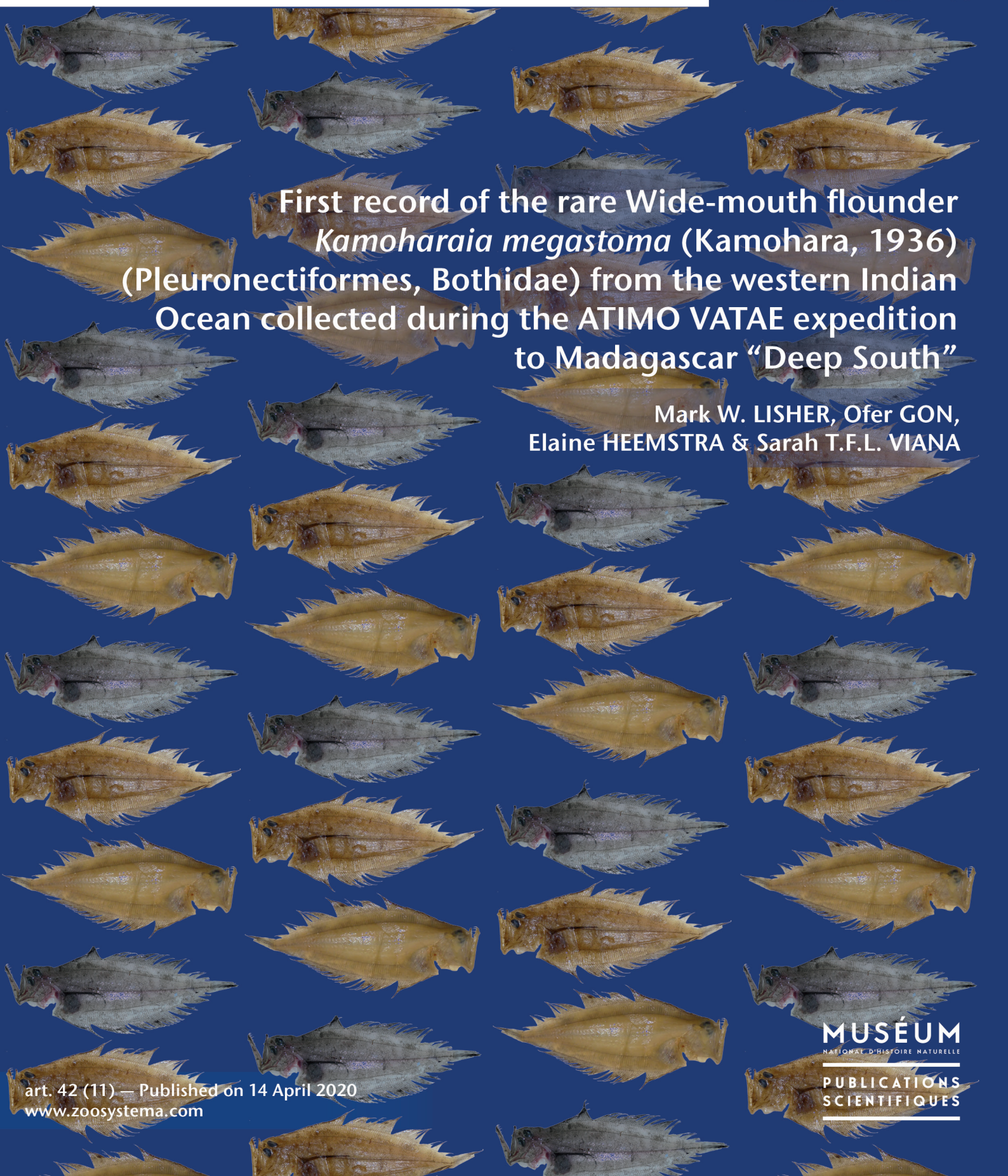




First record of the rare Wide-mouth flounder
Kamoharaia megastoma (Kamohara, 1936)
(Pleuronectiformes, Bothidae) from the western Indian
Ocean collected during the ATIMO VATAE expedition
to Madagascar “Deep South”

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Kamoharaia megastoma (Kamohara, 1936), SAIAB 189603, 108.7 mm SL, Sud-Ouest Pointe Barrow, Madagascar: ocular side fresh specimen (photograph by S. Ribes); ocular side preserved specimen; blind side preserved specimen.

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First record of the rare Wide-mouth flounder *Kamoharaia megastoma* (Kamohara, 1936) (Pleuronectiformes, Bothidae) from the western Indian Ocean collected during the ATIMO VATAE expedition to Madagascar “Deep South”

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ABSTRACT

Four specimens of *Kamoharaia megastoma* (Kamohara, 1936) were collected during the Atimo Vatae expedition to the “Deep South” region of Madagascar for the exploration of fauna and flora, representing the first record of this species from the western Indian Ocean. *Kamoharaia megastoma* has been known to occur exclusively in the southeastern Indian and Western Pacific Oceans. Morphometric and meristic characters of these specimens are congruent with those described for *K. megastoma*. A description of the morphology and morphometrics are provided along with photographs. These records constitute a considerable range extension for the species.

RÉSUMÉ

Première signalisation de la rare plie à grande bouche *Kamoharaia megastoma* (Kamohara, 1936) (Pleuronectiformes, Bothidae) de l’océan Indien occidental, collectée lors de l’expédition ATIMO VATAE à Madagascar “Deep South”.

Quatre spécimens de *Kamoharaia megastoma* (Kamohara, 1936) ont été collectés lors de l’expédition ATIMO VATAE “Deep South” dans la région de Madagascar pour l’exploration de la faune et de la flore, représentant la première signalisation de cette espèce dans l’océan Indien occidental. *Kamoharaia megastoma* est connue exclusivement dans le sud-est de l’océan indien et dans l’océan Pacifique occidental. Les caractères morphométriques et méristiques de ces spécimens correspondent à ceux décrits pour *K. megastoma*. Nous donnons ici une description de la morphologie et de la morphométrie, ainsi que des photographies. Ces signalisations constituent une extension considérable de l’aire de répartition de l’espèce.

KEY WORDS

Bothidae,
new locality,
flatfish,
Kamoharaia megastoma,
new records.

MOTS CLÉS

Bothidae,
localité nouvelle,
poisson plat,
Kamoharaia megastoma,
signalisations nouvelles.

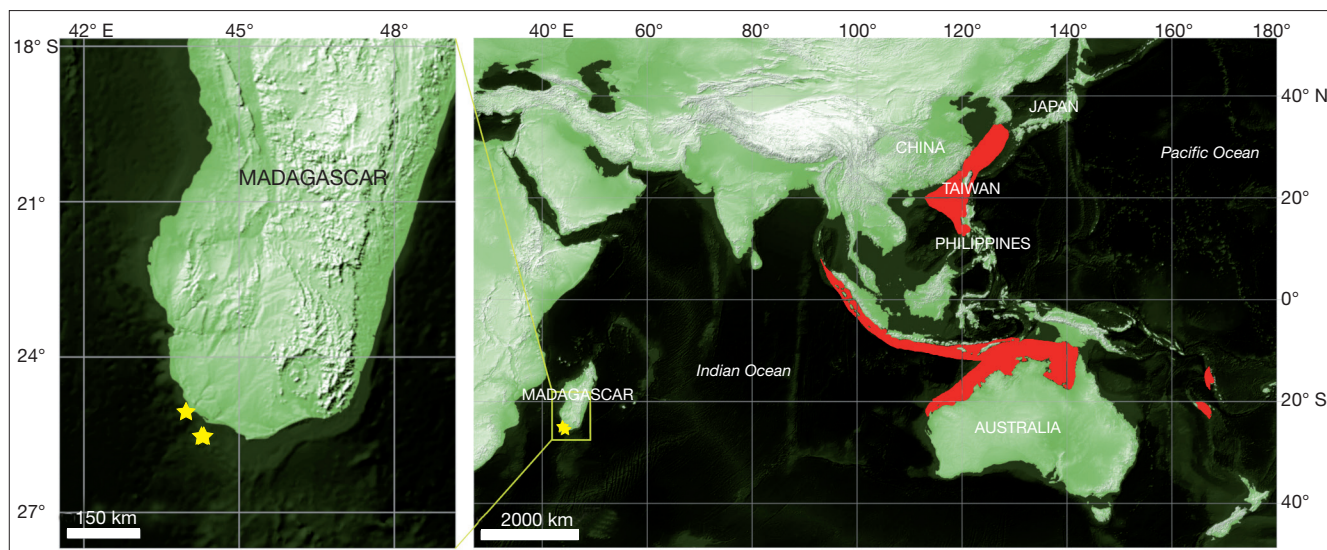


FIG. 1. — Map of geographical distribution of *Kamoharaia megastoma* (Kamohara, 1936) in the Western Pacific and southeastern Indian Ocean (red, after Hensley & Amaoka (2001)) and the southwestern Indian Ocean off Madagascar (yellow stars).

INTRODUCTION

In 2010 the Muséum national d'Histoire naturelle (MNHN, Paris), the Institut d'Halieutique et des Sciences Marines, University of Toliara (IH.SM), and the Wildlife Conservation Society (WCS) Madagascar Programme united to undertake an expedition to explore the fauna and flora of the “Deep South” region of Madagascar. The expedition took place between April and June 2010 under the name ATIMO VATAE meaning “Deep South” in the regional Antandroy language. During this expedition, four specimens of *Kamoharaia megastoma* (Kamohara, 1936) described herein were collected between 10 and 11 May 2010.

The monotypic genus *Kamoharaia* Kuronuma, 1940 comprises a species of flounder that is characterized by having enlarged canine teeth on the anterior tip of the lower jaw, upper jaw protruding past tip of snout, and tip of vomer protruding into mouth cavity. *Kamoharaia megastoma* (Kamohara, 1936) is a rare species, originally described as a species of *Chascanopsetta* Alcock, 1894 based on a single specimen from Mimase, Kochi Prefecture, Japan. Nine years after its discovery, in 1945, the holotype of *K. megastoma* was destroyed in a war-caused fire (Kamohara 1961). T. Kamohara thus set out to collect and replace all the lost types within his laboratory, and in 1961 published an article in which he designated neotypes for many of the types destroyed in the 1945 fire. In this report he designated a neotype for *K. megastoma* based on a 207 mm standard length (SL) specimen collected from Mimase, Kochi Prefecture, Japan on 20 April 1951 and lodged in the Kochi University, Department of Natural Science collection with the catalog number BSKU 9592. Unfortunately, this new type designation was not done in a revisory work and is considered invalid under the code of nomenclature (Fricke *et al.* 2019).

K. megastoma has been sporadically reported from several locations within the Western Pacific and southeastern Indian Oceans at depths of up to 800 meters (Hensley & Amaoka 2001). Known geographical distributions include Japan, southern Taiwan, Korea, Philippines, New Caledonia, northwestern Australia and Kyushu-Palau Ridge (Kamohara 1936; Kuronuma 1940; Kamohara 1961; Matsunuma 2016; Voronina *et al.* 2016; Jang *et al.* 2018). The four specimens identified herein as *K. megastoma* based on morphometric and meristic characters were collected during a benthic trawl and represent the first record from the southwestern Indian Ocean. The present study provides a morphological description and external morphometrics of four specimens of *K. megastoma* from this region and comparative analysis with specimens from the Western Pacific and southeastern Indian Oceans.

MATERIAL AND METHODS

All the specimens analyzed within this study were collected during the ATIMO VATAE expedition. Upon collection specimens were labeled, photographed and placed in a 10% formaldehyde solution. Specimens were later lodged in the South African Institute for Aquatic Biodiversity National Fish Collection (SAIAB) where they underwent curation and preservation in 70% ethanol. A single specimen was deposited into the ichthyological collection of the Muséum national d'Histoire naturelle (MNHN).

External measurements were obtained from specimens preserved in 70% ethanol by means of a digital caliper (with a precision of 0.1 mm). Measurements follow Hubbs & Lagler (1958) and are expressed as percentage of standard length (% SL), in standard length (In SL), percentage of head length (% HL), and in head length (In HL) (Table 1). Morphometric

TABLE 1. — Morphometric and meristic characters of *Kamoharaia megastoma* expressed as percentage standard length (% SL); in standard length (in SL); percentage head length (% HL); and in head length (in HL). SL is provided in millimeters; O, ocular side; B, blind side. Abbreviations, see Material & Methods. Variation of characters are emphasized in bold.

Locality	Present study		Amaoka (1969)	Amaoka (1982)	Chen & Weng (1985)	Jang et al. (2018)	Kamohara (1936)	Kamohara (1961)	Kuronuma (1940)	Matsunuma (2016)	Voronina et al. (2016)
	Western Indian Ocean, Madagascar	4	Tosa Bay, Japan	Kyushu-Palau Ridge	Tungkong	Southern Jeju-do Island, Korea	Jeju-do, Japan	East China Sea			Vietnam
Number of specimens			3	1	1	1	1	1	1	2	1
Standard length (mm; SL)	98.0-131.2		126.4-153.1	208	99	170	113.9	141.1-155.9	214	141.1-155.9	200.2
	% SL	In SL	In SL	% SL	In SL	In SL	% SL	In SL	% SL	% SL	% SL
Head length (HL)	18.9-19.9	5.0-5.3	4.9-5.0	20.1	5.2	—	21.6	5.3	18.1	19.7-20.1	—
Body depth	35.4-38.7	2.6-2.8	2.6-2.7	43.3	2.8	—	36.2	2.6	39.7	34.7-37.6	—
Caudal-fin length	13.6-16.3	6.1-7.4	—	—	—	—	—	—	—	16.8-17.6	—
	% HL	In HL	In HL	% HL	In HL	In HL	% HL	In HL	% HL	% HL	% HL
Upper eye diameter	25.2-33.4	3.0-4.0	3.3-3.5	28.2	—	—	28.5	3.1	—	28.7-31.5	—
Lower eye diameter	23.2-30.7	3.3-4.3	3.6-3.7	—	—	—	29.3	—	—	27.5-28.0	—
Interorbital width	3.6-5.0	20.2-27.5	—	3.58	—	—	3.3	—	—	3.3-3.6	—
Upper-jaw length (O)	78.3-90.1	1.1-1.3	1.0-1.0	101.7	—	—	96.3	—	—	94.4-96.2	—
Upper-jaw length (B)	78.2-91.5	1.1-1.3	—	—	—	—	97.6	—	—	96.1-97.4	—
Lower-jaw length (O)	103.7-116.5	0.9-1.0	—	126.5	—	—	120.3	—	—	121.7-122.2	—
Lower-jaw length (B)	104.0-117.5	0.9-1.0	—	—	—	—	121.1	—	—	122.3-122.5	—
Pectoral-fin length (O)	116.8-130.0	0.8-0.9	0.9-0.9	100.5	—	—	—	—	—	105.3-113.9	—
Pectoral-fin length (B)	36.4-45.9	2.2-2.8	2.2-2.3	—	—	—	—	—	—	42.4-48.9	—
Pelvic-fin length (O)	38.4-40.1	2.5-2.6	2.5-2.6	—	—	—	—	—	—	48.0	—
Pelvic-fin length (B)	33.8-36.3	2.8-3.0	2.5-2.6	—	—	—	—	—	—	46.7	—
Pelvic-fin base length (O)	17.2-21.3	4.7-5.8	5.1-5.8	—	—	—	—	—	—	15.1	—
Pelvic-fin base length (B)	12.7-17.2	5.8-7.9	7.4-9.7	—	—	—	—	—	—	15.6	—
Caudal-peduncle depth	26.8-30.0	3.3-3.7	3.2-3.5	—	—	—	—	—	—	25.3-30.5	—
Dorsal-fin rays	108-109		109-112	110	109	104	109	110	110	106-108	110
Anal-fin rays	83-85		84-86	85	84	84	84	86	85	83-87	85
Pectoral-fin rays (O/B)	10-12/10-12		15-16/11-12	13/11	broken/11	12	broken/11	—	12/11	11/10-11	—
Pelvic-fin rays (O/B)	6-7/6		—	6/-	6/6	—	6/6	—	—	6/6	—
Lateral line scales	114-131		126-127	131	127	119	130	—	133	121-127	132

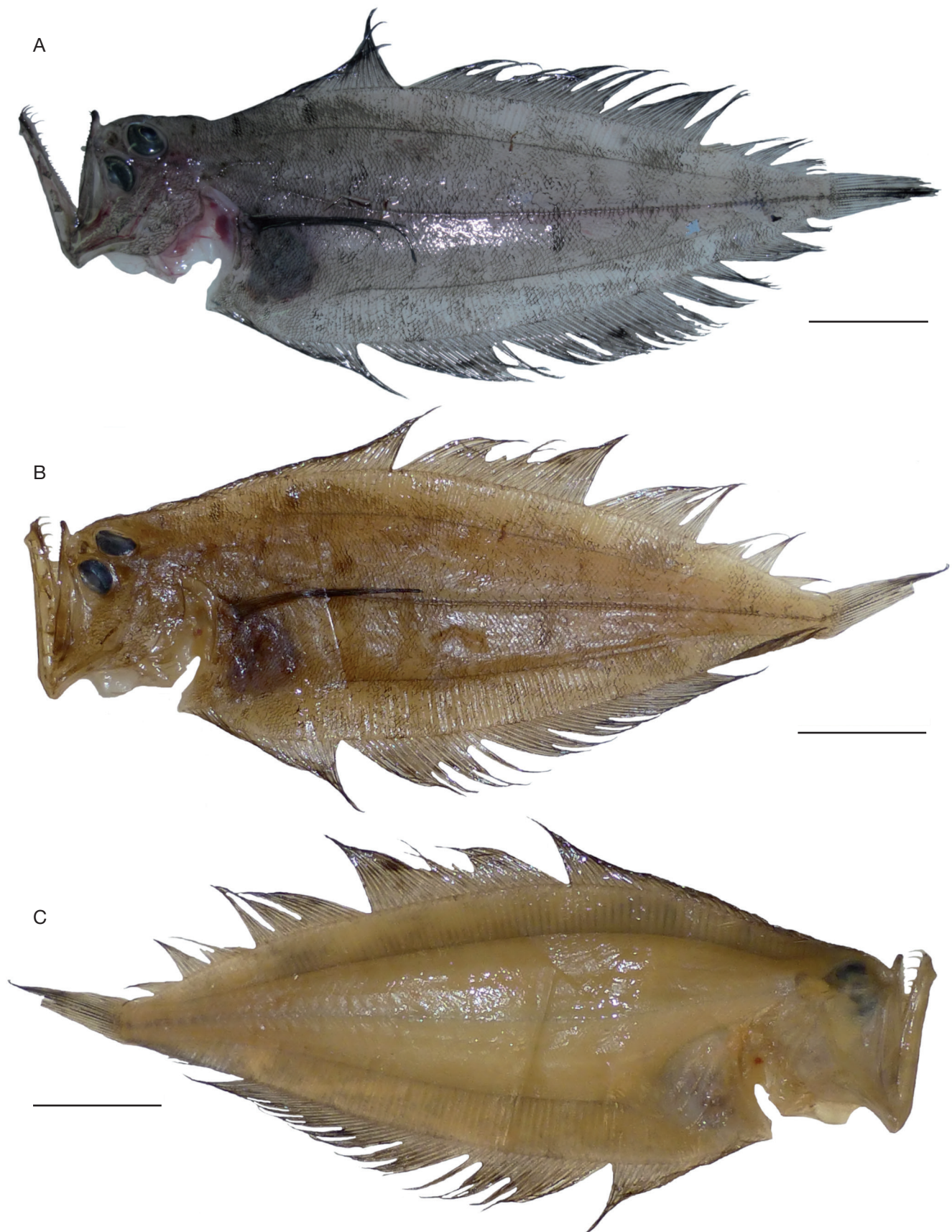


FIG. 2. — *Kamoharaia megastoma* (Kamohara, 1936), SAIAB 189603, 108.7 mm SL, Sud-Ouest Pointe Barrow, Madagascar: **A**, ocular side fresh specimen (photograph by S. Ribes); **B**, ocular side preserved specimen; **C**, blind side preserved specimen. Scale bar: 20 mm.

and meristic data for *K. megastoma* from the Pacific and eastern Indian Oceans where extracted from Amaoka (1969, 1982), Chen & Weng (1965), Fourmanoir (1985), Jang *et al.* (2018), Kamohara (1936, 1961), Kuronuma (1940), Matsunuma (2016) and Voronina *et al.* (2016) for comparison. Terminology of general external morphology and colouration follows Kuronuma (1940). Fresh colouration is based on photographs taken upon collection of the specimens, and preserved colouration is based on specimens preserved in 70% ethanol. Specimens were photographed in ocular and blind side views, as well as individual body parts (e.g. mouth) using a Panasonic Lumix DMC-TZ27 digital camera with a Leica lens.

Scales were imaged using scanning electron microscopy (SEM). Scale terminology and morphology of body scales follows Bräger & Moritz (2016) and lateral line scales follows Voronina (2007, 2009).

A map of collecting localities of specimens (Fig. 1) was generated using QGIS 2.14.2 Essen (QGIS Development Team, QGIS Geographic Information System, Open Source Geospatial Foundation Project; <http://qgis.osgeo.org/>) and Google Earth (http://www.google.co.uk/intl/en_uk/earth). Institutional abbreviations are in accordance to Sabaj (2016).

RESULTS

Family BOTHIDAE Smitt, 1892
Genus *Kamoharaia* Kuronuma, 1940

Kamoharaia megastoma (Kamohara, 1936)
(Figs 1-4; Table 1)

Chascanopsetta megastoma Kamohara, 1936: 306.

Kamoharaia megastoma – Kuronuma 1940: 35.

TYPE LOCALITY. — Mimase, Kochi Prefecture, Japan.

COMMON NAMES. — Wide-mouthed flounder, Wani-garei (Japanese), keun-ip-dung-geul-neop-chi-sok (Korean).

MATERIAL EXAMINED. — **Madagascar** • 1 specimen; [MNHN-IC-2019-0265](#) (formerly SAIAB 189569); 102.37 mm SL; Sud Pointe Barrow, Madagascar, southwestern Indian Ocean; 25°33'S, 44°18'E; 155–156 m depth; 10.V.2010; B. de Forges, S. Rafamantanantsoa and E. Ranaivoson leg.; ATIMO VATAE; FV Nosy Bé 11 • 1 specimen; SAIAB 189569; 99.65 mm; same data as preceding • 1 specimen; SAIAB 189603; 108.72 mm SL; Sud-Ouest Pointe Barrow, Madagascar, southwestern Indian Ocean; 25°02'S, 43°59'E; 300–309 m depth; 11.V.2010; B. de Forges, S. Rafamantanantsoa and E. Ranaivoson leg.; ATIMO VATAE; FV Nosy Bé 11 • 1 specimen; SAIAB 189783; 131.16 mm SL; Sud Pointe Barrow, Madagascar, southwestern Indian Ocean; 25°33'S, 44°16'E; 549–576 m depth; 10.V.2010; B. de Forges, S. Rafamantanantsoa and E. Ranaivoson leg.; ATIMO VATAE; FV Nosy Bé 11.

DESCRIPTION

Body oblong, somewhat elongate, greatest depth 35.4–38.7% SL. Head relatively short, 18.9–19.9% SL. Mouth extremely large; jaws elongate; maxilla extending beyond dorsal contour of snout; tip of vomer protruding well into mouth cavity (Fig. 3).

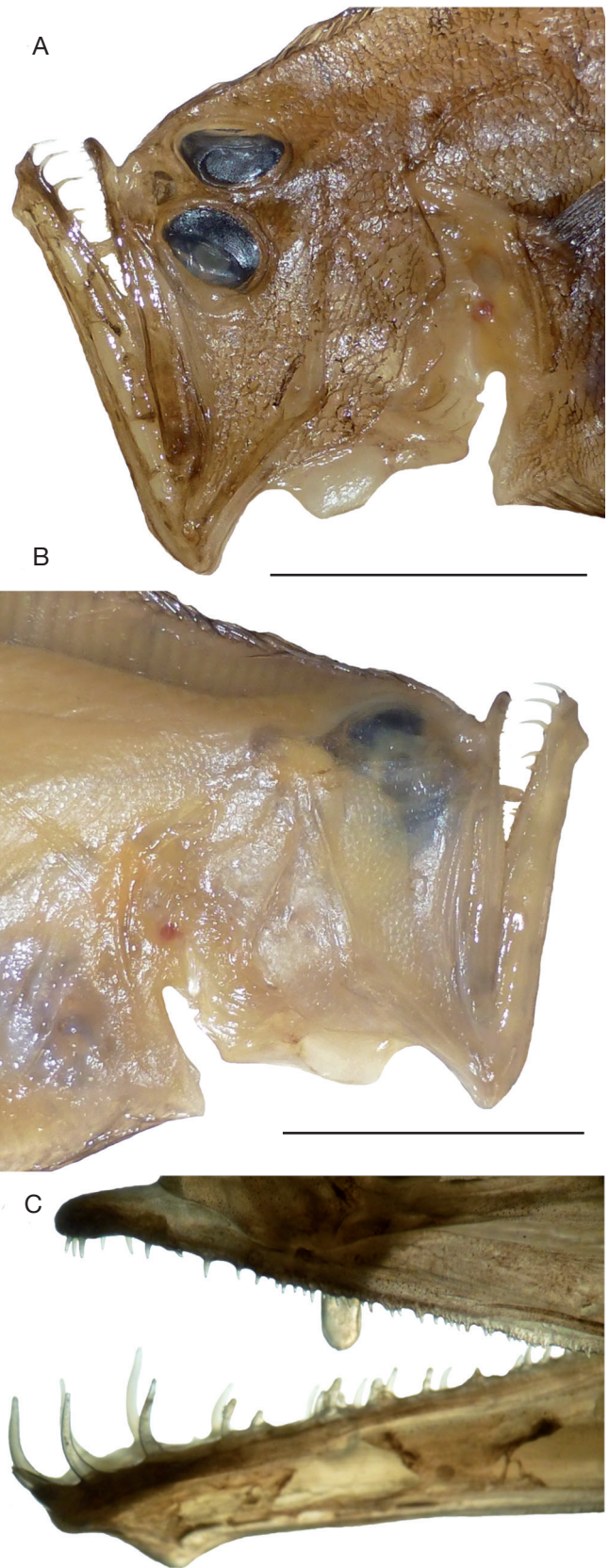


FIG. 3. — *Kamoharaia megastoma* (Kamohara, 1936), SAIAB 189603, 108.7 mm SL, Madagascar: **A**, close-up of ocular side of head; **B**, close-up of blind side of head; **C**, close-up of ocular side of mouth. Scale bars: A, B, 20 mm; C, not to scale.

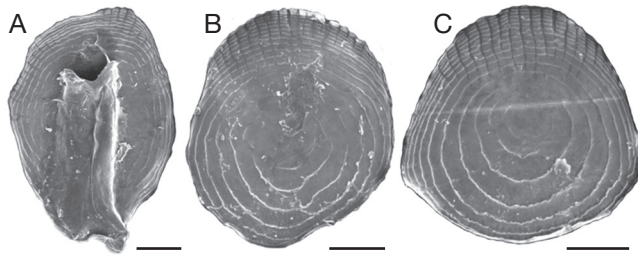


FIG. 4. — *Kamoharaia megastoma* (Kamohara, 1936), SAIAB 189603, 108.7 mm SL, Madagascar: **A**, lateral line scale ocular side; **B**, body scale ocular side; **C**, body scale blind side. Scale bars: 200 µm.

Teeth arranged in a single series; three pairs of enlarged teeth on anterior tip of lower jaw, greater than twice the length of adjacent teeth in lower jaw; all teeth in lower jaw curved backwards. Teeth in upper jaw significantly shorter than those in lower jaw and more numerous, villiform tooth-band on posterior half; three to four pairs of enlarged teeth on anterior tip of upper jaw, greater than twice the length of adjacent teeth in upper jaw; all teeth in upper jaw conical (Fig. 3C). Eyes of moderate size, upper eye slightly larger than lower eye (25.2–33.4% HL vs 23.2–30.7% HL); situated at the same level and close together with a short interorbital width of 3.6–5.0% HL. Lateral line on ocular side running from uppermost opercular opening to caudal peduncle, with small curve above base of pectoral fin; 114–131 pored lateral line scales. Lateral line absent on blind side. Dorsal fin originating above snout, with 108–109 rays (all unbranched). Origin of anal fin slightly posterior to anus with 83–85 rays (all unbranched). Pectoral fin on ocular side substantially longer than on blind side (116.8–130.0% HL vs 36.4–45.9% HL); 10–12 rays on both ocular and blind sides. Pelvic fins short on both ocular and blind sides, origin of blind side at level of 3rd ray of ocular side; 6 rays on both ocular and blind sides. Caudal fin of moderate length (13.6–16.3% SL), its posterior margin somewhat rounded. Body scales on both ocular and blind sides cycloid; circular shape, uniform throughout both ocular and blind sides. Lateral line scales oval to rounded shape; circuli distinct on anterior and lateral fields; radii present in anterior field; tubular wide (32.98% scale width) and extending 69.95% of the scale length (Fig. 4).

Fresh colouration

Ocular side of body greyish throughout with darker grey blotches. Blind side of body whitish. Dorsal and anal fins greyish with distal half darker grey to blackish. Ocular side pectoral fin black; blind side pectoral fin translucent. Pelvic fins whitish. Caudal fin greyish with central rays darker grey to blackish (Fig. 2A).

Preserved colouration

Ocular side of body light brown throughout, with dark blotches scattered throughout body; blind side light brown throughout. Ocular side pectoral fin black; blind side pectoral fin translucent. Pelvic fins whitish. Dorsal and anal fins light brown with distal half greyish. Caudal fin light brown with central rays greyish, and posterior third greyish (Fig. 2B, C).

DISCUSSION

The specimens collected off Madagascar were identified as *K. megastoma* based on the following combination of characters as described in Kuronuma (1940): canine teeth well developed on anterior tip of lower jaw; tip of vomer protruding into mouth cavity; lateral line absent on blind side; ocular side pelvic fin far in advance of right pelvic fin; length of maxilla longer than head; upper jaw projecting beyond snout; 83–85 anal fin rays; and 10–12 pectoral fin rays. Several morphological variations were noticed when comparing specimens from the western Indian Ocean in the present study to those from the southeastern Indian and Western Pacific Oceans, including (main differences in bold in Table 1): a longer ocular side pectoral fin (116.8–130.0% HL vs 100.5–113.9% HL); shorter caudal fin length (13.6–16.3% HL vs 16.8–17.6% HL); larger interorbital width of 3.6–5.0% HL vs 3.3–3.6% HL; a shorter upper jaw length of 78.3–90.1% HL vs 94.4–101.7% HL; and shorter lower jaw length (103.7–116.5% HL vs 120.3–126.5% HL). These differences are most likely intraspecific variations as noticed in Matsunuma (2016) for recent specimens from the East China Sea.

Fricke *et al.* (2018) recognized 47 species of Pleuronectiformes within 26 genera and 8 families as occurring in Madagascan waters, without mention of the widemouthed flounder *K. megastoma*. Thus, the specimens studied herein represent the 48th species of Pleuronectiformes for Madagascar.

K. megastoma is a rare species which inhabits sandy-mud bottoms at depths of 300–500 m, and feeds on small benthic organisms (Amaoka 2016). Amaoka (2016) reported a juvenile (102 mm) and a young adult (120 mm), and noted they have a shorter lower jaw than adults. There has been very little genetic work done with one and four sequences available respectively in the Barcode of Life BOLD System (Ratnasingham & Hebert 2007) and GenBank (NCBI 2019). Although some genetic sequences are available, they could not be used within this study as the specimens described herein did not have tissue samples taken prior to being fixed in formaldehyde. The status of *K. megastoma* has not yet been assessed on the IUCN Red List of Threatened Species. This may be due to its rarity, deficiency of biological knowledge and lack of economic interest to fisheries due to its small size.

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