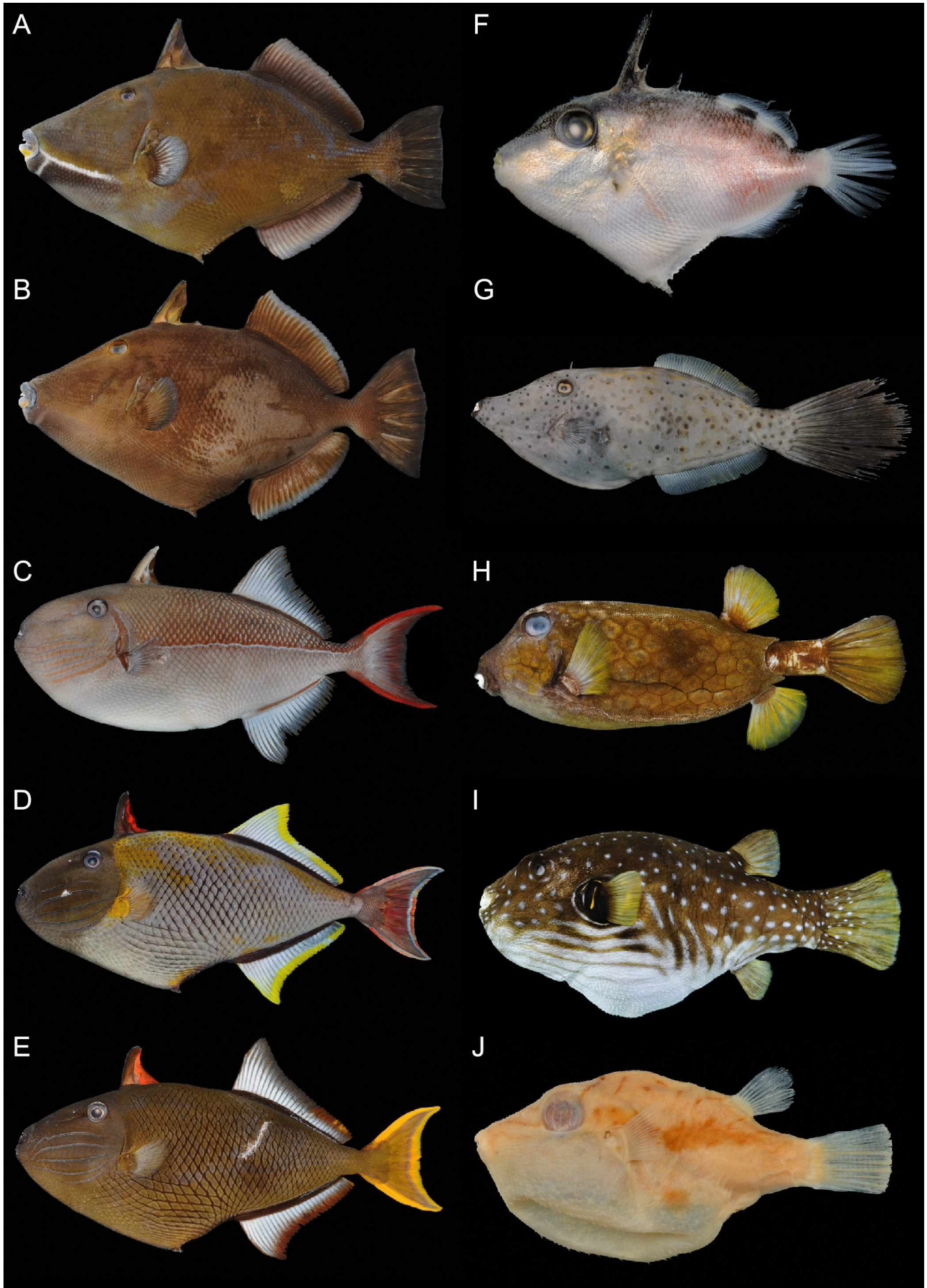


FIGURE 17. (A) *Sufflamen fraenatum*, NSMT-P 103183, 271.4 mm SL, male; (B) *Sufflamen fraenatum*, NSMT-P 103127, 225.6 mm SL, female; (C) *Xanthichthys caeruleolineatus*, NSMT-P 103441, 245.3 mm SL; (D) *Xanthichthys mento*, NSMT-P 103179, 201.2 mm SL, male; (E) *Xanthichthys mento*, NSMT-P 103442, 188.9 mm SL, female; (F) *Abalistes* sp., NSMT-P 108813, 29.8 mm SL; (G) *Aluterus scriptus*, NSMT-P 103444, 329.7 mm SL; (H) *Ostracion immaculatus*, NSMT-P 103180, 153.0 mm SL; (I) *Arothron hispidus*, NSMT-P 103177, 195.7 mm SL; (J) *Canthigaster inframacula*, NSMT-P 22288, 40.3 mm SL, preserved specimen.