

FIRST NORTHERN HEMISPHERE RECORDS OF THE SAMOAN ANCHOVY, *STOLEPHORUS APIENSIS* (ACTINOPTERYGII: CLUPEIFORMES: ENGRAULIDAE)

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Abstract. Two Japanese specimens of the Samoan anchovy, *Stolephorus apiensis* (Jordan et Seale, 1906), previously known only from Papua New Guinea, Fiji, and Samoa, were confirmed during a revisionary taxonomic study of the genus. Although *S. apiensis* has been redescribed recently, details of its distributional range and habitat have remained unclear. The presently reported study sought to clarify some aspects of both. Two specimens of *S. apiensis* were examined, counts and proportional measurements following Hata and Motomura (2017). All measurements were made with digital calipers to the nearest 0.01 mm. Institutional codes follow Sabaj (2019). Two specimens, collected from Japanese river estuaries, represent the first Northern Hemisphere records of *S. apiensis*, extending the northern limit of the species' distribution by approx. 4300 km. *Stolephorus apiensis* is considered to be widely distributed in the western Pacific from southern Japan to Samoa, most likely as a sometime inhabitant of estuarine waters. The new standard Japanese name “Nampu-ainokoiwashi” is proposed for the species.

Keywords: *Stolephorus commersonii*, *Stolephorus insignis*, Shikoku, Ryukyu Islands, Japan

INTRODUCTION

Stolephorus Lacepède, 1803, an Indo-Pacific genus of marine and/or brackish water anchovies (Engraulidae), comprises 26 valid species (Whitehead et al. 1988, Wongratana et al. 1999, Kimura et al. 2009, Hata and Motomura 2018a, 2018b, Hata et al. 2019, 2020, Gangan et al. 2020), many being abundantly caught and marketed in tropical Asia (Rau and Rau 1980, Talwar and Kacker 1984, Conlu 1986, Phui Kong 1998, White et al. 2013, Psomadakis et al. 2015, 2019, Hata 2018b, 2019, Hata et al. 2020), although rarely seen off Japan. In fact, only two species, *Stolephorus commersonii* Lacepède, 1803 and *Stolephorus indicus* (van Hasselt, 1823), have been formally recorded from Japanese waters (Nishishimamoto 1963a, Kimura et al. 1999, Aonuma and Yagishita, 2013b). The occurrence and catch of *S. indicus* off southern Japan, including Kyushu and the Ryukyu Islands, are comparatively rare (Miura 2012, Hata 2017, 2018a, Kobayashi 2019), and records of *S. commersonii* from Japanese waters even more limited [so deficient in habitat and biological information (Kimura et al. 1999, Yoshigou 2014) that the species is ranked as “DD (Data Deficient)” in the Red List of threatened marine fishes issued by the Ministry of the Environment, Government of Japan].

During a revisionary study of the genus, two engraulid specimens collected from the Shimanto River estuary,

Kochi Prefecture and Urauchi River estuary, Iriomotejima Island, Japan, were found in the collections of the Faculty of Science, Department of Natural Science, Kochi University and Okinawa Churashima Foundation, respectively. They were identified as *Stolephorus apiensis* (Jordan et Seale, 1906), previously recorded only from New Ireland (Papua New Guinea), Fiji, and Samoa (Hata and Motomura 2018b, Fricke et al. 2019). The present specimens, described in detail herein, represent the first Japanese records of the species, the Kochi specimen also being the northernmost record known.

MATERIALS AND METHODS

Counts and proportional measurements, expressed as percentages of standard length (SL), followed Hata and Motomura (2017). All measurements were made with digital calipers to the nearest 0.01 mm. Institutional codes follow Sabaj (2019).

RESULTS

Family ENGRAULIDAE

Stolephorus apiensis (Jordan et Seale, 1906)

[English name: Samoan Anchovy; new standard Japanese name: Nampu-ainokoiwashi]

(Fig. 1; Tables 1, 2)

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Material examined. 2 specimens, 53.0–54.2 mm SL. BSKU 55110, 54.2 mm SL, approx. 400 m below the junction of the Takeshima and Nabeshima rivers (Shimanto Basin), Shimanto City, Kochi Prefecture, southern Japan, 12 October 1999; URM-P 15468, 53.0 mm SL, estuary of Urauchi River, Iriomote-jima Island, Ryukyu Islands, Japan, 18 August 1985.

Description. Counts and measurements, expressed as percentages of SL or HL, given in Tables 1 and 2. Body laterally compressed, elongate, deepest at dorsal fin origin. Dorsal profile of head and body gently elevated from snout tip to dorsal fin origin, thereafter gradually lowering to uppermost point of caudal fin base. Ventral profile of head and body gently lowering from lower-jaw tip to below pectoral fin, thereafter nearly straight (parallel to body axis) to anal fin origin, gradually elevated along anal fin base, thereafter nearly straight (parallel to body axis) to lowermost point of caudal fin base. Abdomen rounded, covered with three or five spine-like scutes anterior to pelvic fin insertion. Pelvic scute without spine. Postpelvic and predorsal scutes absent. Anus just anterior to anal fin origin. Snout round, projecting, length less than eye diameter. Eye large, round, covered with adipose eyelid, positioned laterally on head dorsal to horizontal through pectoral fin insertion, visible in dorsal view. Pupil round. Orbit elliptical. Nostrils close to each other, anterior to orbit. Mouth large, inferior, ventral to body axis, extending backward beyond posterior margin of eye. Maxilla rather long, its posterior tip slightly short of posterior margin of preopercle. Lower jaw slender. Single row of conical teeth on each jaw and palatines. Several conical teeth on vomer. Small fine teeth on pterygoids. Posterior margins of preopercle, subopercle and opercle rounded, smooth (opercle broken on both sides in BSKU 55110). Gill membrane without serrations. Interorbital space flat. Interorbital width less than eye diameter. Pseudobranchial filaments present, length of longest filament less than eye diameter. Gill rakers long, slender, rough, visible from side of head when mouth opened. Isthmus muscle long, reaching anteriorly to posterior margin of gill membranes. Urohyal hidden by isthmus muscle (not visible without dissection). Gill membrane on each side joined distally, most of isthmus muscle exposed (not covered by gill membrane). Head scales absent. Lateral line absent. Fins scaleless, except for broad triangular sheath of scales on caudal fin. Dorsal fin origin posterior to vertical through base of last pelvic-fin ray, slightly posterior to middle of body. Dorsal and anal fins with three anteriormost rays closely spaced and unbranched. First dorsal- and anal-fin rays minute. Dorsal profile of dorsal fin elevated from dorsal fin origin to third fin ray tip and lowering to last dorsal-fin ray tip. Anal fin origin just below base of tenth or eleventh dorsal-fin ray. Posterior tip of depressed anal fin not reaching caudal fin base. Uppermost pectoral-fin ray unbranched, inserted below midline of body. Posterior tip of pectoral fin not reaching vertical through pelvic fin insertion. Dorsal, ventral, and posterior contours of pectoral fin nearly straight. Pelvic fin shorter than pectoral fin; pelvic fin insertion anterior to vertical through dorsal

fin origin. Posterior tip of depressed pelvic fin reaching to vertical through third or fifth dorsal-fin ray base. Caudal fin forked, tips of both lobes pointed.

Coloration of preserved specimens. Body uniformly pale ivory. Indistinct light brown longitudinal band narrower than eye running from opercle to caudal-fin base. Paired dark patches on parietal and occipital regions (those on occipital region relatively indistinct; Fig. 2B, E). No dark lines on dorsum. Melanophores scattered along scale pockets on dorsum, a few on snout tip, no black spots below eye and lower-jaw tip. Fins pale, semi-transparent. Melanophores scattered along caudal-fin rays.

Distribution. *Stolephorus apiensis* has been previously recorded from Papua New Guinea (New Ireland), Fiji, and Samoa (Whitehead et al. 1988, Wongratana et al. 1999, Hata and Motomura 2018b, Fricke et al. 2019), and is here newly recorded from Japan (Yaeyama Islands and Kochi Prefecture).

DISCUSSION

The specimens collected from Japan were assigned to the genus *Stolephorus*, as defined by Whitehead et al. (1988) and Wongratana et al. (1999), due to having a long isthmus muscle reaching anteriorly to the posterior margin of the gill membrane, and hidden urohyal and prepelvic scutes, and the absence of postpelvic scutes. The specimens were further identified on the basis of the following combination of characters, closely matching the diagnostic features of *Stolephorus apiensis* given by Whitehead et al. (1988), Wongratana et al. (1999), and Hata and Motomura (2018b): maxilla rather long, its posterior tip slightly short of posterior margin of preopercle; no predorsal scutes; pelvic scute without spine; posterior margin of preopercle round, convex; paired obscure dark patches on parietal and occipital regions without following dark lines; black spots below eye and lower-jaw tip absent; body elongate, posterior tip of depressed pelvic fin reaching to vertical through third or fifth dorsal-fin ray origin; gill rakers numerous, 21 + 27–28 = 48–50 (1st gill arch), 15 + 25–26 = 40–41 (2nd), 11–12 + 15 = 26–27 (3rd), 10 + 12 = 22 (4th) on each gill arch; body elongate, its depth 18.6%–19.4% of SL; anal fin base long, its length 20.2%–20.6% of SL; caudal peduncle short, its length 17.5%–17.7% of SL. In addition, the meristics and morphometrics of the presently reported specimens closely matched those of *S. apiensis* given by Hata and Motomura (2018b) (Tables 1, 2). Only two *Stolephorus* species, *Stolephorus commersonnii* Lacepède, 1803 and *Stolephorus indicus* (van Hasselt, 1823), have been recorded previously from Japanese waters (Aonuma and Yagishita 2013b). However, the number of lower gill rakers on the first gill arch is generally lower in the latter species (23–28 in *S. commersonnii*, 20–28 in *S. indicus*), compared with *S. apiensis* (27–30). *Stolephorus apiensis* also differs from *S. commersonnii* in having paired obscure dark patches on the parietal and occipital regions without following dark lines (vs. pairs of dark patches on both regions and pair of dark lines on the dorsum from the parietal region to the dorsal fin origin in *S. commersonnii*). *Stolephorus apiensis* is easily distinguishable from *S. indicus* by its longer



Fig. 1. Preserved specimens of *Stolephorus apiensis* from Kochi Prefecture (BSKU 55110, 54.2 mm SL; **A**: lateral, **B**: dorsal, and **C**: ventral) and Iriomote-jima Island (URM-P 15468, 53.0 mm SL; **D**: lateral, **E**: dorsal, and **F**: ventral), Japan

maxilla, posteriorly short of or just reaching the posterior preopercle margin (vs. just reaching the preopercle anterior margin of in *S. indicus*) and depressed pelvic fin extending posteriorly beyond vertical through the dorsal fin origin (vs. not reaching vertical through the fin origin) (Whitehead et al. 1988, Wongratana et al. 1999, Hata and Motomura 2018b).

Although the specimens reported here have extended the northern limit of the species' distribution by approx. 4300 km (and represent the first records of the species from the Northern Hemisphere), the currently known distributional range of *S. apiensis* is discontinuous.

However, *Spratelloides atrofasciatus* Schultz, 1943, a small clupeiform species like *S. apiensis*, is also distributed intermittently in Samoa, the Marshall Islands, and the Ryukyu Islands, Japan (Schultz 1943, Nishishimamoto 1963b, Aonuma and Yagishita 2013a, Ishimori et al. 2015, Koeda et al. 2016, Nakae et al. 2018). It is likely, therefore, that *S. apiensis* is similarly distributed in areas between Samoa and Japan, such as the Marshall Islands.

No biological or habitat information on *S. apiensis* has been reported. However, the Japanese specimens,

Table 1

Meristics of specimens of *Stolephorus apiensis*

| | This study | | Hata and Motomura (2018b) | | |
|--|------------|-------------|---------------------------|--------------|---------------|
| | Non-types | | Holotype | Paratypes | Non-types |
| | BSKU 55110 | URM-P 15468 | USNM 51720 | <i>n</i> = 7 | <i>n</i> = 35 |
| Standard length (mm) | 54.2 | 53.0 | 60.9 | 55.2–66.3 | 38.8–74.6 |
| Dorsal-fin rays (unbranched) | 3 | 3 | 3 | 3 | 3 |
| Dorsal-fin rays (branched) | 13 | 13 | 12 | 12–13 | 12–14 |
| Anal-fin rays (unbranched) | 3 | 3 | 3 | 3 | 3 |
| Anal-fin rays (branched) | 19 | 18 | 18 | 17–19 | 17–19 |
| Pectoral-fin rays (unbranched) | 1 | 1 | 1 | 1 | 1 |
| Pectoral-fin rays (branched) | 13 | 13 | 12 | 12–13 | 11–14 |
| Pelvic-fin rays (unbranched) | 1 | 1 | 1 | 1 | 1 |
| Pelvic-fin rays (branched) | 6 | 6 | 6 | 6 | 6 |
| Caudal-fin rays | 10 + 9 | 10 + 9 | 10 + 9 | 10 + 9 | 10 + 9 |
| Gill rakers on 1st gill arch (upper) | 21 | 21 | 21 | 20–21 | 20–24 |
| Gill rakers on 1st gill arch (lower) | 27 | 29 | 29 | 28–30 | 27–30 |
| Gill rakers on 1st gill arch (total) | 48 | 50 | 50 | 48–51 | 48–53 |
| Gill rakers on 2nd gill arch (upper) | 15 | 15 | 16 | 15–17 | 14–17 |
| Gill rakers on 2nd gill arch (lower) | 25 | 26 | 29 | 24–26 | 25–30 |
| Gill rakers on 2nd gill arch (total) | 40 | 41 | 45 | 41–42 | 40–47 |
| Gill rakers on 3rd gill arch (upper) | 11 | 12 | 12 | 11–12 | 11–13 |
| Gill rakers on 3rd gill arch (lower) | 15 | 15 | 15 | 13–17 | 14–16 |
| Gill rakers on 3rd gill arch (total) | 26 | 27 | 27 | 24–29 | 25–29 |
| Gill rakers on 4th gill arch (upper) | 10 | 10 | 9 | 8 | 8–10 |
| Gill rakers on 4th gill arch (lower) | 12 | 12 | 12 | 10–12 | 11–13 |
| Gill rakers on 4th gill arch (total) | 22 | 22 | 21 | 19–21 | 19–22 |
| Gill rakers on posterior face of 3rd gill arch | 5 | 6 | 5 | 4–5 | 3–6 |
| Prepelvic scutes | 5 | 3 | 4 | 3–4 | 2–5 |
| Scale rows in longitudinal series | 37 | 35 | 35 | 35–38 | 34–38 |
| Transverse scales | 8 | 8 | 8 | 8 | 8 |
| Pseudobranchial filaments | 17 | 18 | 17 | 18 | 16–20 |

having been collected from river estuaries, indicate that the species at least sometimes occurs in brackish waters.

Because there is no Japanese name for *S. apiensis*, we propose the new standard Japanese name “Nampu-ainokoiwashi” for the species, based on a specimen reported herein (BSKU 55110); “Nampu” meaning the south wind, derived from its main distributional area, Southern Hemisphere, with “ainokoiwashi” being the common Japanese name for the genus *Stolephorus*.

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Table 2

Morphometrics of specimens of *Stolephorus apiensis*

| | This study | | Hata and Motomura (2018b) | | |
|--------------------------------------|------------|-------------|---------------------------|--------------|---------------|
| | Non-types | | Holotype | Paratypes | Non-types |
| | BSKU 55110 | URM-P 15468 | USNM 51720 | <i>n</i> = 7 | <i>n</i> = 35 |
| Standard length (mm) | 54.2 | 53.0 | 60.9 | 55.2–66.3 | 38.8–74.6 |
| As % SL | | | | | |
| Head length | broken | 24.1 | 24.4 | 23.9–24.8 | 23.3–26.0 |
| Body depth | 18.6 | 19.4 | 18.9 | 18.1–19.6 | 17.0–20.0 |
| Pre-dorsal fin length | 53.6 | 52.3 | 55.3 | 53.3–56.0 | 51.9–56.5 |
| Snout tip to pectoral fin insertion | 25.4 | 26.1 | 26.6 | 25.5–7.3 | 25.4–28.5 |
| Snout tip to pelvic fin insertion | 43.8 | 44.3 | 45.4 | 43.6–46.0 | 42.4–47.4 |
| Snout tip to anal fin origin | 62.5 | 61.6 | 65.1 | 61.9–66.6 | 59.9–66.6 |
| Dorsal fin base length | 14.8 | 15.2 | 13.7 | 13.8–15.3 | 13.5–16.0 |
| Anal fin base length | 20.36 | 20.2 | 20.4 | 20.2–21.8 | 20.4–23.3 |
| Caudal peduncle length | 17.5 | 17.7 | 16.5 | 15.2–17.8 | 14.4–18.3 |
| Caudal peduncle depth | 8.4 | 8.8 | 9.4 | 8.9–9.8 | 8.3–10.0 |
| D–P1 | 32.6 | 32.7 | 33.3 | 32.9–36.8 | 31.3–36.4 |
| D–P2 | 20.3 | 22.6 | 21.8 | 20.2–21.8 | 20.1–23.5 |
| D–A | 19.8 | 20.8 | 20.8 | 19.9–21.8 | 19.4–21.6 |
| P1–P2 | 19.2 | 18.5 | 19.1 | 17.6–21.8 | 17.0–20.2 |
| P2–A | 19.3 | 17.6 | 20.7 | 17.8–21.7 | 16.4–20.7 |
| Pectoral fin length | 16.2 | 15.1 | broken | 16.8 | 13.7–16.1 |
| Pelvic fin length | 11.1 | 10.5 | 11.8 | 10.1–11.3 | 9.4–11.9 |
| Maxilla length | 17.3 | 18.2 | broken | broken | 17.3–18.7 |
| Mandibular length | 15.6 | 16.2 | 16.5 | 16.2–16.9 | 15.5–17.7 |
| Supramaxilla end to maxilla end | 3.3 | 3.0 | broken | broken | 2.3–4.1 |
| 1st unbranched dorsal-fin ray length | 2.3 | 2.0 | 1.6 | 0.9–2.0 | 1.4–2.8 |
| 2nd unbranched dorsal-fin ray length | 8.7 | 8.4 | broken | broken | 6.6–9.6 |
| 3rd dorsal-fin ray length | broken | broken | broken | broken | 15.2–18.5 |
| 1st unbranched anal-fin ray length | 2.3 | 1.7 | 1.0 | 1.1–1.8 | 1.3–3.6 |
| 2nd unbranched anal-fin ray length | 6.3 | 6.1 | broken | broken | 4.9–6.7 |
| 3rd anal-fin ray length | 13.8 | 12.1 | broken | broken | 11.6–15.6 |
| As % HL | | | | | |
| Orbit diameter | broken | 34.7 | 34.6 | 33.4–34.8 | 31.1–36.0 |
| Eye diameter | broken | 29.7 | 26.5 | 27.6–29.8 | 24.5–29.3 |
| Snout length | broken | 17.0 | 16.8 | 15.2–16.9 | 14.4–17.6 |
| Interorbital width | broken | 24.7 | 25.6 | 23.6–24.8 | 22.0–25.4 |
| Postorbital length | broken | 51.1 | 50.7 | 49.4–51.1 | 48.1–53.6 |

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