Platax 12: 71-79, 2015

New record of a brackish water goby (Perciformes: Gobiidae: *Acentrogobius*) from Taiwan

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Abstract

A specimen of *Acentrogobius audax* Smith, 1959 was recently collected from an estuary of the Tsengwen River, and we herein report this species as a newly recorded brackish water goby in Taiwan. The detailed morphometric and meristic features, color patterns, and cephalic lateral-line system are described herein. This study may be beneficial to understanding the unexplored diversity of brackish water gobies in Taiwanese waters, and the morphological features detailed may aid other researchers in identifying not only this species, but also congeneric gobies.

Key words: *Acentrogobius audax*, estuary, goby, newly recorded species, Taiwan, taxonomy

Introduction

The genus *Acentrogobius* Bleeker, 1874 is one group of small, benthic gobies, the members of which occur in both brackish water and seawater (Nakabo, 2000; Senou et al., 2004). To date, five species of *Acentrogobius* have been recorded in Taiwan (Chen and Fang, 1999; Shao et al., 2008), including *A. caninus* (Valenciennes, 1837), *A. janthinopterus* (Bleeker, 1853c), *A. pflaumii* (Bleeker, 1853b), and *A. viganensis* (Steindachner, 1893). *A. audax* Smith, 1959 is a small, benthic, brackish water goby that is widely distributed across the Indo-Pacific Ocean, and it has even been documented in the Ryukyu Archipelago of Japan (Senou et al., 2004; Nakabo, 2013).

However, this species has never been observed in Taiwanese waters.

In recent years, a series of intensive surveys of brackish water gobies have been carried out in Taiwan, and several new species and newly recorded species have been described, including *Pseudogobius taijiangensis* Chen, Huang and Huang, 2013 (new species), *Lentipes armatus* Sakai and Nakamura, 1979 (newly recorded genus), *Hemigobius crassa* Herre, 1945 (newly recorded species), *Mugilogobius chulae* Smith, 1932 (newly recorded species), *Mugilogobius mertoni* Weber, 1911 (newly recorded species), *Mugilogobius myxodermus* Herre, 1935 (newly recorded species), *Pseudogobius gastrospilos* Bleeker, 1853a (newly recorded species), and *Wuhanlinigobius polylepis* Wu and Ni, 1985 (newly recorded species) (Chen et al., 2007; Chen et al., 2013; Huang et al., 2013a, b, c). These studies revealed that brackish water gobies have been under-surveyed in estuary and mangrove habitats of Taiwan, in particular. In this study, a specimen of *A. audax* was collected from Taiwan for the first time. The detailed morphometric measurements, meristic features, and color patterns of this newly recorded brackish water goby are described herein.

Materials and Methods

The examined specimen was collected by hand net in an estuary of the Tsengwen River (see details below.). The specimen was fixed in 10% formalin solution for three days before being transferred into 70% ethanol for long-term preservation. The morphological measurements followed those of Miller (1988), and meristic counts followed Chen & Shao (1996) and Huang (2013a). The terminology for the cephalic sensory canals and free neuromast organ (sensory papillae) was from Miller (1988), Chen & Shao (1998), and Huang et al. (2013a, b, c), all of which were based on Sanzo (1911). The following meristic features were analyzed: anal fin, first and second dorsal fins, pectoral fin, longitudinal scale series, transverse scale series, predorsal scales, and scale series from origin of first dorsal fin to upper pectoral origin. All body lengths presented are standard length (SL). The examined specimen was deposited at the Biodiversity Research Center, Academia Sinica, Taipei, Taiwan. A museum webpage link to the examined specimen is listed as follows: http://fishdb.sinica.edu.tw/eng/specimendetail.php?id=ASIZP0078394.

Results and Discussion

***Acentrogobius audax* Smith, 1959**

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Table 1 and Figs. 1-2

Acentrogobius audax Smith, 1959 (Type locality: Mozambique). Nakabo, 2000: 1244; Senou et al., 2004: 412; Nakabo, 2013: 1469.

Table 1. Morphometric measurements of an *Acentrogobius audax* specimen from Taiwan.

	Acentrogobiusaudax
Feature	Percent of standard length
Head length	30.3
Predorsal length	32.1
Snout to 2nd dorsal origin	50.8
Snout to anus	48.9
Snout to anal fin origin	56.6
Pre-pelvic length	28.3
Caudal peduncle length	21.7
Caudal peduncle depth	11.8
1st dorsal fin base	14.8
2nd dorsal fin base	27.1
Anal fin base	29.0
Caudal fin length	25.5
Pectoral fin length	24.8
Pelvic fin length	23.2
Body depth at pelvic fin origin	17.5
Body depth at anal fin origin	20.1
Body width at anal fin origin	11.9
Pelvic fin origin to anus	20.7
	Percent of head length
Snout length	27.1
Eye diameter	31.9
Cheek depth	19.0
Post-orbital length	48.4
Head width(maximum)	53.4
Head width at upper gill	42.0
Bony interorbital width	7.1
Fleshy interorbital width	19.2
Lower jaw length	38.8

Material examined

ASIZP0078394, 20.0 mm SL, estuary of Tsengwen River, Tainan City, Southwestern Taiwan (latitude: 23.088176N, longitude: 120.108721E), coll. S. P. Huang and N. H. Jang-Liaw at 15 cm depth on 06 June, 2015.

Diagnosis

This newly recorded goby can be readily distinguished from congenerics by the following features: (1) second dorsal fin rays I/10, anal fin rays I/9, pectoral fin rays 16, longitudinal scale series 28, transverse scale series 9; (2) predorsal scales 8, first dorsal fin spine rounded, the second and third spines longest; (3) neck and upper region of trunk with five black cross-bands, the central axis of body with about eight longitudinally-aligned bright blue spots, anterior orbital region with an oblique black stripe, cheek with a horizontal black bar, operculum with an oblique black stripe, lower region of operculum with a large, bright blue mark,

Fig. 1. a: An *Acentrogobius audax* specimen from Taiwan. ASIZP0078394, 20.0 mm standard length (SL). **b**: An *in situ* image of the same specimen.

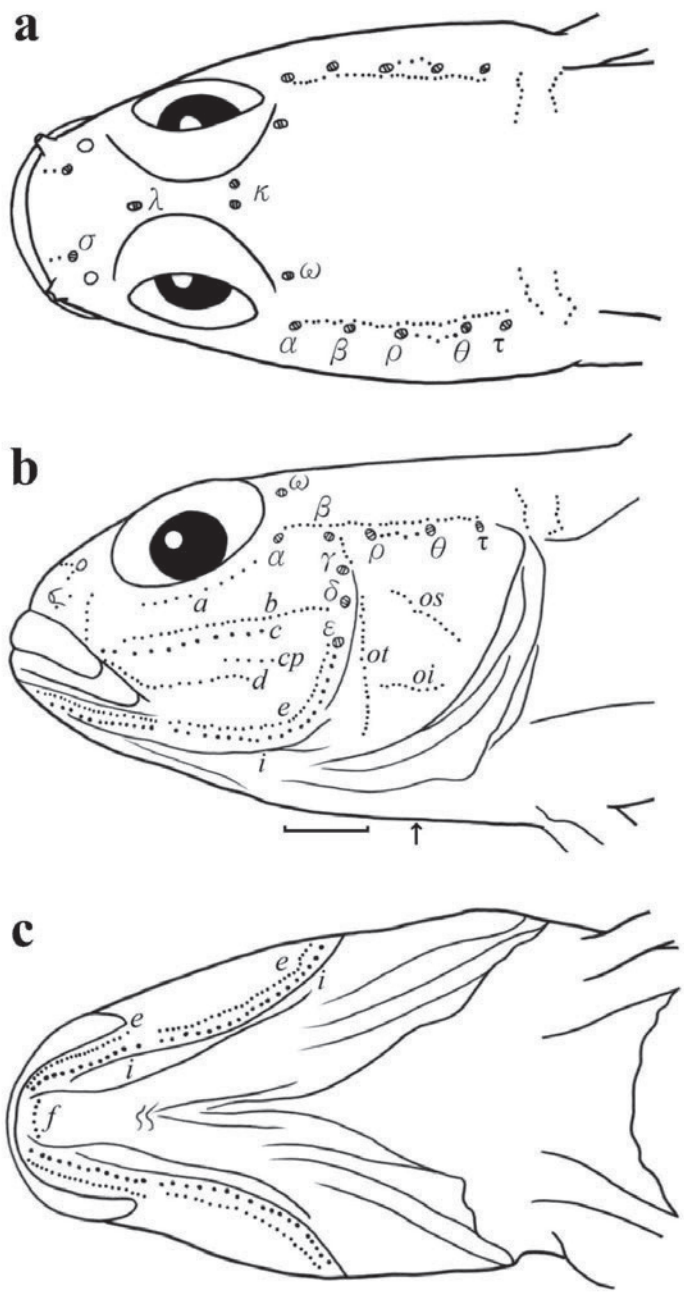

Fig. 2. The cephalic lateral line system of an *Acentrogobius audax* specimen from Taiwan. ASIZP0078394, 20.0 mm SL. **a**: dorsal view. **b**: lateral view. The arrow denotes the position of the gill opening. **c**: ventral view. Bar = 1 mm.

pectoral fin base with two vertically-aligned black bars, caudal fin base with a distinct black mark and fin membrane with four rows of vertically-aligned brown lines.

Description

The morphometric measurements are given in Table 1. Body elongated, sub-cylindrical anteriorly and compressed posteriorly. Head large (30.3% of SL). Lower lip slightly more prominent than upper lip when closed. Eyes large. Mouth medium-sized, maximum extent reaches the vertical position of anterior margin of orbit. Anterior nasal bone as short tube, and posterior nasal bone as rounded hole. Gill opening rather restricted, extending ventrally, reaching the middle vertical line of the operculum.

Fins

First dorsal fin rays VI, second dorsal fin rays I/10, anal fin rays I/9, pectoral fin rays 16. First dorsal fin spine rounded, the second and third spines longest, the spine of first dorsal fin reach anterior margin of second dorsal fin when compressed. Pectoral fin rather large, with tips reaching the vertical position of the anterior margin of the anal fin when compressed. Pelvic fin rounded and well developed. Caudal fin rounded.

Scales

Longitudinal scale series 28, transverse scale series 9, predorsal scales 8, and scale series from origin of first dorsal fin to upper pectoral origin 8. Body covered with large, ctenoid scales. Predorsal region covered with smaller, cycloid scales. Belly covered with small, cycloid scales. Pre-pelvic and pectoral base regions always naked. Cheek and operculum also naked.

Coloration

Only one male individual was described in this study (Fig. 1). Head and body with creamy, yellow background. Belly grayish white. Neck and upper region of trunk always with five black cross-bands. The central axis of body with about eight longitudinally-aligned, bright blue spots. Anterior orbital region with an oblique, black stripe, extending to lower lip when closed. Cheek with a horizontal black bar. Operculum with an oblique black stripe. Lower region of operculum with a large, bright blue mark. First dorsal fin membrane with a longitudinal black blotch. Basal region of second dorsal fin membrane with a longitudinal black blotch. Anal fin membrane grayish white, with a brown blotch. Pelvic fin membrane grayish white. Pectoral fin base with two vertically-aligned black bars. Caudal fin base with a distinct black mark. Caudal fin membrane with four rows of vertically aligned brown lines.

Cephalic lateral-line system

Head canals- Anterior oculoscapular canal present, interior termination with a pair of pores σ and single λ, median interorbital region with a pair of pores κ (Fig. 2a). Posterior region of orbit with a pair of pores ω. Lateral termination with a

pair of pores α. Posterior margin of pre-opercular region with pairs of the following pores: β, γ, δ, and ε. Upper margin of opercular region with pairs of the following pores: ρ, θ, and τ.

Sensory papillae- This species has a longitudinal type of papillae pattern. Rows of longitudinal papillae are located along and below the orbit. The papillae of row *b* are densely set and rather long, extending to the posterior margin of the pre-operculum. Those of row *c* are long, approximately equivalent to the diameter of the eye. Row *cp* consists of short papillae. Papillae of row *d* are densely-set papillae and rather long, extending to the vertical position of the posterior margin of the orbit (Fig. 2b). Opercular region with rows *ot*, *oi*, and *os*. Rows *ot* and *oi* slightly separated. Row *f* (ventral) with aligned papillae (Fig. 2c).

Distribution and habitat in Taiwan

So far, this newly recorded goby species has only been sited along the sandy bottom of an estuary of the Tsengwen River in southwestern Taiwan. The salinity and temperature at the sampling locality were 5.1 psu and 28.9ºC, respectively. According to our field observations, *A. audax* is solitary and prefers to hide under stones. We hypothesize that this species is probably widely distributed in western and northeastern Taiwan, yet has been overlooked due to its cryptic nature. We therefore recommend that researchers include this goby in their list of brackish water fish species when conducting surveys throughout estuarine ecosystems in Taiwan.

Acknowledgements

The authors are grateful to the assistants of the laboratories of Drs. Kwang-Tsao Shao and I-Shiung Chen for their valuable assistance in both the field and laboratory.

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