

Taxonomic Reassessment of *Albula* (Albuliformes: Albulidae) from Japan and Adjacent Waters with Reliable Records of *Albula argentea*, *A. koreana* and *A. oligolepis* from Japan

Mizuki Matsunuma^{1,5}, Nene Nagaya², Koichi Hidaka³, and Yoshiaki Kai⁴

¹ The Kyoto University Museum, Yoshida-honmachi, Sakyo-ku, Kyoto 606-8317, Japan

E-mail: k1139853@kadai.jp

² Numata, Gunma, Japan

³ Marine Fisheries Research and Development Center (JAMARC), Japan Fisheries Research and Education Agency, 6F Techno Wave 100, 1-1-25 Shin-urashima-cho, Kanagawa-ku, Yokohama, Kanagawa 221-8529, Japan

⁴ Maizuru Fisheries Research Station, Field Science Education and Research Center, Kyoto University, Nagahama, Maizuru, Kyoto 625-0086, Japan

⁵ Corresponding author

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A taxonomic review of *Albula* Scopoli, 1777 (Albuliformes: Albulidae) in Japanese and adjacent waters, based on morphology and mtDNA cytochrome *b* sequence data, resulted in the recognition of four species: *Albula argentea* (Forster, 1801), *Albula glossodonta* (Forsskal, 1775), *Albula koreana* Kwun and Kim, 2011, and *Albula oligolepis* Hidaka, Iwatsuki, and Randall, 2008. Although Japanese ichthyologists have long considered *A. glossodonta* and a second *Albula* species (referred to by the Japanese name “Sotoiwashi”) to be distributed in Japanese waters, the latter having been reported as *A. koreana* or *Albula* sp. in recent literature, the present study revealed that, in fact, “Sotoiwashi” included three species, viz., *A. argentea*, *A. koreana* and *A. oligolepis*. Examined specimens of the latter three species represent the first reliable records of all three from Japanese waters, with comparative specimens of *A. koreana* from Vietnam and Malaysia also representing distributional range extensions (formerly known only from Korea and Taiwan). *Albula koreana* is readily distinguished from Japanese congeners by the striking yellow stripe on the cheek (just behind the mouth) in the former, a large dark blotch in front of the nostril, a dark oval blotch under an arc-shaped dark band on the snout tip, and greater numbers of body scales and vertebrae. As has been previously demonstrated, *A. argentea* and *A. oligolepis* are distinguished by pored lateral-line scale numbers (68–74 in the former vs. 61–67 in the latter) and total vertebrae (68–75 vs. 64–70). Updated distributional information shows *A. argentea* to be distributed from Indonesia east to French Polynesia, and north to Japan and Korea (there being no reliable records from Sri Lanka, Madagascar or the Hawaiian Islands); *A. koreana* in waters off Korea, Japan, Taiwan, Vietnam and Malaysia (east coast of Malay Peninsula); and *A. oligolepis* from the east coast of Africa to the Coral Sea, and north to Japan.

Key Words: Pisces, Bonefish, distribution, morphology, *Albula glossodonta*.

Introduction

The genus *Albula* Scopoli, 1777 (Albuliformes: Albulidae) comprises shallow-dwelling marine fishes found in coastal and estuarine waters, and off oceanic islands in the tropical Pacific (including the Eastern Pacific), Indian and Atlantic oceans (Smith and Randall 1999; Pickett et al. 2020). The taxonomy of the component species has remained confused worldwide, due to the lack of distinct species-diagnostic morphological characters in most (Bowen et al. 2008; Pickett et al. 2020). The review by Hidaka et al. (2008) of Indo-Pacific species of *Albula* on the basis of morphology, recognized four species, viz., *Albula argentea* (Forster in Bloch and Schneider, 1801), *Albula glossodonta* (Forsskal in Niebuhr, 1775), *Albula oligolepis* Hidaka, Iwatsuki, and Randall, 2008, and *Albula virgata* Jordan and Jordan, 1922, with *Albula koreana* Kwun and Kim, 2011 being subsequently described. Three eastern Pacific Ocean species [*Albula esuncula* (Garman, 1899), *Albula pacifica* (Beebe, 1942), and

Albula gilberti Pfeiler and van der Heiden in Pfeiler et al., 2011] were recognized by Pfeiler (2008) and Pfeiler et al. (2008, 2011), and in the Atlantic Ocean, three species, including *Albula vulpes* (Linnaeus, 1758); *Albula goreensis* Valenciennes in Cuvier and Valenciennes, 1847; and *Albula nemoptera* (Fowler, 1911), are currently regarded as valid, although *A. vulpes* and *A. goreensis* each apparently represent a species complex (see Pickett et al. 2020). In total, 11 valid species are currently recognized worldwide.

Among the Indo-Pacific species of *Albula*, *A. glossodonta* is widely distributed throughout the region, whereas *A. virgata* is endemic to the Hawaiian Islands (Hidaka et al. 2008; Pickett et al. 2020). *Albula oligolepis* has been recorded from the Indian Ocean (east coast of Africa to the Andaman Sea and northwestern Australia) and south-west Pacific (eastern Australia and Papua New Guinea) (Hidaka et al. 2008; Wallace 2015). The distributional range of *A. argentea* has been problematic, Hidaka et al. (2008) identifying specimens from Indonesia (southeastern Indian Ocean) and many Pacific Ocean localities (including Vietnam as the northern-

most record) as that species. However, in the most recent review of *Albula*, Pickett et al. (2020) included Indian Ocean localities, including Madagascar, the Seychelles, and Sri Lanka in the distributional range of *A. argentea*, as well as Japan which has not been accepted by Japanese studies (see Aizawa and Doiuchi 2013), despite Kim et al. (2019) reporting *A. argentea* from Jeju Island (south of the Korean Peninsula, vicinity of Nagasaki Prefecture, Japan), based on a voucher specimen and supported by a mtDNA cytochrome *b* sequence.

In Japanese waters, only a single *Albula* taxon (Japanese name “Sotoiwashi”) has long been recognized. Prior to Colborn et al. (2001), who showed previously recognized “*A. vulpes*” to be polyphyletic, Japanese ichthyologists regarded “Sotoiwashi” as *A. vulpes* (see Uyeno 1984). Although Aizawa (1993) referred “Sotoiwashi” to *Albula neoguinaica* Valenciennes in Cuvier and Valenciennes, 1847 (now synonymized under *A. argentea*), Hidaka et al. (2004) followed Randal and Bauchot (1999) and referred the species to *Albula forsteri* Valenciennes in Cuvier and Valenciennes, 1847. Hidaka et al. (2004) also recorded a single specimen of *A. glossodonta* from Iriomote-jima Island, southern Ryukyu Islands, and proposed the Japanese name “Marukuchi-sotoiwashi” for the species. More recently, Hidaka et al. (2008) reviewed the Indo-Pacific members of the *A. argentea* complex sensu Hidaka et al. (2008) and considered *A. argentea* to have priority over *A. forsteri*. However, they failed to include Japanese examples in their study. Although Aizawa and Doiuchi (2013) considered “Sotoiwashi” to be identical with *A. argentea*, they deferred such identification due to a mismatch of important characters, including numbers of pored lateral-line scales and vertebrae, between their Japanese examples of “Sotoiwashi” and *A. argentea* of Hidaka et al. (2008). Since Hidaka et al. (2008: fig. 7) considered that *A. oligolepis* and *A. argentea* were allopatrically distributed in the Indian Ocean (and Coral Sea) and Pacific Ocean (including Indonesia facing the southeastern Indian Ocean), respectively, Aizawa and Doiuchi (2013) overlooked the possibility of *A. oligolepis* occurring in Japanese waters. Subsequently, Aizawa and Doiuchi (2013) and other Japanese studies, including Hatooka (2018, 2022) have treated “Sotoiwashi” as an unidentified species, *Albula* sp., although most recent literature, including Hata (2018a, b, 2020), Nakae et al. (2018) and Motomura (2022), has identified Japanese “Sotoiwashi” as *A. koreana*, originally described from Korea and Taiwan, without discussion.

Taxonomic examination of Japanese examples of *Albula* species, based on morphology and partial cytochrome *b* gene sequences, resulted in the recognition of four *Albula* species, including *A. argentea*, *A. koreana*, *A. oligolepis* and *A. glossodonta*, in Japanese waters. The former three species have all been confused under the name “Sotoiwashi.”

Materials and Methods

Methods of counts and proportional measurements followed Hidaka et al. (2008), with the following addition:

number of scale rows between lateral line and mid-dorsal-fin base (at 9–11th dorsal-fin ray base). Body depth was taken at the dorsal fin origin. Mandible length was taken from the posteriormost margin of the maxilla to the anterior tip of the mandible. Interorbital width was taken at the mid-orbit. Vertebrae were counted on X-ray photographs of all examined specimens, except FAKU 68304. A dataset of counts and measurements for all examined specimens has been uploaded to Zenodo (available at <https://doi.org/10.5281/zenodo.6837600>) for future taxonomic studies.

Total DNA of each specimen was extracted from muscle tissue preserved in 99% ethanol, by using the Wizard Genomic DNA Purification Kit (Promega Inc.). The partial cytochrome *b* (*cyt-b*) gene was amplified with the primer pairs GluDG-L (forward, 5'-TGA CTT GAA RAA CCA YCG TTG-3'; Palumbi 1996) and CB2H (5'-AAA CTG CAG CCC CTC AGA ATG ATA TTT GTC CTC A-3'; Kocher et al. 1989). The PCR proceeded for 30 cycles, with denaturation at 94°C for 15 s, annealing at 54°C for 15 s and extension at 72°C for 30 s, using the KAPA2G Robust PCR Kit (KAPA Biosystems). The PCR products were purified with ExoSAP-It (USB Corporation) enzyme, and then Sanger-sequenced using the forward primer. Sequencing reactions were performed by the Sequencing Service of Eurofins Genomics (Tokyo, Japan), using an Applied Biosystems automated sequencer. The sequences determined here were aligned using MAFFT version 7 (Kato and Standley 2013) with previously determined sequences of species of *Albula* and the out-group taxon *Elops hawaiiensis* Regan, 1909, deposited at INSDC (International Nucleotide Sequence Database Collaboration) or BOLD (Barcode of Life Data System) (Table 1). All sequences determined here have been deposited in INSDC under accession numbers LC707189–LC707221. Because the determined region of *cyt-b* (355 bp) differed somewhat from previous studies, short alignment sequences (220 bp) were used for phylogenetic reconstruction to identify species. A pairwise matrix of simple uncorrected distances (*p*-distance) was prepared, and a neighbor-joining (NJ) tree (Saitou and Imanishi 1987) reconstructed using MEGA 11 (Tamura et al. 2016). Branch support was measured using nonparametric bootstrapping with 1000 replications, based on the same algorithm (Felsenstein 1985).

Species identification was based on diagnostic morphology and color characters, and molecular comparisons. Since an overall comparison of morphological features for all valid species was unavailable, Indo-Pacific members, including *A. argentea*, *A. glossodonta*, *A. koreana*, *A. oligolepis* and *A. virgata*, were assessed from Smith and Randall (1999), Hidaka et al. (2004, 2008) and Kwun and Kim (2011). Morphological diagnostic characters for other species were given by Rivas and Warlen (1967) for *A. nemoptera*, Pfeiler (2008) for *A. pacifica* (particularly), and Pfeiler et al. (2011) for *A. esuncula* and *A. gilberti*. Since the two Atlantic species, *A. vulpes* and *A. goreensis* form a morphologically cryptic complex with *Albula* sp. cf. *vulpes* sensu Wallace and Tringali (2010) (see Wallace and Tringali 2010; Wallace 2015; Pickett et al. 2020), their morphological features are uncertain.

Table 1. International Nucleotide Sequence Database Collaboration (INSDC) accession numbers of mitochondrial cytochrome *b* gene sequences used in this study.

Species	INSDC Accession No.	Voucher specimen	Reference	Locality
<i>A. argentea</i> *	AF311765	—	Colborn et al. (2001)	Unknown
<i>A. argentea</i>	HQ683755–HQ683761	see reference	Kwun and Kim (2011)	Fiji
<i>A. argentea</i>	LC707215	FAKU 147971	This study	Japan
<i>A. argentea</i>	LC707192	FAKU 148568	This study	Japan
<i>A. argentea</i>	LC707193	KAUM–I. 34311	This study	Japan
<i>A. argentea</i>	LC707194	KAUM–I. 50220	This study	Japan
<i>A. argentea</i>	LC707195	KAUM–I. 50221	This study	Japan
<i>A. argentea</i>	LC707216	KAUM–I. 50223	This study	Japan
<i>A. argentea</i>	LC707219	KAUM–I. 80897	This study	Japan
<i>A. argentea</i>	LC707217	KAUM–I. 86567	This study	Japan
<i>A. argentea</i>	LC707196	KAUM–I. 110168	This study	Japan
<i>A. argentea</i>	LC707197	KAUM–I. 120187	This study	Japan
<i>A. argentea</i>	LC707189–LC707191	KAUM–I. 159048–159050	This study	Japan
<i>A. argentea</i>	LC707198–LC707210	FAKU 210559–210563, 210565–210572	This study	Japan
<i>A. argentea</i>	LC707211	OCF-P 4243	This study	Japan
<i>A. argentea</i>	LC707214	NSMT-P 68020	This study	Indonesia
<i>A. esuncula</i>	AF311760–AF311762	—	Colborn et al. (2001)	Unknown
<i>A. gilberti</i> **	AF311757–AF311759	—	Colborn et al. (2001)	Unknown
<i>A. glossodonta</i>	AF311767–AF311769	—	Colborn et al. (2001)	Unknown
<i>A. goreensis</i> ***	AF311751, AF311756	—	Colborn et al. (2001)	Unknown
<i>A. koreana</i>	HM119396–HM119400	see reference	Kwun and Kim (2011)	Korea, Taiwan
<i>A. koreana</i>	LC707221	KAUM–I. 125129	This study	Taiwan
<i>A. nemoptera</i>	AF311754, AF311755	—	Colborn et al. (2001)	Unknown
<i>A. oligolepis</i> ****	AF311770, AF311772, AF311773	—	Colborn et al. (2001)	Unknown
<i>A. oligolepis</i>	KP090230–KP090237, KJ910041–KJ910043	see reference	Wallace (2015)	South Africa, Papua New Guinea, Australia
<i>A. oligolepis</i>	LC707220	KAUM–I. 50222	This study	Japan
<i>A. oligolepis</i>	LC707218	KAUM–I. 144516	This study	Japan
<i>A. oligolepis</i>	LC707212–LC707213	NSMT-P 129038–129039	This study	Japan
<i>A. pacifica</i>	DQ272657–DQ272659	see reference	Pfeiler et al. (2006), Pfeiler (2008)	Mexico
<i>A. virgata</i> *	AF311763, AF311764	—	Colborn et al. (2001)	Hawaii
<i>A. vulpes</i>	AF311753, AF311766, AF311771	—	Colborn et al. (2001)	Unknown
<i>Elops hawaiiensis</i> *****	HQ157201	PKU 3268	Kwun et al. (2011)	Korea

* Reported as *A. neoguinaica* in Colborn et al. (2001); ** reported as *Albula* sp. A in Colborn et al. (2001); *** reported as *Albula* sp. B in Colborn et al. (2001); **** reported as *Albula* sp. D in Colborn et al. (2001); ***** out group.

Molecular identifications, based on *cyt-b* sequences, were determined by comparisons among the present samples and sequences published in INSDC. The published sequences used in this study were obtained from Colborn et al. (2001), Pfeiler et al. (2006), Pfeiler (2008), Kwun and Kim (2011), and Wallace (2015) (see Table 1). The relationships between unidentified lineage names (*Albula* spp. A–E) used in Colborn et al. (2001) and currently recognized valid species names were summarized by Pickett et al. (2020: table 2).

Species accounts are ordered alphabetically, each diagnosis, including morphological and color characters, separating the species only from Indo-Pacific congeners. Since the Japanese species of *Albula* are morphologically similar to each other, a full-description is given only for *A. argentea*, with characters included in that account (but also applicable to other species) being generally omitted in subsequent descriptions. Standard length is abbreviated as SL. Synonym

lists include Japanese records and those representing distributional range extension. Institutional codes follow Fricke and Eschmeyer (2022), with the following additions: Hagi Museum (Yamaguchi, Japan) (HH), and Kitakyushu Museum of Natural History and Human History (Fukuoka, Japan) (KMNH). Specimens from Vietnam, Malaysia and Indonesia were collected before 1950. The distribution map was prepared using QGIS 3.10 (QGIS Development Team 2021), with data from ETOPO1 (NOAA National Geophysical Data Center 2009) and Natural Earth (free vector and raster map data at naturalearthdata.com). Distributional data included the following literature records: *A. argentea*: Hidaka et al. (2008) (Indo-Pacific); Kwun and Kim (2011) (Fiji); Kim et al. (2019) (Korea); Koeda (2019, 2020; photograph of KMNH VR 100246 provided by Y. Hibino) (Taiwan); Sonoyama et al. (2020) (Yamaguchi, Japan). *Albula glossodonta*: Takagi et al. (2010) (Ehime, Japan); Lee et al.

Table 2. Frequency distributions of selected meristic characters of three Japanese species of *Albula*.

	Dorsal-fin rays		Anal-fin rays		Pectoral-fin rays				Pelvic-fin rays		SR above LL								
	17	18	8	9	16	17	18	19	9	10	8	9	10						
<i>A. argentea</i>	2	39	37	4	2	11	23	5	1	40	5	36							
<i>A. koreana</i>		5	5		1	1	2	1		5		3	2						
<i>A. oligolepis</i>		5	5				4	1		5	4	1							
	SR below LL		Pre-dorsal-fin SR								Branchiostegal rays								
	6	7	18	19	20	21	22	23	24	25	26	10	11	12	13	14			
<i>A. argentea</i>	41		1	8	9	9	9	4				1	5	12	21	2			
<i>A. koreana</i>	1	4					1	1		2	1			2	3				
<i>A. oligolepis</i>	4	1			1	2	1		1					4	1				
	Upper gill rakers							Lower gill rakers					Total gill rakers						
	4	5	6	7	8	9	10	9	10	11	12	13	15	16	17	18	19	20	21
<i>A. argentea</i>	1	2	4	6	20	3	1		1	15	20	1		2	4	7	5	15	4
<i>A. koreana</i>	1	1		3				1	2	1	1		1	2	1	1			
<i>A. oligolepis</i>	1			1	2	1					5			1			1	2	1

SR and LL indicate scale rows and lateral line, respectively.

(2021) (Korea). *Albula oligolepis*: Hidaka et al. (2008) (Indo-Pacific); Wallace (2015) (Australia and Papua New Guinea).

Results

Albula argentea (Forster in Bloch and Schneider, 1801)
[Standard Japanese name: Sotoiwashi]
(Figs 1A, 2A–C, 3A, 4A, 5A–C, 6, 8B; Tables 2–5)

Albula vulpes (not of Linnaeus): Okada et al. 1935: 62, pl. 13-3 [atlas; Japan; identified by numbers of pored lateral-line scales (PLS) and vertebrae]; Okada and Matsubara 1938: 38, pl. 5-3 [in part?; atlas; Japan; identified from drawing (specimen from Tokyo Bay)].

Albula neoguinaica Valenciennes, 1847: Aizawa 1993: 155, unnumbered fig. (in part; key; Japan); Aizawa 2000: 189, unnumbered fig. (in part; key; Japan); Nagatomo 2001: 145, unnumbered fig. (atlas; Iburi, Kochi, Japan; specimen: FAKU 68304); Aizawa 2002: 189, unnumbered fig. (in part; key; Japan).

Albula sp.: Aizawa and Doiuchi 2013: 235, unnumbered fig. (in part; key; Japan); Hatooka 2018: 63, unnumbered fig. (in part; atlas; Japan); Ikeda and Nakabo 2015: 35, pl. 34-7 [in part?; atlas, short description; Wakayama, Japan; 2 specimens: WMNH-PIS-WW 02102, PLS: 66 or 71 (from description)]; Hatooka 2022: 63, unnumbered fig. (in part; atlas; Japan).

Albula koreana not of Kwun and Kim: Hata 2018a: 51, unnumbered figs. (atlas; Uchinoura Bay, Kagoshima, Japan; specimens: KAUM–I. 34311, 80897); Hata 2020: 59, unnumbered figs (atlas; Uchinoura Bay, Kagoshima, Japan; specimens: KAUM–I. 34311, 80897, 120187); Sonoyama et al. 2020: 16 (checklist; Shimonoseki, Yamaguchi, Japan; specimen: HH-Pi 2156); Hata 2022: 22, unnumbered figs (in part; atlas; Satsuma Peninsula, Kagoshima, Japan; specimen: KAUM–I. 9013).

Albula argentea: Koeda 2019: 82, unnumbered figs [in part; atlas; southern Taiwan; specimens: 2 of 4, KMNH VR 100246 and NMMB-P29859, PLS: ca. 70 (from photographs)]; Koeda 2020: 82, unnumbered figs (same as Koeda 2019).

?*Albula koreana* not of Kwun and Kim: Murase 2021: 76, unnumbered fig. [atlas; Kadogawa Bay, Miyazaki, Japan; specimen (KPM-NI 53373) not examined here]; Shimose 2021: 44, unnumbered fig. (atlas; Okinawa, Japan).

Material examined. 41 specimens, 49.3–495.5 mm SL. **JAPAN: Kyoto Prefecture:** FAKU 147971, 390.1 mm SL, Tai, Miyazu (Sea of Japan coast), set net, 27 October 2020. **Iwate Pref.:** FAKU 148568, 299.9 mm SL, Miyako, set net, October 2020. **Shizuoka Pref.:** KPM-NI 16350, 347.5 mm SL, west of Sagami Bay, Akazawa, Ito, H. Senou, set net, 5 November 2005. **Kochi Pref.:** FAKU 68304, 271.4 mm SL, Iburi, Tosashimizu, set net, 1 September 1998. **Ehime Pref.:** NSMT-P 76247, 316.1 mm SL, Oitsukami-jima Island, Uwa-jima, 30 m depth, S. Kyōe, 25 September 2004. **Oita Pref.:** KAUM–I. 140898, 308.0 mm SL, off Kamae-senzaki, Saiki (32°49'N, 132°02'E), K. Hoshino, set net, 19 September 2002. **Kagoshima Pref.:** KAUM–I. 9013, 265.4 mm SL, off Sakinoyama, Kataura, Kasasa, Minamisatsuma (31°25'44"N, 130°11'49"E), 27 m depth, M. Ito, set net, 22 October 2007; KAUM–I. 29899, 309.9 mm SL, off Kawajiri Port, Kaimon-kawajiri, Ibusuki (31°10'N, 130°32'E), T. Ose, 16 November 2011; KAUM–I. 34311, 289.8 mm SL, Uchinoura Bay, Kimotsuki (31°17'N, 131°05'E), 40 m depth, M. Yamada, set net, 6 November 2010; KAUM–I. 50220, 347.0 mm SL, KAUM–I. 50221, 365.2 mm SL, KAUM–I. 50223, 368.3 mm SL, off Makikawa, Nakatane, Tanega-shima Island (30°36'59"N, 130°56'56"E), 20 m depth, M. Meguro et al., set net, 26 July 2012; KAUM–I. 60578, 464.9 mm SL, KAUM–I. 60579, 483.6 mm SL, KAUM–I. 60580, 472.0 mm SL, KAUM–I. 60581, 495.5 mm SL, Sumiyoshi Port, Nishinoomote, Tanega-shima Island (30°39'50"N, 130°55'50"E),

Table 3. Frequency distributions of diagnostic meristic characters of three Japanese species of *Albula*.

	Scale rows between lateral line and mid-dorsal-fin base									Dorsum stripes							
	7		8		9		10		7		8		9		10		
<i>A. argentea</i>	1		39						2		33		1				
<i>A. koreana</i>					4		1						4		1		
<i>A. oligolepis</i>			5								4		1				
	Pored lateral-line scales																
	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
<i>A. argentea</i>									2	1	3	8	10	9	7		
<i>A. koreana</i>															2	1	2
<i>A. oligolepis</i>	1	2		1		1											
	Vertebrae																
	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78		
<i>A. argentea</i>					1	1	10		13	11	3	1					
<i>A. koreana</i>													1	2	2		
<i>A. oligolepis</i>	1	1	2			1											
	Number of pored lateral-line scales+vertebrae																
	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	
<i>A. argentea</i>											1				1	1	
<i>A. koreana</i>																	
<i>A. oligolepis</i>	1			1		1		1	1								
	Number of pored lateral-line scales+vertebrae (continued)																
	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155		
<i>A. argentea</i>	2	4	6	6	8	3	5	1	1								
<i>A. koreana</i>											1		3	1			
<i>A. oligolepis</i>																	

N. Oshikawa, gill net, 11 March 2014; KAUM-I. 62406, 463.0 mm SL, off Yakutsu Port, Nakatane, Tanega-shima Island (30°28'N, 130°51'E), M. Takayama, line-fishing, 16 June 2014; KAUM-I. 80897, 293.5 mm SL, Uchinoura Bay, Kimotsuki (31°17'31"N, 131°04'49"E), 30–35 m depth, K. Koeda et al., set net, 9 December 2015; KAUM-I. 86567, 237.9 mm SL, off Minatosakae, Nishinoomote (30°43'50"N, 130°59'30"E), 9 m depth, S. Nishi, line-fishing, 22 January 2016; KAUM-I. 110168, 470.0 mm SL, south of Haya-ma Port, Mage-shima Island (30°43'N, 130°52'E), 22 m depth, gill net, 27 November 2017; KAUM-I. 120187, 306.0 mm SL, Uchinoura Bay, Kimotsuki (31°17'31"N, 131°04'49"E), 30–35 m depth, H. Hata et al., set net, 9 December 2015; KAUM-I. 159048, 306.9 mm SL, KAUM-I. 159049, 298.7 mm SL, KAUM-I. 159050, 298.2 mm SL, off Sakinoyama, Kataura, Kasasa, Minamisatsuma (31°26'00"N, 130°10'05"E), 36 m depth, M. Ito, set net, 2 August 2021; FAKU 210559, 426.0 mm SL, 210560, 440.0 mm SL, 210561, 458.1 mm SL, 210562, 453.5 mm SL, 210563, 418.1 mm SL, 210564, 426.3 mm SL, 210565, 413.4 mm SL, 210566, 432.2 mm SL, 210567, 331.1 mm SL, 210568, 312.7 mm SL, 210569, 348.3 mm SL, 210570, 356.8 mm SL, 210571, 341.7 mm SL, 210572, 343.3 mm SL precise localities unknown but probably Osumi Islands (obtained at fish market in Naha, Okinawa Pref.), Y. Sakurai, 14–15 May 2021. **Okinawa Pref.:** OCF-P 4234, 271.3 mm SL, Iriomote-jima

Island, October 2019; OCF-P 7740, 102.2 mm SL, Gesashi-gawa river, Okinawa-jima Island, November 2000. **INDONESIA:** NSMT-P 68020, 49.3 mm SL, Lombok.

Diagnosis. A species of *Albula* distinguished from Indo-Pacific congeners by the following combination of characters: tip of lower jaw pointed; scale rows between lateral line and mid-dorsal-fin base 7 or 8; pored lateral-line scales 68–74; total vertebrae 68–75; short indistinct yellow stripe on cheek; blotch in front of nostrils small, not larger than twice nostril size; oval blotch under arc-shaped band on snout tip absent.

Description. Meristics and morphometrics taken from examined specimens given in Tables 2–4. Body elongate, fusiform, slightly compressed laterally; head pointed, moderately short; caudal peduncle short and slightly compressed laterally (Figs 1A, 2A–C, 3A). Eye large, covered with developed adipose translucent layer. Molariform tooth patches on mesopterygoids (MP) and parasphenoid (PS) (mouth roof), and on basibranchial (mouth floor); PS tooth patch oval, located between elongate MP tooth patches; anterior portion of PS tooth patch sharply elongated, its tip at level of anterior tips of MP tooth patches; minute villiform teeth on both jaws, ca. 5 and 6 rows in widest portion of upper and lower jaw teeth bands, respectively; large, U-shaped tooth band of villiform teeth on vomer, small rounded tooth patches on both palatines. Mouth inferior, snout projecting strongly be-

Table 4. Proportional measurements, expressed as percentages* of SL, taken from specimens of *Albula argentea*, *A. koreana* and *A. oligolepis*.

SL (mm)	<i>A. argentea</i>	<i>A. koreana</i>	<i>A. oligolepis</i>
	<i>n</i> =41 49.3–495.5	<i>n</i> =5 243.7–272.7	<i>n</i> =5 289.0–373.4
Head length (% of SL)	27.3–31.2 (29.0)	29.9–30.9 (30.5)	28.3–29.8 (29.0)
Body depth	15.3–25.0 (22.2)	22.9–23.2 (23.0)	20.3–25.4 (21.8)
Body width	8.3–14.0 (12.9)	12.6–13.5 (13.0)	11.9–13.3 (12.6)
Snout length	10.9–12.5 (11.8)	12.2–12.7 (12.3)	11.5–12.2 (11.9)
Upper jaw length	9.5–12.1 (10.3)	11.2–11.9 (11.6)	9.7–10.7 (10.1)
Mandible length	7.1–10.8 (7.8)	8.8–10.0 (9.3)	7.0–8.3 (7.5)
Width of mouth	5.6–7.1 (6.3)	6.7–7.7 (7.0)	5.6–6.3 (5.8)
Maxillary depth	1.1–1.7 (1.4)	1.2–1.6 (1.5)	1.3–1.5 (1.4)
Bony interorbital width	6.5–8.0 (7.2)	6.8–7.1 (7.0)	6.5–7.2 (6.9)
Interorbital width	6.8–9.3 (8.4)	8.1–8.7 (8.4)	7.4–8.7 (8.0)
Orbit diameter	3.3–8.3 (4.3)	4.3–4.9 (4.6)	3.7–4.5 (4.2)
Suborbital width	2.2–4.4 (3.9)	3.8–4.3 (4.1)	3.8–4.3 (4.0)
Postorbital length	11.9–14.5 (13.3)	13.6–14.7 (14.1)	12.3–13.3 (13.0)
Longest dorsal-fin ray length	15.0–18.9 (16.4)	15.4–17.5 (16.7)	15.6–18.7 (16.8)
Last dorsal-fin ray length	5.4–7.7 (6.3)	6.8–7.8 (7.2)	5.7–6.9 (6.4)
Longest anal-fin ray length	6.8–9.2 (8.0)	8.8–9.3 (9.0)	7.5–9.8 (8.4)
Last anal-fin ray length	4.6–6.9 (6.0)	5.7–7.4 (6.9)	5.9–7.0 (6.4)
Pre-pectoral fin length	25.7–31.5 (27.5)	28.1–30.4 (28.9)	26.3–28.4 (26.9)
Pre-dorsal fin length	46.5–53.3 (50.7)	50.7–52.2 (51.6)	50.2–51.5 (50.9)
Pre-anal fin length	84.4–88.5 (86.6)	86.7–87.7 (87.3)	83.7–87.6 (85.9)
Pre-anus length	70.2–76.1 (73.6)	74.6–76.1 (75.3)	71.5–74.0 (72.3)
Pre-pelvic fin length	58.3–62.9 (61.1)	61.8–63.3 (62.7)	58.8–60.7 (59.6)
Dorsal-fin base length	14.8–17.2 (16.2)	16.1–16.4 (16.2)	15.5–17.2 (16.2)
Anal-fin base length	4.6–6.2 (5.6)	5.4–6.0 (5.6)	5.6–6.2 (5.9)
Pectoral fin length	14.6–16.6 (15.5)	16.1–16.7 (16.4)	15.3–16.9 (16.0)
Pelvic fin length	9.6–14.1 (11.7)	12.6–13.1 (12.8)	10.8–13.1 (12.0)
Caudal peduncle length	7.9–10.8 (9.4)	8.5–9.6 (8.9)	9.4–10.4 (10.0)
Caudal peduncle depth	6.8–7.8 (7.3)	7.1–7.5 (7.3)	7.0–7.8 (7.3)
Upper caudal-fin lobe length	23.6–29.6 (26.8)	27.4–28.6 (28.0)	27.6–28.9 (28.2)
Lower caudal-fin lobe length	22.6–27.4 (25.4)	24.2–27.3 (25.7)	25.9–27 (26.5)

* Means in parenthesis.

yond upper jaw; lower jaw tip relatively pointed (Fig. 4A); posterior margin of maxilla not reaching vertical through anterior margin of orbit; dorsal portion of upper jaw (pre-maxilla) broadly covered with lacrimal when mouth closed. Nostrils small, anterior and posterior nasal pores close together, anterior nasal pore oval, posterior pore a minute slit covered by skin flap. Gill rakers rudimentary, molariform. Exposed margins of preopercle, subopercle, interopercle and opercle smooth. Single row of 7–10 embedded scales along ventral edge of preopercle, just posterior to maxilla; no other scales on head. All fins (including dorsal and anal fins) comprising soft rays only. Dorsal fin single, located at mid-body; last ray slightly elongate, but not filamentous. Anal fin small, located near caudal fin; last ray slightly elongate, but not reaching vertical through caudal-fin base. Pelvic fin moderately large; its origin under 10 or 11th dorsal-fin ray base; posterior tip of depressed pelvic fin almost reaching or extending beyond anus in specimens <45 cm SL, but not reaching in larger specimens (usually ca. 50 cm or more); fin base with elongate triangular axillary scales. Pectoral fin relatively long, located well below lateral line; posterior tip of longest ray well anterior to vertical through dorsal fin

origin. Caudal fin very large, both lobes well developed, of similar length. Body scales thin, cycloid; lateral line almost straight, mid-lateral, extending slightly onto caudal fin; dorsalmost horizontal scale row (dorsal-fin basal scales) relatively small, elongate (triangular), about half size of lower row scales; all fins covered with minute cycloid scales. Most specimens with 8 well-formed horizontal scale rows between mid-dorsal-fin base and lateral line, a 9th row very short, restricted to around dorsal fin origin (Fig. 5A, B); 2 specimens with posteriorly extended 9th scale row but not beyond mid-dorsal-fin base (Fig. 5C).

Color of fresh specimens: Head and body entirely silver, darker dorsally; dorsal surface of head black (Figs 1A, 2A–C). Dorsal and ventral edges of each body scale dark, forming many longitudinal, faint wavy dark lines, especially obvious on dorsum above lateral line, absent on abdomen. Cheek with a single short indistinct yellow stripe. No dark stripe in front of orbit. Iris pale yellow, a single horizontal black stripe crossing black pupil. Arched black band over snout tip, ends directed slightly upward or sideward. Small black blotch in front of nostril. Dorsal fin rays dusky yellow to gray, dorsal portion blackish; membranes semitranslu-

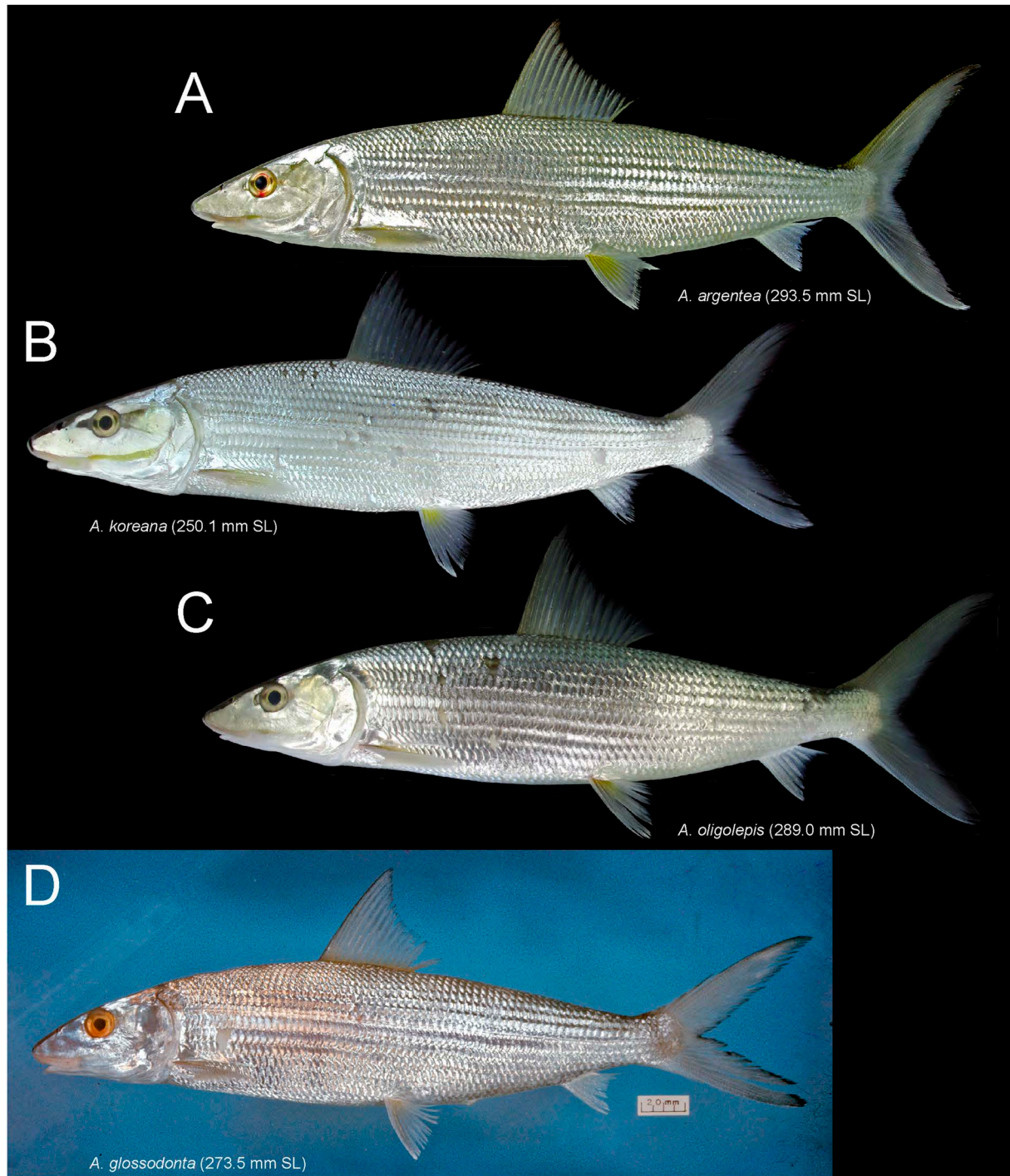


Fig. 1. Fresh specimens of (A) *Albula argentea*, (B) *A. koreana*, (C) *A. oligolepis* and (D) *A. glossodonta* from Japan. (A) KAUM-I. 80897, 293.5 mm SL, Uchinoura Bay, Kagoshima; (B) KAUM-I. 1246, 250.1 mm SL, Kasasa, Minamisatsuma, Kagoshima; (C) NSMT-P 129038, 289.0 mm SL, Amami-oshima Island, Kagoshima; (D) NSMT-P 102552, 273.5 mm SL, Iriomote-jima Island, Okinawa. Photos by KAUM (A, B), NSMT (C) and H. Kishimoto (D).

cent, densely covered with minute melanophores. Anal fin white to gray, densely covered with melanophores. Pectoral fin outer surface whitish-gray to blackish, inner axis vivid yellow (not apparent when fin closed). Pelvic fin dusky gray (semitranslucent with dense melanophores), basal portion largely yellowish but less vivid. Caudal fin yellowish in small specimens (<ca. 300 mm SL), becoming dusky with growth.

Color of preserved specimens: Head and body becoming

creamy-yellow, blackish dorsally, scale reflection sometimes retained; 7–9 longitudinal dark or brownish lines always retained on dorsum above lateral line (Fig. 3A) (dorsalmost lines interconnected, uncountable in large specimens >ca. 400 mm SL); dark blotches around nostrils and tip of snout always retained, even in long-term preserved specimens (Fig. 6A). Yellow coloration, including cheek stripe, completely obscured.

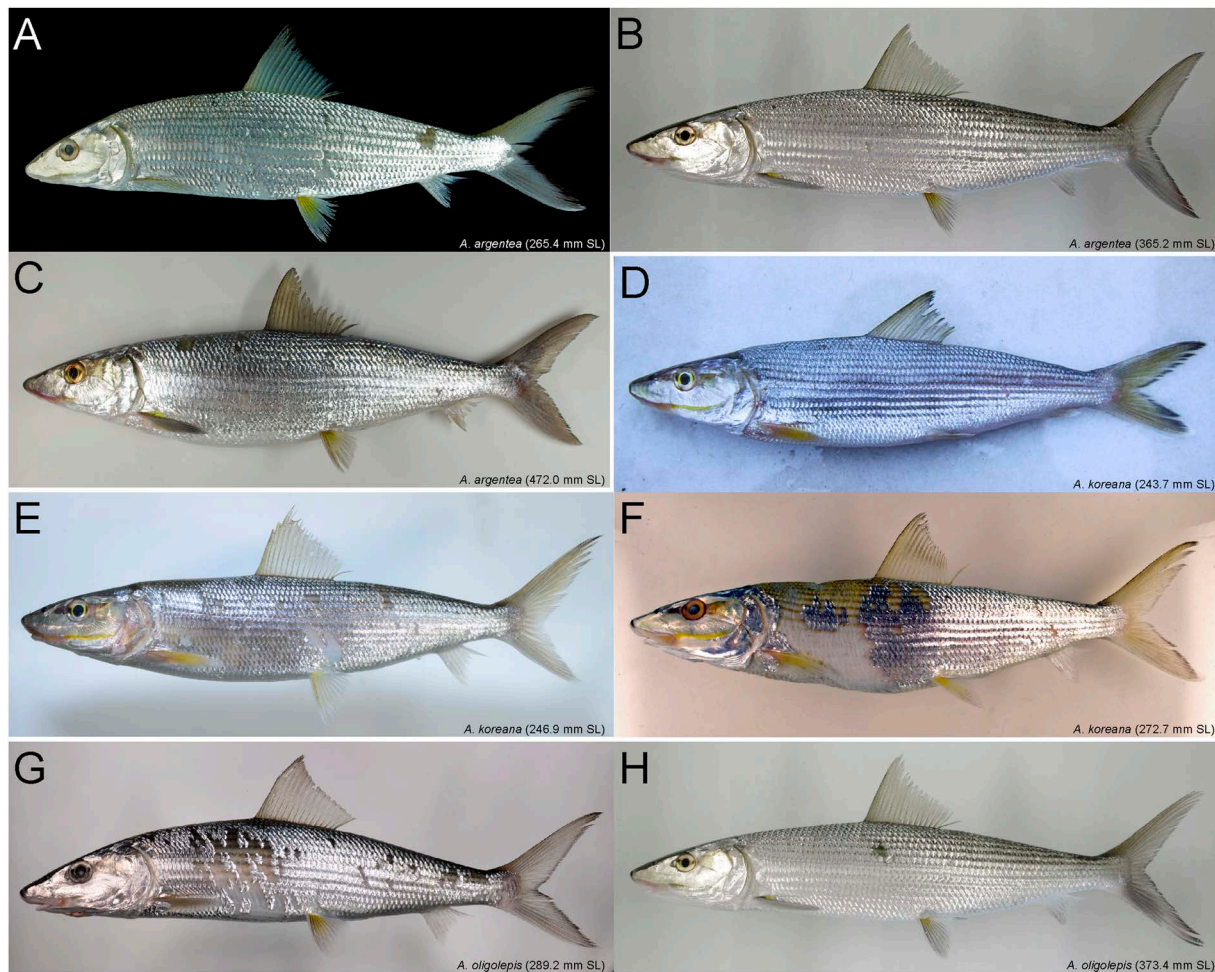


Fig. 2. Fresh specimens of (A–C) *Albula argentea*, (D–F) *A. koreana* and (G–H) *A. oligolepis*. (A) KAUM-I. 9013, 265.4 mm SL, Kasa-sa, Minamisatsuma, Kagoshima, Japan; (B) KAUM-I. 50221, 365.2 mm SL, Tanega-shima Island, Kagoshima, Japan; (C) KAUM-I. 60580, 472.0 mm SL, Tanega-shima Island, Kagoshima, Japan; (D) NSMT-P 67748, 243.7 mm SL, Cat Ba Island, Vietnam; (E) KAUM-I. 125129, 246.9 mm SL, Kaohsiung, Taiwan; (F) KAUM-I. 16854, 272.7 mm SL, Terengganu, Malaysia; (G) NSMT-P 129038, 289.2 mm SL, Amami-oshima Island, Kagoshima, Japan; (H) KAUM-I. 50222, 373.4 mm SL, Tanega-shima Island, Kagoshima, Japan. Photos by KAUM (A–C, E, F, H) and NSMT (D, G).

Distribution. *Albula argentea* is distributed in the southeastern Indian Ocean (Indonesia) and Pacific Ocean (reliable records from Papua New Guinea, Vanuatu, Fiji, French Polynesia, Singapore, the Philippines, Taiwan, Korea and Japan) (Fig. 7). Two specimens (KMNH VR 100246 and NMMB-P29859) noted in Koeda (2019, 2020) were correctly reported as *A. argentea* from Taiwan, with two other illustrated specimens (KAUM-I. 125129 and 125130) being identified here as *A. koreana*. Recently, Pickett et al. (2020) included Madagascar, the Seychelles, Sri Lanka and the Hawaiian Islands in the distributional range of the species, following the IUCN Red List (Adams et al. 2012). However, references used by Adams et al. (2012) included some previous studies (e.g., Colborn et al. 2001), but not the most recent available at that time (e.g., Hidaka et al. 2008; redescription of *A. argentea*). Due to the lack of verified supporting evidence, the latter localities are deleted from the distributional range of the species.

Remarks. Throughout all editions of “Fishes of Japan, with Pictorial Keys to the Species”, Aizawa (1993, 2000,

2002) and Aizawa and Doiuchi (2013) gave the number of pored lateral-line scales and total vertebrae for “Sotoiwashi” [as *A. neoguinaica* (now regarded as a junior synonym of *A. argentea*; see Hidaka et al. 2008) or *Albula* sp.] as 62–72 and 65–69, respectively. Following Hidaka et al. (2008) and the present study, the above accounts of “Sotoiwashi” included both *A. argentea* and *A. oligolepis* (see Table 5). Since Hattooka (2018, 2022) followed Aizawa and Doiuchi (2013), his *Albula* sp. also included both species. Some literature records of *A. vulpes* and *A. neoguinaica* from Japan, listed in the above synonymies, could be identified as *A. argentea* from photographs, drawings and/or descriptions. In addition, previous records of leptocephalus specimens of *Albula* from Japan, including Mochioka (2014: 5; *Albula* spp.), Koeda et al. (2016: 6; as *Albula* sp.) and Kimura et al. (2017: 77; as *Albula* sp.), are possibly identical based on the number of total myomeres. A leptocephalus specimen (HH-Pi 2156, 38.8 mm SL), previously reported by Sonoyama et al. (2020: 16) as *A. koreana* from Shimonoseki, Yamaguchi Pref., Japan, possessed ca. 71 total myomeres (counted from

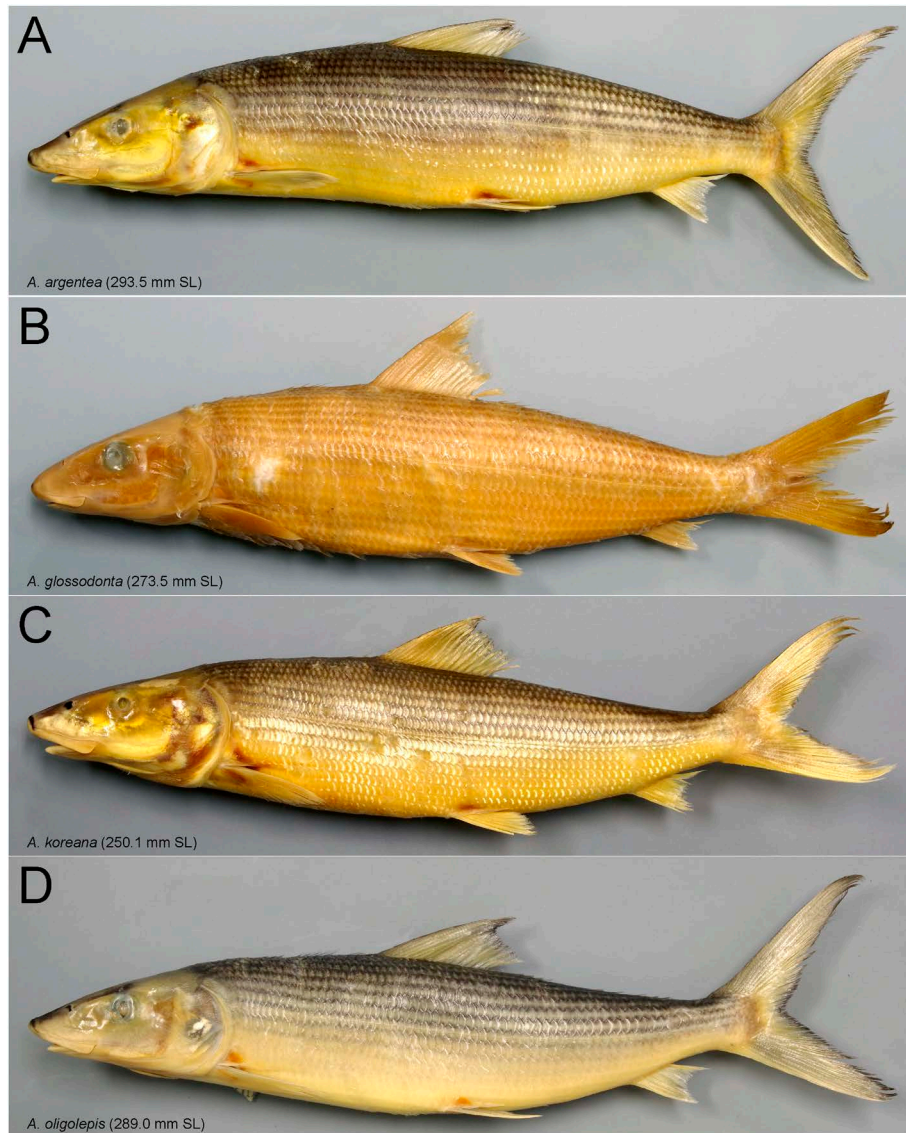


Fig. 3. Preserved specimens of (A) *Albula argentea*, (B) *A. glossodonta*, (C) *A. koreana* and (D) *A. oligolepis* from Japan. (A) KAUM-I. 80897, 293.5 mm SL, Uchinoura Bay, Kagoshima; (B) NSMT-P 102552, 273.5 mm SL, Iriomote-jima Island, Okinawa; (C) KAUM-I. 1246, 250.1 mm SL, Kasasa, Minamisatsuma, Kagoshima; (D) NSMT-P 129038, 289.0 mm SL, Amami-oshima Island, Kagoshima.

photographs) and was identical with *A. argentea*.

The standard Japanese name “Sotoiwashi” was first used for either *A. argentea* or *A. oligolepis*. Since *A. argentea* is the most abundant species in Japan among congeners, we suggest that “Sotoiwashi” be retained for *A. argentea*. The Japanese name-bearing specimen (recommended by the Ichthyological Society of Japan) is designated here as KAUM-I. 80897.

Albula glossodonta (Forsskål, 1775)
[Standard Japanese name: Marukuchi-sotoiwashi]
(Figs 1D, 3B, 4D; Table 6)

Albula glossodonta: Hidaka et al. 2004: 62, figs 1A, 2A (description; Iriomote-jima Island, Okinawa, Japan; specimen: IORD 76-1074); Takagi et al. 2010: 177, unnumbered fig. (atlas; Ainan, Ehime, Japan; specimen not re-

tained).

Material examined. JAPAN: NSMT-P 102552 (formerly IORD 76-1074), 273.5 mm SL, Iriomote-jima Island, Ryukyu Islands, Okinawa Prefecture, Japan, H. Kishimoto, gill net, 14 October 1976.

Diagnosis. A species of *Albula* distinguished from Indo-Pacific congeners by having a rounded lower jaw tip.

Description. Meristics and morphometrics taken from examined specimen are given in Table 6. Characters applicable to both *A. glossodonta* and *A. argentea* are not repeated here, except for the following significant features: anterior portion of parasphenoid tooth patch rounded without an anterior extension, its anterior tip not exceeding level of anterior tips of mesopterygoid tooth patches. Lower jaw tip relatively rounded (Fig. 4D). Single row of 8 embedded scales along ventral edge of preopercle, just posterior to

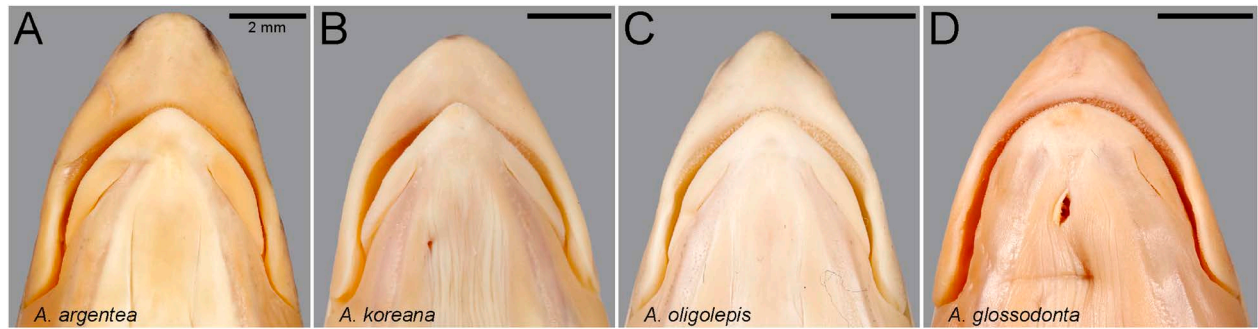


Fig. 4. Ventral views of lower jaw of preserved specimens of (A) *Albula argentea*, (B) *A. koreana*, (C) *A. oligolepis* and (D) *A. glossodonta*. (A) KAUM-I. 80897, 293.5 mm SL, Kagoshima, Japan; (B) KAUM-I. 1246, 250.1 mm SL, Kagoshima, Japan; (C) NSMT-P 129038, 289.0 mm SL, Kagoshima, Japan; (D) NSMT-P 102552, 273.5 mm SL, Okinawa, Japan. Bars indicate 2 mm.

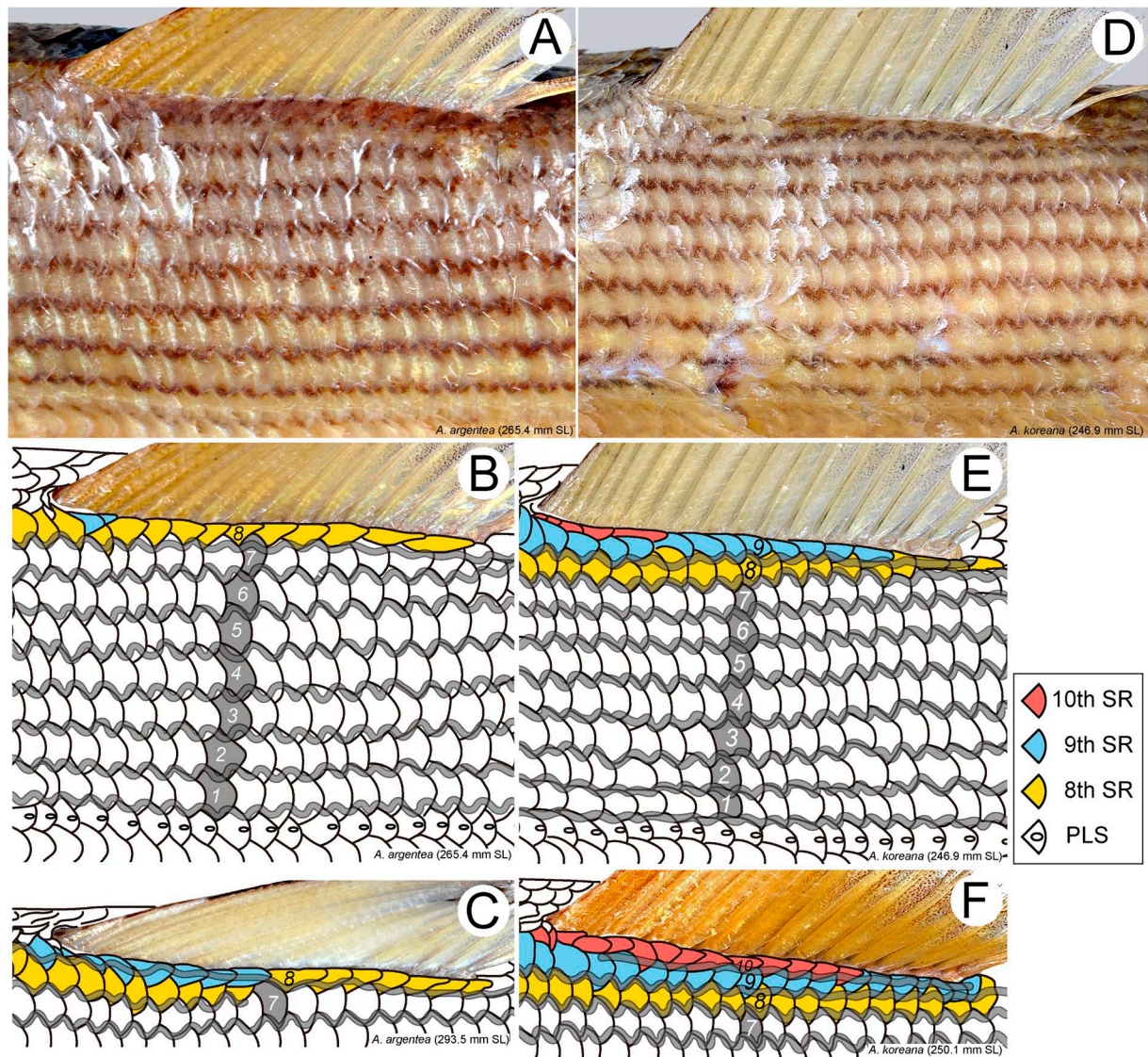


Fig. 5. Dorsum of (A–C) *Albula argentea* and (D–F) *A. koreana* in preserved specimens (A, D), and schematic drawings (B, C, E, F). Scales with number indicate scale rows between lateral line and mid-dorsal-fin base; red, blue and yellow scales indicate 10th, 9th and 8th scale rows (SR) from lateral line; scales with small circle indicate pored lateral-line scales (PLS). (A, B) KAUM-I. 9013, 265.4 mm SL, Kagoshima, Japan; (C) KAUM-I. 80897, 293.5 mm SL, Kagoshima, Japan; (D, E) KAUM-I. 125129, 246.9 mm SL, Kaohsiung, Taiwan; (F) KAUM-I. 1246, 250.1 mm SL, Kagoshima, Japan.

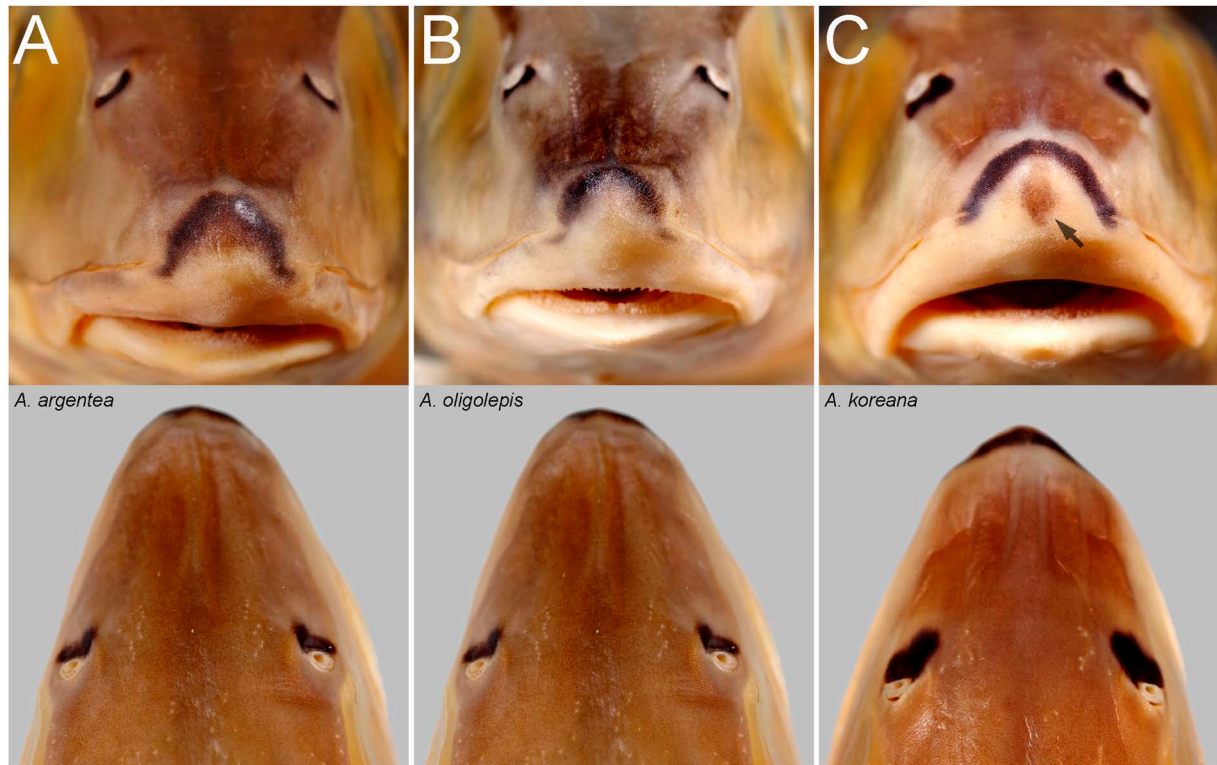


Fig. 6. Frontal (top) and dorsal (bottom) views of snouts of (A) *Albula argentea*, (B) *A. oligolepis* and (C) *A. koreana*. (A) KAUM-I. 80897, 293.5 mm SL, Kagoshima, Japan; (B) NSMT-P 129038, 289.0 mm SL, Kagoshima, Japan; (C) KAUM-I. 1246, 250.1 mm SL, Kagoshima, Japan. Arrow in C indicates blotch on snout tip.

maxilla. Posterior tip of depressed pelvic fin not reaching anus. 8 horizontal scale rows between mid-dorsal-fin base and lateral line; 9th scale row short, restricted to around dorsal fin origin.

Color of fresh specimen: Cheek without a yellow stripe (Fig. 1D). Iris reddish yellow, without a stripe crossing black pupil. Dorsal fin rays gray, blackish dorsally; membranes semitranslucent, with dense melanophores. Anal fin white, with dense melanophores. Pectoral fin outer surface whitish, inner axis coloration not apparent on specimen photograph. Pelvic fin whitish entirely (basal portion not yellowish), anterior portion with dense melanophores. Caudal fin gray with narrow black margin.

Color of preserved specimen: Head, body and fins becoming entirely yellowish-brown (Fig. 3B); black arched band on snout tip retained, no blotch under band; no dark marking around nostril; longitudinal lines on body retained as pale brown lines.

Distribution. *Albula glossodonta* is widely distributed in the Indo-Pacific region, including the Red Sea (see Pickett et al. 2020). In Japan, only two examples of large adults from the southern Ryukyu Islands and Ehime Prefecture (Shikoku Island) have been recorded (Hidaka et al. 2004; Takagi et al. 2010; Fig. 7). Lee et al. (2021) reported a leptocephalus specimen of the species from southern Korea (north of Jeju Island). Leptocephalus larvae of the species may be regularly transported by the Kuroshio Current from southern regions, but the settlement of such appears to be unsuccessful, since juvenile and subadult specimens have at

no time been reported from Japanese waters. The adult Japanese examples suggest occasional migration of large adults along the Kuroshio Current.

Remarks. Hidaka et al. (2004) first reported the species from Japan on the basis of a single specimen (NSMT-P 102552, formerly IORD 76-1074) from Iriomote-jima Island, southern Ryukyu Islands. That specimen was also examined here. Hidaka et al. (2004) also proposed the standard Japanese name “Marukuchi-sotoiwashi” for the species.

***Albula koreana* Kwun and Kim, 2011**

[New standard Japanese name: Kisuji-sotoiwashi]
(Figs 1B, 2D–F, 3C, 4B, 5D–F, 6C, 8A; Tables 2–5)

Albula argentea (not of Forster): Hidaka et al. 2008: 58 (in part; description; Vietnam; specimen: NSMT-P 67748); Matsunuma 2011: 26, unnumbered fig. (atlas; Terengganu, Malaysia; specimen: KAUM-I. 16854); Koeda 2019: 82, unnumbered figs (in part; atlas; southern Taiwan; specimens: 2 of 4, KAUM-I. 125129 and 125130, examined herein); Koeda 2020: 82, unnumbered figs (same as Koeda 2019).

Albula neoguinaica (not of Valenciennes): Kohno et al. 2011: 80 unnumbered fig. (in part; atlas; photographed specimen from South East Asia, Hiroshi Kohno, personal communication).

Albula koreana: Hata 2022: 22, unnumbered figs (in part; atlas; Satsuma Peninsula, Kagoshima, Japan; specimen: KAUM-I. 1246).

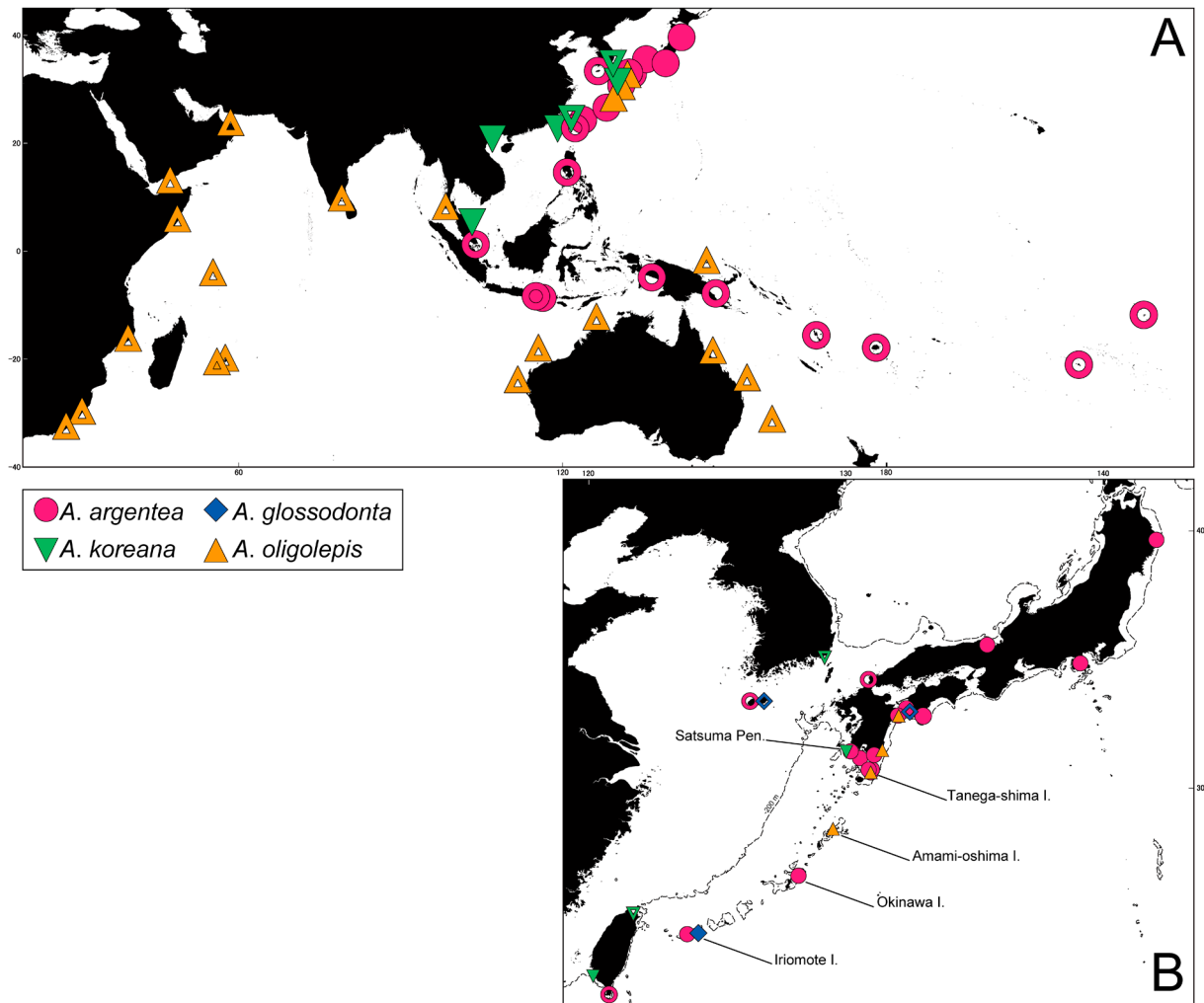


Fig. 7. Distributional map of *Albula argentea* (red circles), *A. glossodonta* (blue diamond), *A. koreana* (green downward-triangles) and *A. oligolepis* (yellow upward-triangles) in Indo-Pacific region (A) and Japan and adjacent waters (B). *Albula glossodonta* omitted in A. Closed and open symbols indicate records based on examined specimens and literature.

Table 5. Counts of pored lateral-line scales and vertebrae of *A. argentea*, *A. koreana* and *A. oligolepis* in present study, Hidaka et al. (2008) and Kwun and Kim (2011).

	<i>A. koreana</i>	<i>A. argentea</i>	<i>A. oligolepis</i>
Pored lateral-line scales			
Present study	75–77 (n=5)	68–74 (41)	61–67 (5)
Hidaka et al. (2008)*	—	68–74 (28)	61–65 (30)
Kwun and Kim (2011)	77 or 80 (2)	71–74 (3)	—
Combined	75–80	68–74	61–67
Vertebrae			
Present study	76–78 (5)	68–75 (41)	64–70 (5)
Hidaka et al. (2008)*	—	71–74 (29)	64–66 (19)
Kwun and Kim (2011)	77 or 78 (5)	72 or 73 (7)	—
Combined	76–78	68–75	64–70

* One specimen (NSMT-P 67748) referred to *A. argentea* in Hidaka et al. (2008) reidentified as *A. koreana*. Numbers of specimens given in parenthesis.

Material examined. Five specimens, 243.7–272.7 mm SL. **JAPAN:** KAUM–I. 1246, 250.1 mm SL, northeast of Matsu-shima Island, Kasasa, Minami-satsuma, Kagoshima Prefecture (31°25′06″N, 130°12′32″E), 20 m depth, M. Ito, set net, 10 November 2006. **TAIWAN:** KAUM–I. 125129,

246.9 mm SL, KAUM–I. 125130, 271.9 mm SL, off Ke-tzu-liao, Ziguan, Kaohsiung, K. Koeda and H. Hata, 26 December 2018. **VIETNAM:** NSMT-P 67748, 243.7 mm SL, Cat Ba Island (obtained at fish market in Hai Phong). **MALAYSIA:** KAUM–I. 16854, 272.7 mm SL, off Kuala Terengganu,

Table 6. Meristic counts and proportional measurements of *Albula glossodonta*, expressed as percentages of SL.

	NSMT-P 102552
Dorsal-fin rays	18
Anal-fin rays	8
Pectoral-fin rays	18
Pelvic-fin rays	10
Pored LL scales	68
SR above LL	9
SR below LL	6
SR btw. LL and mid-DB	9
Pre-dorsal-fin SR	21
Branchiostegal rays	13
Gill rakers	8+13
Vertebrae	69
SL (mm)	273.5
Head length (% of SL)	27.4
Body depth	23.6
Body width	12.0
Snout length	11.0
Upper jaw length	8.5
Mandible length	6.4
Width of mouth	5.8
Maxillary depth	1.3
Bony interorbital width	7.2
Interorbital width	8.4
Orbit diameter	4.0
Suborbital width	4.4
Postorbital length	11.9
Longest dorsal-fin ray length	18.9
Last dorsal-fin ray length	6.8
Longest anal-fin ray length	8.9
Last anal-fin ray length	6.2
Pre-pectoral fin length	25.1
Pre-dorsal fin length	49.6
Pre-anal fin length	87.7
Pre-anus length	72.5
Pre-pelvic fin length	58.8
Dorsal-fin base length	14.8
Anal-fin base length	5.4
Pectoral fin length	15.4
Pelvic fin length	12.0
Caudal peduncle length	10.9
Caudal peduncle depth	7.9
Upper caudal fin lobe length	30.9
Lower caudal fin lobe length	—

Terengganu (5°22'N, 103°15'E), bottom trawl.

Diagnosis. A species of *Albula* distinguished from Indo-Pacific congeners by the following combination of characters: tip of lower jaw pointed; scale rows between lateral line and mid-dorsal-fin base 9 or 10; pored lateral-line scales 75–77; total vertebrae 76–78; long, vivid yellow stripe on cheek; obvious blotch in front of nostrils, about twice nostril size; single oval blotch present under arc-shaped band on snout tip.

Description. Meristics and morphometrics taken from examined specimens given in Tables 2–4. Characters applicable to both *A. koreana* and *A. argentea* are not repeated

here, except for the following significant features: Anterior portion of parasphenoid tooth patch rounded, without pointed extension, its tip not reaching level of anterior tips of mesopterygoid tooth patches. Lower jaw tip relatively pointed (Fig. 4B). Single row of 8–10 embedded scales along ventral edge of preopercle, just posterior to maxilla. Posterior tip of depressed pelvic fin just reaching anus. Most specimens with 9 well-formed horizontal scale rows present between mid-dorsal-fin base and lateral line, a 10th row short, restricted to around dorsal fin origin (Fig. 5D, E); 1 specimen with long posteriorly extended 10th scale row, exceeding level of mid-dorsal-fin base (Fig. 5F).

Color of fresh specimens: Cheek with single long, striking yellow stripe, its posterior end almost reaching anterior edge of preopercle (Figs 2D–F, 8A). Iris whitish, horizontal black band crossing black pupil, extending anteriorly onto snout as a short semitranslucent dark band in front of orbit (not reaching level of nostril; Fig. 8A). Snout tip surrounded by large arched black band, with single oval pale black blotch under arch (Fig. 6C, preserved condition). Relatively large black blotch in front of nostrils, size larger than nostril (Fig. 6C). Dorsal fin rays pale yellow to brown, dorsal edge blackish, membranes semitranslucent, densely covered with minute melanophores. Anal fin whitish, densely covered with melanophores. Pectoral fin outer surface yellow, inner axis coloration not apparent. Pelvic fin whitish, basal portion yellowish. Caudal fin yellowish to brown with narrow black margin.

Color of preserved specimens: Head, body and all fins creamy-yellow, body blackish dorsally; upper dark lines retained as brown or blackish lines (Fig. 3C); 9 or 10 longitudinal dark lines on dorsum above lateral line. Yellow coloration, including cheek stripe, completely obscured; dark markings on snout retained.

Distribution. *Albula koreana* occurs in the north-western Pacific Ocean, in waters off Malaysia (east coast of Malay Peninsula), Vietnam, Taiwan, southern Japan (Kagoshima Pref., Kyushu) and southern Korea (Fig. 7). The species is most likely associated with the continental coast of East Asia, being widely distributed along the coast of the Malay Peninsula and Gulf of Thailand, north to China and the Korean Peninsula. A single Japanese specimen was caught by a set net off southern Kyushu (Satsuma Peninsula), Kagoshima Pref., in 20 m depth. The Malaysian specimen was caught by bottom trawl.

Remarks. *Albula koreana* was originally described by Kwun and Kim (2011) on the basis of five specimens (62.8–350.1 mm SL) from Korea (Busan) and Taiwan (Wanli, Taipei). In addition to the numbers of pored lateral-line scales and vertebrae [as stated by Kwun and Kim (2011)], the species can be easily distinguished from Indo-Pacific congeners by coloration (see Discussion). The present specimens of *A. koreana* from Vietnam (NSMT-P 67748), Malaysia (KAUM-I. 16854) and Taiwan (KAUM-I. 125129 and 125130) were reported as *A. argentea* by Hidaka et al. (2008), Matsunuma (2011) and Koeda (2019, 2020), respectively.

Hata (2022) correctly reported a Japanese specimen

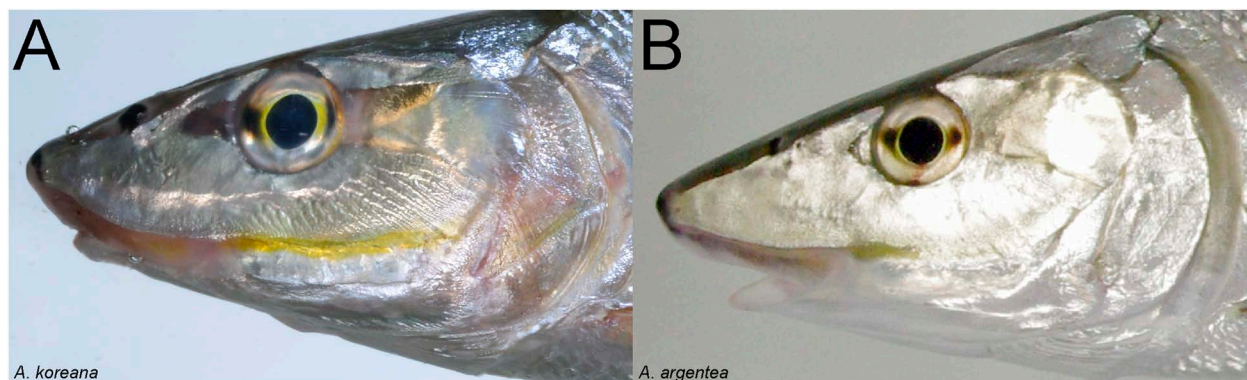


Fig. 8. Heads of *Albula koreana* (A) and *A. argentea* (B), showing comparison of color markings. (A) KAUM-I. 125129, 246.9 mm SL, Taiwan; (B) KAUM-I. 50220, 347.0 mm SL, Japan. Photos by KAUM.

(KAUM-I. 1246) as *A. koreana*, but did not discuss the basis for its identification. A second specimen considered by Hata (2022) was identified here as *A. argentea*. *Albula koreana* reported by Murase (2021) from Miyazaki Pref. was identical to either *A. argentea* or *A. oligolepis*, due to the lack of an obvious yellow stripe on the cheek; that specimen (KPM-NI 53373) was not examined during this study. Other previous records of *A. koreana* from Japan included both *A. argentea* and *A. oligolepis* (see synonymies of those species).

The standard Japanese name “Kisuiji-sotoiwashi” is newly proposed for *A. koreana* based on KAUM-I. 1246.

Albula oligolepis Hidaka, Iwatsuki, and Randall, 2008
[New standard Japanese name: Arame-sotoiwashi]
(Figs 1C, 2G, H, 3D, 4C, 6B; Tables 2–5)

Albula neoguinaica (not of Valenciennes): Aizawa 1993: 155, unnumbered fig. (in part; key; Japan); Aizawa 2000: 189, unnumbered fig. (in part; key; Japan); Aizawa 2002: 189, unnumbered fig. (in part; key; Japan).

Albula sp.: Aizawa and Doiuchi 2013: 235, unnumbered fig. (in part; key; Japan); Hatooka 2018: 63, unnumbered fig. (in part; atlas; Japan); Ikeda and Nakabo 2015: 35, pl. 34–7 [in part?; atlas, short description; Wakayama, Japan; 2 specimens: WW 02102, PLS: 66 or 71 (from description)]; Hatooka 2022: 63, unnumbered fig. (in part; atlas; Japan).

Albula koreana not of Kwun and Kim: Hata 2018b: 18, unnumbered figs (atlas; Amami-oshima Island, Kagoshima, Japan; specimens: NSMT-P 129038, 129039); Hata 2019: 20, unnumbered fig. (atlas; Amami-oshima Island, Kagoshima, Japan; specimen: NSMT-P 129038); Nakae et al. 2018: 210 (checklist; Amami-oshima Island, Japan; specimens: NSMT-P 129038, 129039).

?*Albula koreana* not of Kwun and Kim: Murase 2021: 76, unnumbered fig. (atlas; Kagogawa Bay, Miyazaki, Japan; specimen: KPM-NI 53373, not examined); Shimose 2021: 44, unnumbered fig. (atlas; Okinawa, Japan).

Material examined. Five specimens, 289.0–373.4 mm SL. **JAPAN: Oita Prefecture:** KAUM-I. 140897, 333.9 mm SL, off Kamae-senzaki, Saiki (32°49'N, 131°02'E), K. Hoshi-

no, set net, 19 September 2002. **Miyazaki Pref.:** KAUM-I. 144516, 289.0 mm SL, off Kushima, 30 m depth, R. Miki, set net, 17 July 2020. **Kagoshima Pref.:** KAUM-I. 50222, 373.4 mm SL, off Makikawa, Nakatane, Tanega-shima Island (30°36'59"N, 130°56'56"E), 20 m depth, M. Meguro et al., set net, 26 July 2012; NSMT-P 129038, 289.2 mm SL, NSMT-P 129039, 334.7 mm SL, Amami-oshima Island, Ryukyu Islands (obtained at Naze fish market), T. Maekawa, 8 December 2016.

Diagnosis. A species of *Albula* distinguished from Indo-Pacific congeners by the following combination of characters: tip of lower jaw pointed; scale rows between lateral line and mid-dorsal-fin base 8; pored lateral-line scales 61–67; total vertebrae 64–66; short indistinct yellow stripe on cheek; blotch in front of nostrils small, not larger than twice nostril size; oval blotch absent under arched band on snout tip.

Description. Meristics and morphometrics taken from examined specimens are given in Tables 2–4. Characters applicable to both *A. oligolepis* and *A. argentea* are not repeated here, except for the following significant features: anterior portion of parasphenoid tooth patch, sharply elongated, its tip at level of anterior tips of mesopterygoid tooth patches; lower jaw tip relatively pointed (Fig. 4C); single row of 7–9 embedded scales along ventral edge of preopercle, just posterior to maxilla; posterior tip of depressed pelvic fin almost reaching or extending beyond anus; 8 horizontal scale rows between mid-dorsal-fin base and lateral line, a 9th row very short, restricted to around dorsal fin origin.

Color of fresh specimens: Very similar to *A. argentea*. Cheek with short indistinct yellow stripe (Figs 1C, 2G, H); arched black band surrounding snout tip, with ends directed slightly sideward (Fig. 6B, preserved specimen).

Color of preserved specimens: Head, body and fins becoming creamy-yellow (Fig. 3D); fresh yellow coloration obscured; dark markings retained; 8 or 9 brown wavy lines on dorsum between lateral line and mid-dorsal-fin base.

Distribution. *Albula oligolepis* is widely distributed in the Indian and West Pacific oceans, from the east coast of Africa to the Andaman Sea and Western Australia, and from eastern Australia and Papua New Guinea, north to southern Japan (Fig. 7). The species is probably more widely distrib-

uted in the Pacific Ocean than presently recorded (e.g., off Taiwan and the Philippines).

Albula argentea and *A. oligolepis* have been reported sympatrically in Japan. A single specimen of *A. oligolepis* (KAUM-I. 50222) and three specimens of *A. argentea* (KAUM-I. 50220, 50221 and 50223) were collected together in the same set net off Tanega-shima Island (Kagoshima), suggesting that both species had been schooling together. As in *A. glossodonta*, the occurrence of *A. oligolepis* in Japanese waters most likely represents occasional migration.

Remarks. *Albula oligolepis* was originally described by Hidaka et al. (2008) on the basis of 36 specimens (type locality: Durban, South Africa). Since the species has previously been restricted to Papua New Guinea and eastern Australia (southern Pacific Ocean), the present Japanese specimens represent the first reliable records of *A. oligolepis* from the northwestern Pacific Ocean.

Since the standard Japanese name “Sotoiwashi” has been retained here for *A. argentea*, the new Japanese name “Ar-ame-sotoiwashi”, based on KAUM-I. 144516, is newly proposed for *A. oligolepis*.

Discussion

Morphological comparisons. The present specimen of *A. glossodonta* (NSMT-P 102552) was identified as the Indo-Pacific species characterized by a rounded lower-jaw tip (vs. pointed in Indo-Pacific congeners; see Hidaka et al. 2004, 2008, Kwun and Kim 2011; Fig. 4). Moreover, among the Indo-Pacific species of *Albula*, *A. glossodonta* and *A. koreana* differ from *A. argentea*, *A. oligolepis* and *A. virgata* (Hawaiian endemic) by having a relatively rounded parasphenoid tooth patch, its anterior margin not reaching that of the mesopterygoid tooth patches on the mouth roof, whereas the anterior margins of the parasphenoid and mesopterygoid tooth patches are at same level in the latter three species (see Smith and Randall 1999: fig. 2; Hidaka et al. 2004: fig. 3; Kwun and Kim 2011: fig. 2). Such features were confirmed in the present specimens.

In addition to the shape of mouth roof tooth patches, *A. koreana* is characterized by a greater number of (smaller) body scales, 75–80 pored lateral-line scales [counts combined from Kwun and Kim (2011) and this study], and

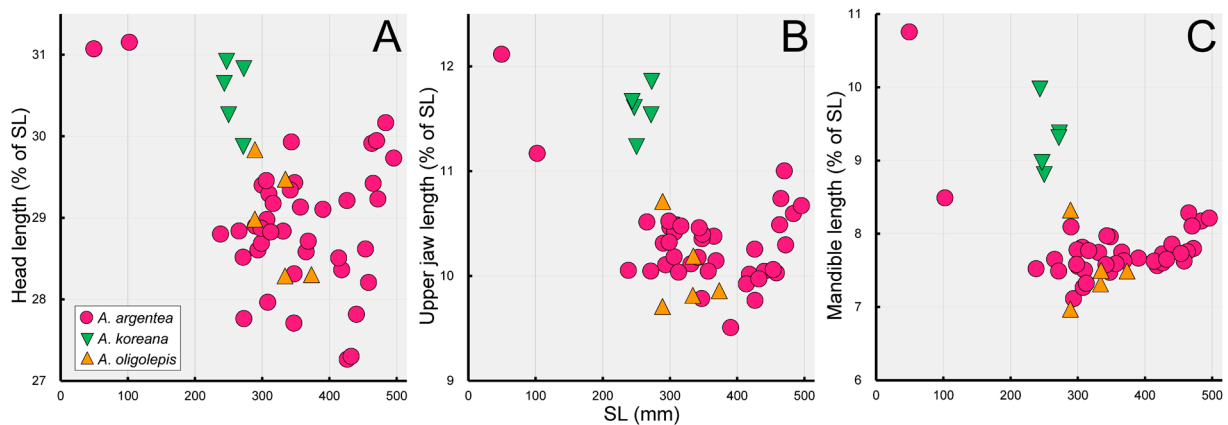


Fig. 9. Relationships between (A) head length, (B) upper jaw length and (C) mandible length (all as % of SL) and SL (mm) in *Albula argentea* (red circles), *A. koreana* (green downward-triangles) and *A. oligolepis* (yellow upward-triangles).

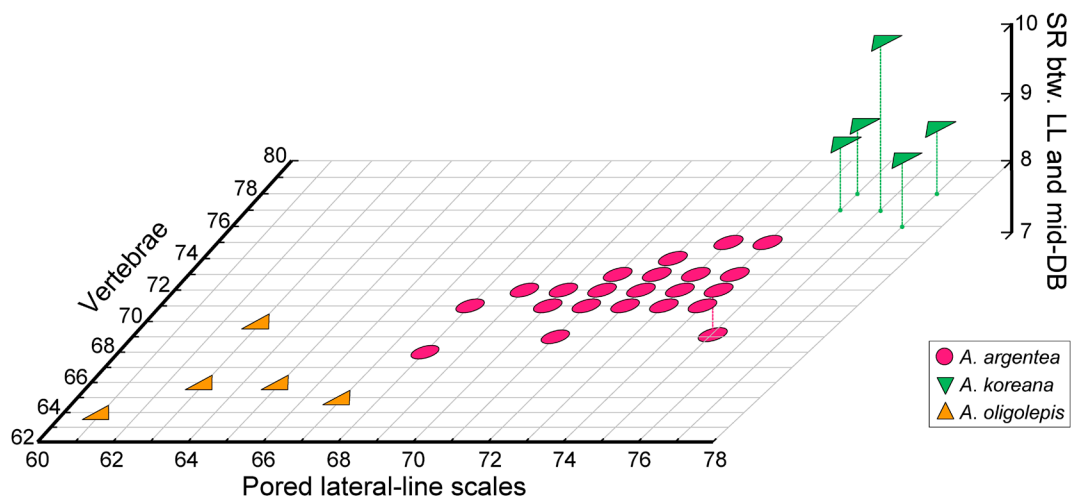


Fig. 10. Relationships among numbers of scale rows (SR) between lateral line (LL) and mid-dorsal-fin base (DB), vertebrae and pored lateral-line scales in *Albula argentea* (red circles), *A. koreana* (green downward-triangles) and *A. oligolepis* (yellow upward-triangles).

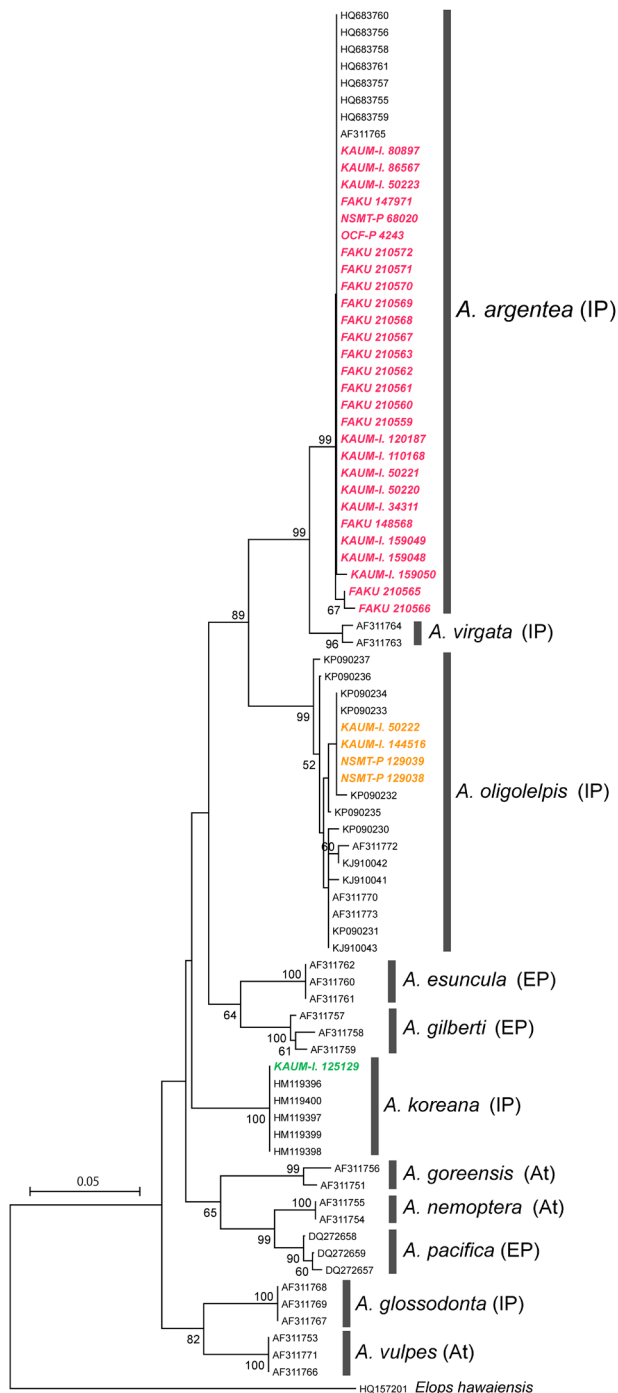


Fig. 11. Neighbor-joining (NJ) dendrogram showing derived *p*-distance matrix from parietal mitochondrial Cytochrome *b* gene sequence. Numbers at branches indicate >50% bootstrap probabilities in 1000 bootstrap replications. Colored (italicized) sample names indicate determined in present study; other sample names indicate accession numbers (see Table 1). At, EP and IP indicate Atlantic Ocean, Eastern Pacific Ocean and Indo-Pacific Oceans, respectively (showing distributional ranges).

76–78 total vertebrae, compared with 74 or fewer pored lateral-line scales and 75 or fewer vertebrae in *A. argentea*, *A. oligolepis* and *A. virgata* (see Hidaka et al. 2008: table 3; Kwun and Kim 2011; this study: Tables 4, 5). Moreover, *A. koreana* can also be distinguished from *A. argentea* and *A. oligolepis* by having an additional horizontal scale row be-

tween the lateral line and mid-dorsal-fin base (9 or 10 in *A. koreana* vs. 7 or 8 in the latter two species) (Fig. 5; Table 3). Since the dark stripes on the dorsum are associated with successive dorsal and ventral scale margins, the number of stripes above the lateral line are also greater in *A. koreana* (Fig. 5; Table 3). Fresh specimens of *A. koreana* are readily distinguished from those of *A. argentea* and *A. oligolepis* due to the striking yellow stripe on the cheek extending well posteriorly from the posterodorsal corner of the maxilla, whereas a stripe is relatively indistinct and fails to reach the anterior edge of the preopercle in the latter two species (Fig. 8). The outer surface of the pectoral fin of *A. koreana* is entirely yellow, compared with that of *A. argentea* and *A. oligolepis* (grayish-yellow to dark gray; at least posterior portion grayish; Figs 1A–C, 2). Moreover, *A. koreana* is characterized by a dark (semitranslucent) band in front of the orbit when fresh (absent in *A. argentea* and *A. oligolepis*; Fig. 8). Although the yellow coloration and dark band around the orbit are completely obscured in preserved specimens, the shape of dark blotches around the snout tip and nostrils can be helpful to separate *A. koreana* from *A. argentea* and *A. oligolepis*. *Albula koreana* possesses a large, semicircular arched band on the snout tip, with an oval blotch within it (Fig. 6C), whereas those of the latter two species are small, with the ends pointed slightly upward or sideward, and lack a blotch within the band (Fig. 6A, B). The pointed ends of the afore-mentioned bands in *A. argentea* and *A. oligolepis* are visible from ventral view (Fig. 4A, C). Additionally, in *A. koreana*, the dark blotch front of the nostril is obvious, being larger than the latter and extending well anteriorly, compared with *A. argentea* and *A. oligolepis* (Fig. 6). Furthermore, *A. koreana* tends to have a longer head and larger mouth [head length 29.9–30.9% of SL (vs. 27.3–30.2% of SL in specimens >200 mm SL of *A. argentea* and 28.3–29.8% of SL in *A. oligolepis*), upper-jaw length 11.2–11.9% of SL (vs. 9.5–11.0% of SL and 9.7–10.7% of SL), and mandible length 8.8–10.0% of SL (vs. 7.1–8.3% of SL and 7.0–8.3% of SL)] (Fig. 9). Even without a vertebral count, *A. koreana* can be identified by the combination of number of scale rows between the lateral line and mid-dorsal-fin base, pored lateral-line scales (see Fig. 10), and coloration and marking features (even in preserved specimens).

Although *A. argentea* and *A. oligolepis* are closely similar to each other in morphological characters and coloration, Hidaka et al. (2008) distinguished between the two species by numbers of pored lateral-line scales and total vertebrae. Such differences were confirmed in this study. *Albula oligolepis* tends to have fewer longitudinal scales, with pored lateral-line scales numbering 61–67, compared with 68–74 in *A. argentea* (Tables 3, 5). However, no difference in the number of horizontal scale rows on the dorsum above the lateral line was found between the two species. Moreover, *A. oligolepis* also tends to have fewer total vertebrae (64–70, compared with 68–75 in *A. argentea*). Although the ranges of vertebrae counts overlapped between the two species, the latter can be more precisely separated by summing the counts of pored lateral-line scales and total vertebrae (125–133 in *A. oligolepis* vs. 136–149 in *A. argentea*; see Table 3).

No other morphological or color features for distinguishing the two species were found during this study, due possibly to limited examples of *A. oligolepis*.

Molecular identification. The molecular analysis based on the partial *cyt-b* sequence (220 bp) supported the present identification, although Japanese examples of *A. koreana* and *A. glossodonta* were not available for that analysis. In the NJ tree, 11 monophyletic groups were recovered with high bootstrap probabilities (96–100%), one group, including the present Japanese specimens, being morphologically identified as *A. argentea*, together with samples determined by Kwun and Kim (2011) from Fiji, and a second, *A. oligolepis* together with Wallace's (2015) materials from South Africa, Papua New Guinea and Australia (Fig. 11). A single Taiwanese specimen (KAUM-I. 125129) was included in *A. koreana*, together with the type series of that species, as determined by Kwun and Kim (2011).

Key to species of *Albula* from Japan

1. Lower-jaw tip rounded
..... *A. glossodonta* (Japanese name:
Marukuchi-sotoiwashi)
- Lower-jaw tip pointed. 2
2. Scale rows between lateral line and mid-dorsal-fin base 9 or 10; pored lateral-line scales 75–80; single dark blotch present on tip of snout within arched band; blotch in front of nostril large; striking yellow stripe on cheek in fresh specimens, almost reaching anterior edge of preopercle *A. koreana* (Kisuji-sotoiwashi)
- Scale rows between lateral line and mid-dorsal-fin base 7 or 8; pored lateral-line scales 74 or fewer; dark blotch within arched band on snout tip absent; blotch in front of nostril small; indistinct yellow stripe on cheek in fresh specimens 3
3. Pored lateral-line scales (PLS) 68–74; total vertebrae (V) 68–75; PLS+V=136–149
..... *A. argentea* (Sotoiwashi)
- Pored lateral-line scales (PLS) 61–67; total vertebrae (V) 64–70; PLS+V=125–133
..... *A. oligolepis* (Arame-sotoiwashi)

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