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Redescription of a Sanddiver, *Trichonotus blochii* (Actinopterygii: Perciformes: Trichonotidae), with Confirmation of Its Validity

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A trichonotid sanddiver, *Trichonotus blochii* Castelnau, 1875, known only from its short original description, is redescribed on the basis of the holotype and 11 additional specimens from northern Australia. This species differs from its congeners by displaying the following combination of characters: dorsal fin soft rays 43–46; anal fin soft rays 39–41; lateral line scales 57–60; gill rakers 4–6+17–21; vertebrae 55; infraorbital and supraorbital canals separated anterior to eye; elongated dorsal fin spines 4–6 in males; caudal fin with 2 black stripes in males.

Key Words: Redescription, Trichonotidae, *Trichonotus blochii*, northern Australia.

Introduction

Sanddivers of the Indo-Pacific shore-fish genus *Trichonotus* Bloch and Schneider are characterized by an elongate and cylindrical body with long-based dorsal and anal fins, a pointed snout, and eyes with a dorsal iris flap, and they exhibit remarkable sexual dimorphism (Randall and Tarr 1994; Nelson 2001). Nine of 11 nominal species are considered valid (Bleeker 1854; Randall and Tarr 1994; Eschmeyer 1998): *T. setiger* Bloch and Schneider, 1801, *T. blochii* Castelnau, 1875, *T. filamentosus* (Steindachner, 1867), *T. cyclograptus* (Alcock, 1890), *T. nikii* Clark and von Schmidt, 1966, *T. marleyi* (Smith, 1936), *T. elegans* Shimada and Yoshino, 1984, *T. arabicus* Randall and Tarr, 1994, and *T. halstead* Clark and Pohle, 1996. *Trichonotus polyophthalmus* Bleeker, 1853 and *T. multistriatus* (Kotthaus, 1977) have been regarded as junior synonyms of *T. setiger* and *T. nikii*, respectively (Bleeker 1854; Randall and Tarr 1994). Although Bloch and Schneider (1801) used two different spellings of the name in their original description, viz., *T. setiger* in the text and *T. setigerus* in the figure, we follow Shimada (2002), who followed Bleeker (1854) in choosing *setiger* as the correct original spelling.

Trichonotus blochii was originally described based on a single specimen from the Gulf of Carpentaria in northern Australia, and no additional specimens have been reported. The original description of *T. blochii* is short, without an accompa-

nying figure, and is insufficient to establish the identity of the species. Regarding the holotype, Eschmeyer (1998) stated that the whereabouts of the specimen is unknown. Without referring to any voucher specimens, Hoese and Bray (2006) noted that *T. blochii* is distributed around northern Australia. Recently, we retrieved the holotype of *T. blochii* from the Muséum National d'Histoire Naturelle, Paris (MNHN) collection, enabling us to redescribe the species based on it and 11 additional specimens from northern Australia, and to confirm the validity of *T. blochii*.

Material and Methods

Counts and measurements follow Hubbs and Lagler (1958) except the following: predorsal length, the least distance between the tip of the snout and the base of the first dorsal fin spine; nape to dorsal fin origin, the least distance between the posterior margin of the supratemporal canal to the origin of the dorsal fin; preanal length, the least distance between the tip of the snout and the origin of the anal fin; prepectoral length, the least distance between the tip of the snout and the base of the uppermost pectoral fin ray; prepelvic length, the least distance between the tip of the snout and the base of the pectoral fin spine; interorbital width, the least distance between the orbits; and suborbital depth, the least distance between the lower margin of the orbit and the margin of the upper jaw. Vertebral and dorsal pterygiophore counts were determined from radiographs. Standard and head lengths are expressed as SL and HL, respectively. Terminology of the cephalic sensory pore system follows Shimada and Yoshino (1984); these pores were observed using 1% cyanine blue solution.

Specimens examined in this study have been deposited in the Australian Museum, Sydney (AMS); Bernice P. Bishop Museum, Honolulu (BPBM); Department of Biology, Faculty of Science, Kochi University, Kochi (BSKU); Coastal Branch of Natural History Museum and Institute, Chiba, Katsuura, Chiba (CMNH); Hebrew University, Jerusalem (HUJ); MNHN; National Museum of Nature and Science, Tokyo (NSMT); Department of Marine Sciences, Faculty of Science, University of the Ryukyus, Nishihara, Okinawa (URM); and Museum Support Center, Smithsonian Institution National Museum of Natural History, Suitland, Maryland (USNM).

Comparative material examined. *Trichonotus arabicus*: BPBM 33412 (paratypes, 2 males and 2 females, 103.5–168.2 mm SL), Tarut Bay, Persian Gulf; USNM 326971 (1 male and 1 female, 129.5 and 108.5 mm SL, respectively), Tarut Bay, Persian Gulf. *Trichonotus elegans*: URM-P 6413 (holotype, male, 111.4 mm SL), 6403 (paratype, male, 123.5 mm SL), 6405 (paratype, female, 64.1 mm SL), 6407 (paratype, female, 73.5 mm SL), and 6410–6412 (paratypes, 1 male and 2 females, 67.1–108.0 mm SL), Yaeyama Islands, Okinawa Pref., Japan; NSMT-P 23036 (paratype, male, 105.3 mm SL), Yaeyama Islands, Okinawa Pref., Japan; BSKU 71966 (male, 129.3 mm SL), 71967 (female, 89.0 mm SL), 72036 (female, 84.9 mm SL), 72066 (male, 115.8 mm SL), 72067 (female, 87.4 mm SL), 73080 (male, 85.2 mm SL), and 73094 (male, 118.2 mm SL), Okinoshima, Kochi Pref., Japan. *Trichonotus filamentosus*: BSKU 37362 (male, 107.1 mm SL), 37363 (male, 136.0 mm SL), 37409 (female, 79.4 mm SL), 37450 (male, 112.2 mm SL), 71170 (female, 74.0 mm SL), 71173 (female, 74.5 mm SL), 711761 (male, 89.2 mm SL), 71210 (female, 81.4 mm SL), and 71213 (male, 90.4 mm SL), Tosa Bay,

Kochi Pref., Japan; BSKU 70744 (female, 56.3 mm SL), Usa, Kochi Pref., Japan; NSMT-P 72404 (male, 88.1 mm SL), Okinosima-cho, Oki Islands, Shimane Pref., Japan; NSMT-P 53137 (1 male and 1 female, 79.7 and 64.0 mm SL, respectively), Nagasaki Peninsula, Nagasaki Pref., Japan; NSMT-P 71746 (female, 86.0 mm SL), Shimizu, Shizuoka Pref., Japan; URM-P 6418 (male, 95.0 mm SL), Izu, Shizuoka Pref., Japan; CMNH-ZF 15995 (female, 91.4 mm SL), Shimizu, Shizuoka Pref., Japan. *Trichonotus halstead*: USNM 325924 (paratypes, 2 males and 4 females, 83.7–135.4 mm SL), Milne Bay Province, Papua New Guinea; BPBM 36909 (male, 138.8 mm SL), Milne Bay Province, Papua New Guinea. *Trichonotus nikii*: HUJ 10100 (holotype, male, 109.4 mm SL) and 19241 (male, 108.8 mm SL), Eilat, Israel, Gulf of Aqaba; HUJ 6051 (male, 108.8 mm SL), Dahab, Gulf of Aqaba; HUJ 11266 (female, 91.0 mm SL), Gulf of Aqaba; BPBM 30888 (1 male and 1 female, 124.9 and 117.8 mm SL, respectively), Ras Abu Galum, Gulf of Aqaba; BPBM 35723 (1 male and 1 female, 111.2 and 72.0 mm SL, respectively), Djibouti, Gulf of Aden; USMN 326037 (1 male and 2 females, 84.1–148.8 mm SL), Dahab, Gulf of Aqaba. *Trichonotus setiger*: BPBM 36225, (2 males, 124.0 and 145.4 mm SL), Normanby Island, Papua New Guinea; BPBM 36487 (male, 153.1 mm SL), Ambon, Indonesia.

Taxonomy

Trichonotus blochii Castelnau, 1875

[English name: Bloch's Sanddiver]

(Figs 1–4, Table 1)

Trichonotus blochii Castelnau, 1875: 22 (type locality: Gulf of Carpentaria, Queensland, Australia); Eschmeyer 1998: 242 (comments on whereabouts of the holotype); Hoese and Bray 2006: 1496 (locality: Western Australia to Queensland).

Material examined. Holotype: MNHN A. 5208, male, 143.0 mm SL, Gulf of Carpentaria, Australia, 1877 (year of registration). Additional specimens (11 specimens, 90.8–130.4 mm SL, all from Australia): AMS IA. 1802, male, 129.6 mm SL, Port Denison (20°03'S, 148°15'E), collected by E. H. Rainford, date unknown; AMS IA. 6238, 4 males and 2 females, 94.9–130.4 mm SL, Lindeman Is. (20°27'S, 149°02'E), collected by M. Ward, 1934; AMS IA. 6676, male, 121.9 mm SL, Lindeman Is. (20°27'S, 149°02'E), collected by G. Whitley, 1936; AMS IB. 6441, male, 103.2 mm SL and AMS IB. 6442, female, 90.8 mm SL, Albatross Bay, Weipa, Gulf of Carpentaria (12°40'S, 141°42'E), collected by W. H. Foley, 1963; AMS I. 34579-013, male, 112.6 mm SL, Broome (17°58'S, 122°14'E), collected by B. E. Bardwell, 1924–1947.

Diagnosis. A species of *Trichonotus* with the following combination of characters: dorsal fin rays V–VII, 43–46; anal fin rays I, 39–41; lateral line scales 57–60; gill rakers 4–6+17–21; vertebrae 55; HL 18–20% SL; snout length 25–31% HL; infraorbital and supraorbital canals separated anterior to eye; elongated dorsal fin spines 4–6 in males; and caudal fin with 2 black stripes in males.

Description. Data for the holotype are presented first, followed by those for additional specimens in parentheses.

Dorsal fin rays VI, 44 (V–VII, 43–46); anal fin rays I, 40 (I, 39–41); pectoral fin rays 14 (13–15); pelvic fin rays I, 5; caudal fin rays 13 (13–15); lateral line scales 59

Fig. 1. *Trichonotus blochii* Castelnau, 1875. A, Holotype, MNHN A. 5208, male, 143.0 mm SL; B, additional specimen, AMS IA. 1802, male, 129.6 mm SL; C, additional specimen, AMS IB. 6442, female, 90.8 mm SL.

(57–60); scales above lateral line 6.5 (5–6.5); scales below lateral line 8 (7–8); median predorsal scales 11 (7–11); gill rakers on 1st arch 6+21 (4–6+17–21); pseudo-branchial filaments 11 (10–13); branchiostegal rays 7 (7); vertebrae 55 (55).

Proportions as % SL: HL 19.2 (18.4–20.2); body depth 6.6 (5.6–7.1); body width 5.2 (4.6–6.3); postorbital length 11.8 (10.8–11.9); length of nape to dorsal fin origin 9.4 (8.9–10.0); predorsal length 21.2 (20.2–22.4); preanal length 35.2 (33.6–37.6); prepectoral length 18.5 (18.0–20.5); prepelvic length 17.2 (16.4–18.0); length of dorsal fin base 78.9 (76.0–79.1); length of anal fin base 63.9 (60.6–65.0); length of longest dorsal fin spine 55.7 (20.1–59.5) in males, (5.4–7.9) in females; length of 1st dorsal fin soft ray 11.9 (4.6–15.0); length of 20th dorsal fin soft ray 17.2 (7.6–17.2); length of anal fin spine 4.1 (2.3–4.1); length of 1st anal fin soft ray 5.0 (3.6–5.3); length of 15th anal fin soft ray 9.2 (6.5–8.8); length of pectoral fin 11.5 (10.7–11.4); length of pelvic fin spine 5.0 (5.0–8.2); length of longest pelvic fin soft ray 17.1 (10.7–20.3); length of longest caudal fin ray 17.9 (14.1–20.7). Proportions as % HL: snout length 28.4 (24.9–30.7); eye diameter 15.8 (13.9–18.9); interorbital width 5.4 (1.1–5.9); suborbital depth 5.5 (2.7–5.8); upper jaw length 33.8 (31.1–37.2); caudal peduncle length 16.6 (12.3–26.2); caudal peduncle depth 17.0 (14.1–20.4).

Body long, cylindrical, compressed posteriorly (Fig. 1). Snout long, pointed. Mouth large, maxilla reaching to a vertical through mid-eye. Lower jaw extending anteriorly beyond upper jaw tip. Opercle reaching to pectoral fin base. Gill membranes free from isthmus. Tongue very narrow, slightly expanded anteriorly, tip

Fig. 2. Cephalic sensory pore system in *Trichonotus blochii*, AMS IB. 6441, male, 103.2 mm SL. A, Dorsal view; B, lateral view; C, ventral view. Abbreviations: io, infraorbital canal; m, mandibular canal; po, preopercular canal; so, supraorbital canal; st, supratemporal canal. Scale bar: 5 mm.

round. Eye round, with 12 to 19 hair-like “lashes” on iris flap. Interorbital space narrow, its width less than $1/3$ eye diameter. Nostrils small, closer to snout tip than to anterior margin of eye. Anterior nostrils short, tubular. Tip of infraorbital canal closely adjacent to supraorbital canal, but separated anterior to eye (Fig. 2).

Body covered by cycloid scales with posterior edge of scales slightly angular. Lateral line along mid-body; each lateral-line scale rhomboidal with posterior notch. Scales on abdomen smaller than those on lateral sides of body. Scales be-

Fig. 3. Fins of *Trichonotus blochii*, AMS IA. 1802, male. A, Posterior part of anal fin; B, caudal fin. Scale bars: 10 mm.

tween supratemporal canal and dorsal fin origin small, diagonally arrayed. Row of 3–4 embedded scales on posteroventral margin of eye (holotype with 4 such scales), just ventral to infraorbital canal (Fig. 2).

Upper jaw teeth near symphysis large, canine-like, in 3 irregular rows, becoming small, conical, in 2–3 irregular rows posteriorly. Lower jaw teeth large, in single row anteriorly, gradually decreasing in size and in 2 irregular rows posteriorly. Head of vomer crescentic, palatines narrow, both with villiform teeth. Gill rakers on 1st arch long, most with several spinules. Broad predorsal bone present between 1st and 2nd neural spines. First 2 dorsal pterygiophores located between 4th and 5th neural spines; 1 free pterygiophore between 8th and 9th neural spines. First anal pterygiophore located below 15th or 16th vertebra.

Dorsal fin spines flexible, all prolonged in males, but not in females. Anal fin spine flexible, shorter than following soft rays in both sexes. Caudal fin pointed in males (shape unknown in females because of damage). Pelvic fin inserted anteriorly of pectoral fin base; its 4th soft ray longest, extending beyond anus in males, but not in females.

Color in alcohol. Head and body uniformly dark brown, without saddle-like markings. Dorsal and anal fins pale. In males, 2 longitudinal dark stripes on caudal fin and dark stripe on posterior 1/3 anal fin membrane (Fig. 3). Color when fresh and alive unknown.

Distribution. Known only from northern Australia, from about Broome (Western Australia) to about Bowen (Queensland) (Fig. 4).

Remarks. The holotype (MNHN A. 5208), collected from the Gulf of Carpentaria, is easily identified as a species of the genus *Trichonotus* by having an elongate and cylindrical body with long-based dorsal and anal fins, a pointed snout, and a dorsal iris flap on each eye. We confirmed that this was the only specimen of *Trichonotus* deposited in the MNHN. According to that museum's register, the holotype was collected in 1877, but the original description was published in 1875. The former year probably indicates the date of registration at MNHN, not the date of sampling (Romain Causse, personal communication). In addition, the registered name of the collector of MNHN A. 5208 is Castelnau. In the original description, Castelnau (1875) remarked, "I have received lately, from the Gulf of Carpentaria, a specimen of this rare genus, and for all some of its characters do not allow me to unite it with the typical species, it is certainly very nearly allied to it." Although Castelnau is probably not the collector of MNHN A. 5208, this specimen is apparently the holotype of *T. blochii*.

Fig. 4. Localities of *Trichonotus blochii* specimens examined in this study. Holotype (open circle; location approximate) and other specimens (solid circles).

Our measurements of this presumed holotype are very similar to those presented in the original description: total length 170.2 mm (vs slightly longer than 152 mm in original description), body depth 6.6 in % SL (7.4), HL 19.2 in % SL (18.2), dorsal fin height 17.8 in % SL (18.2). However, slight differences can be seen in the following counts: dorsal and anal fin rays, elongated dorsal fin spines, and lateral line scales (Table 1). The other characteristics and locality clearly indicate that the specimen is the holotype.

Trichonotus blochii is similar to *T. setiger* and *T. halstead* in having more than four dorsal fin spines, elongated dorsal fin spines, a free pterygiophore, and the body completely covered with scales (cf. Bloch and Schneider 1801; Clark and Pohle 1996). However, morphological differences exist between them. The infraorbital canal is separated from the supraorbital canal in *T. blochii*, but these two canals are connected with each other in *T. setiger* and *T. halstead*. In addition, *T. blochii* is clearly distinguished from *T. setiger* by the number of elongated dorsal fin spines, anal fin soft rays, and lateral line scales, and also from *T. halstead* by the number of anal fin soft rays, vertebrae, and saddle-like markings (0 vs 9) (Table 1). Although *T. blochii* and *T. halstead* share similar dark markings on the caudal fin, the former differs from the latter in having two dark stripes there (Fig. 3) (the latter has a row of black spots on the upper lobe and a dark stripe on the lower).

Table 1. Morphological comparison of nine known species of *Trichonotus*.

	<i>T. blochii</i>		<i>T. arabicus</i>	<i>T. cyclograptus</i>	<i>T. elegans</i>	<i>T. filamentosus</i>	<i>T. halstead</i>	<i>T. marleyi</i>	<i>T. nikii</i>	<i>T. setiger</i>
	Castelnau (1875)	Holotype	<i>n</i> = 11	<i>n</i> = 6	Alcock (1890)	<i>n</i> = 16	<i>n</i> = 20	<i>n</i> = 7	Smith (1936), Clark and Schmidt (1966)	<i>n</i> = 3
Dorsal fin spines	—	6	5-7	3-4	4	3-4	4-5	6-7	3	4
Dorsal fin soft rays	46 (total rays)	44	43-46	44-46	45-46	43-46	41-45	39-41	41-44	41-44
Anal fin soft rays	35 (total rays)	40	39-41	37-38	39-40	38-42	35-39	35-37	36-38	37-38
Lateral line scales	more than 53	59	57-60	55-57	57-59	57-59	55-57	54-56	55-57	56-57
Gill rakers (upper+lower)	—	6+21	4-6+17-21	6-8+20-23	—	5-7+21-23	4-6+17-21	4-5+17-20	5-6+21	6-7+20
Vertebrae	—	55	55	52-53	—	53-55	51-53	51-52	—	53
Elongated dorsal fin	8	5	4-6	absent	absent	3-4	absent	5-6	2-3	2
spines in males	—	—	1	1	—	3-4	1	1	—	1
Free pterygiophores	—	absent	absent	absent	absent	present	absent	absent	absent	absent
Scaleless parts of body	absent	absent	absent	14	12	17	absent	9	11	11
Saddle-like markings	—	—	absent	absent*	—	absent**	absent	9	10	—
Saddle-like markings	—	—	absent	absent*	—	absent**	absent	9	10	—
in females	—	separated	separated	separated	—	separated	connected	connected	—	connected
Infraorbital and	—	separated	separated	separated	—	separated	connected	connected	—	connected
supraorbital canals	—	19.2	18.4-20.2	19.5-22.4	—	17.0-20.9	17.3-20.1	20.6-21.8	—	19.7
Head length in % SL	—	28.4	24.9-30.7	27.1-32.2	—	26.3-31.4	24.5-32.0	26.0-32.4	—	28.6-31.4
Snout length in % HL	—	Gulf of	Northern	Arabian	Bay of	Indo-West	Japan to	Papua	South	Indo-West
Distribution	Carpen- taria	Gulf of	Australia	Gulf and	Bengal	Pacific***	South	New	Africa	Pacific***
		Carpen- taria		Oman			China Sea	Guinea		of Aden

* Two longitudinal stripes. ** Three longitudinal stripes. *** Based on this study and Randall (2005).

Trichonotus setiger has been reported widely from the Indo-Western Pacific including southern Japan (e.g., Shimada 2002; Randall 2005). According to the original description, *T. setiger* has two elongated dorsal spines in the male. In this study, three comparative specimens from Papua New Guinea and Indonesia agreed well with the holotype illustrations of *T. setiger* by Bloch and Schneider (1801). However, Japanese specimens have more than three elongated dorsal spines (e.g., Shimada 2002), so we suggest that the Japanese population differs from true *T. setiger*.

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