

Revision of the Cottid Genus *Astrocottus* Bolin (Perciformes: Cottoidei), with the Description of a New Species from Northern Japan

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Abstract Fishes of the cottid genus *Astrocottus* Bolin, 1936, endemic to marine waters of Japan, are reviewed. Among 3 nominal species, *A. leprops* Bolin, 1936 and *A. matsubarae* Katayama, 1942 are redescribed on the basis of their types and additional specimens. *Astrocottus oyamai* Watanabe, 1958 is treated as a *nomen dubium* because of contradictory statements in the original description, loss of the holotype, and no additional specimens. Additionally, a new species *A. regulus* is described on the basis of 31 specimens collected from waters surrounding northern Japan. *Astrocottus regulus* is distinguished from its congeners by the following combination of characters: no scales on pectoral-fin rays and ventral surfaces of head and trunk; head length less than 33% SL; head depth less than 17% SL; interorbital width less than 7.7% head length; basal length of anal fin more than 39% SL; anal-fin rays 13–14. A key to the species of *Astrocottus* is given.

Key words: Cottidae, genus *Astrocottus*, revision, *nomen dubium*, *Astrocottus regulus*, new species, Japan.

The cottid genus *Astrocottus* Bolin, 1936 contains 3 nominal species: *Astrocottus leprops* Bolin, 1936, *Astrocottus matsubarae* Katayama, 1942 and *Astrocottus oyamai* Watanabe, 1958, all endemic to waters around Japan and occurring on sandy and/or cobble bottom between approximately 10 and 420 m in depth (Yabe, 1984; Shinohara *et al.*, 1996). Members of the genus have a small body (maximum 55 mm SL), teeth present on jaws and vomer, ctenoid scales scattered on almost the entire head and body, and pelvic fins with 1 spine and 3 soft rays (Bolin, 1936). *Astrocottus* is closely related to *Radulinopsis*, distributing in shallow waters around northern Japan and Russian Far East, and they compose a monophyletic group based on some synapomorphies (e.g., no entopterygoid bone, the mandibular lamina on the symphysis of lower jaw, the

maxillary head with a anterior process) (Yabe and Maruyama, 2001).

In recent years, in addition to the above 3 species, numerous specimens of an undescribed species of this genus have been collected throughout cold waters around Japan. While studying the undescribed species, considerable taxonomic problems on fishes of this genus, mainly in *A. oyamai*, emerged. These problems were caused by the lack of a comprehensive review of the genus based on type specimens. Thus, the purposes of this study are to taxonomically review the genus *Astrocottus* based on extensive materials including type specimens, and to describe an additional species of this genus.

Materials and Methods

The methods used for taking counts and measurements follow Hubbs and Lagler (1958) and Yabe (1991). Total length (TL), standard length (SL), and head length (HL) are used throughout unless indicated otherwise. Data for paratypes or non-type specimens are indicated in parentheses in the description. All fin-ray elements were counted. Vertebrae and caudal-fin rays were observed and counted from radiographs. Sex was determined by observation of the urogenital papilla and gonads. The higher classification of the family Cottidae follows that presented by Imamura and Yabe (2002). Symbolic codes for institutions are those provided by Eschmeyer (1998).

Genus *Astrocottus* Bolin, 1936

Astrocottus Bolin, 1936: 330 (original description; type species *Astrocottus leprops* Bolin, 1936); Okada and Matsubara, 1938: 314 (key to genus), 321 (diagnosis); Taranetz, 1941: 432 (discussion about subfamily Ricuzeniinae); Matsubara, 1955: 1140 (key to species, diagnosis); Watanabe, 1958: 14 (listed, Japan), 218 (key to species, diagnosis); Watanabe, 1960: 23–24 (English translation of Watanabe, 1958: 218); Watanabe, 1976: 6 (English translation of Watanabe, 1958: 14); Watanabe, 1978: 221 (key to species, diagnosis, after Watanabe, 1960: 23–24); Watanabe, 1980: 426 (English translation of Watanabe 1958: 218); Washington *et al.*, 1984: 442 (meristic features); Yabe, 1985: 111 (discussion about family Cottidae); Eschmeyer and Bailey, 1990: 43 (validity); Eschmeyer, 1998: 1850 (validity); Yabe and Maruyama, 2001: 52 (key to genus).

Diagnosis. A cottid genus having the following characters: teeth present on jaws and vomer, absent on palatine; each mandibular pore on lower jaw subdivided to form a cluster of minute pores; a dermal lamina on lower lip; 4 preopercular spines, the uppermost longest; branchiostegal membranes united, free from isthmus; lateral line scales large, tubular, with serrated margins dorsally and posteriorly; no distinct scale rows above or below lateral line; numerous minute scales scattered on body; pelvic fin with 1 spine and 3 soft rays.

Description. Body slender or relatively short, cylindrical or slightly depressed anteriorly, compressed in caudal region. Nasal spine small, sharp, directed posterodorsally. Anterior nostril on outer base of nasal spine, forming a short tube. Posterior nostril on anterior margin of orbit, with a low rim. Mouth moderately large; lower jaw included in upper jaw. Maxilla extending to below pupil, length 2.4–3.0 in HL. Occipital region slightly concave, without knob or ridge. Uppermost preopercular spines pointed and straight or hooked; lowermost preopercular spine weak, directed anteroventrally, buried under the skin. Occipital region covered with small scales; small scales scattered on opercle, cheek, and suborbital regions. Filamentous cirri on some lateral line scales.

First dorsal fin originating at a vertical through posterior margin of opercular flap. Second dorsal fin separated from first dorsal fin by a short interspace, interdorsal length 15.2–39.5 in SL. Last rays of second dorsal and anal fins free from caudal peduncle. Pectoral fin extending posteriorly to vertical through second ray of second dorsal fin. Pelvic fin base narrow; middle ray barely longer than innermost ray. Caudal fin truncate; 11 rays supported by hypural plates, uppermost and lowermost 2 rays unbranched, middle 7 rays branched. Soft rays of all fins except for middle rays of caudal fin unbranched. Anus located approximately midway between origins of pelvic and anal fins.

Remarks. In the original description of the genus *Astrocottus*, Bolin (1936) regarded the condition of having 3 preopercular spines as one of the diagnostic characters of this genus, subsequently Okada and Matsubara (1938), Matsubara (1955), and Watanabe (1958) followed this description. However, we confirmed that all species of the genus *Astrocottus* have 4 preopercular spines (Fig. 1), although the lowermost is extremely weak and usually buried under the skin. Bolin (1936) also included the condition of lacking palatine teeth in the diagnosis of this genus, but Katayama (1942) and Watanabe (1958) described *A. matsubarae* with a few small teeth

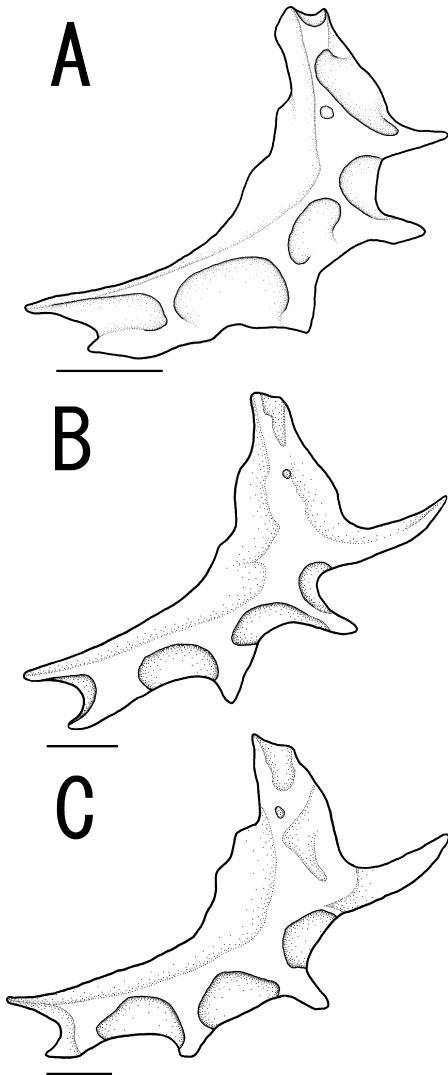


Fig. 1. Lateral view of preopercles of three species of *Astrocottus*. A: *A. leprops*, HUMZ 151707; B: *A. matsubarae*, HUMZ 191747; C: *A. regulus* sp. nov., HUMZ 189828. Bars 2 mm.

on the palatine. However, all specimens of *A. matsubarae*, including its holotype, that we examined lack teeth on the palatines, although tooth-like dermal processes are scattered on the ventro-medial surface of the maxilla. Therefore, absence of palatine teeth is considered to be diagnostic for *Astrocottus*. Bolin (1936) described *A. leprops* with the mandibular pore series consisting of clusters of minute pores, and this condition was adopted into the diagnosis of the genus *Astrocottus* by Yabe and Maruyama (2001).

In the original description of *A. oyamai*, Watanabe (1958) specified 1 spine and 4 soft rays in the pelvic fin and no teeth on the vomer, although he contradicted the latter condition in the generic diagnosis of *Astrocottus*. These characteristics of *A. oyamai* are relatively rare among cottid fishes, and do not conform to the diagnosis of the genus *Astrocottus* given in this study. The condition of the pelvic fin with I, 4 is found only in *Hemilepidotus*, *Leptocottus*, and some *Cottus*; and the absence of vomerine teeth, occurs in *Gymnocanthus* and 1 species of *Radulinopsis* (Yabe, 1985; Yabe and Maruyama, 2001). Therefore, if the descriptions given by Watanabe are accurate, *A. oyamai* should be excluded from the genus *Astrocottus*. Other problems concerning the original description of *A. oyamai* are discussed in the comments on *Astrocottus oyamai*.

Key to Species of the Genus *Astrocottus*

- 1a. Chin strongly covered with numerous small scales (Fig. 3B); small scales present on pectoral-fin rays except the lowermost (Fig. 2); head length more than 36% SL; head depth more than 20% SL; interorbital width more than 7.8% HL *Astrocottus matsubarae* Katayama, 1942
- 1b. No scales on chin and pectoral-fin rays; head length less than 33% SL; head depth less than 18% SL; interorbital width less than 7.7% HL 2
- 2a. Small scales scattered on ventral surface of trunk (Fig. 3A); basal length of anal fin more than 38% SL; anal-fin rays 17–18 *Astrocottus leprops* Bolin, 1936

- 2b. No scales on ventral surface of trunk; basal length of anal fin less than 34% SL; anal-fin rays 13–14. *Astrocottus regulus* sp. nov

Astrocottus leprops Bolin, 1936

(Japanese name: Hohouroko-kajika)

(Figs. 2, 3A, Tables 1, 2)

Astrocottus leprops Bolin, 1936: 331, fig. 27, pl. 34 (B) [original description, holotype, female (48.0 mm SL), Albatross station 4808, Tsugaru Strait, Japan, 41°35.83'N, 140°36.75'E, 86.0 m depth, 1906]; Okada and Matsubara, 1938: 321, pl. 79 (4) (in part?, diagnosis, distribution); Taranetz, 1941: 432 (discussion about subfamily Ricuzeniinae); Katayama, 1942: 336 (key); Matsubara, 1955: 1140 (key, diagnosis, after original description); Ueno, 1971: 91 (listed, Hokkaido and its adjacent waters); Yabe, 1984: 325, pl. 362 (B) (diagnosis); Shinohara *et al.*, 1996: 176 (listed, Pacific coast of northern Honshu, Japan); Eschmeyer, 1998: 892 (validity); Nakabo, 2000: 632 (key); Yabe and Maruyama, 2001: 61 (material for phylogenetic analysis of genus *Radulinopsis* and its related genera); Nakabo, 2002: 632 (key).

Diagnosis. A species of the genus *Astrocottus* having the following combination of characters: head small, length 29–32% SL, depth 13–18% SL; interorbital space barely concave, slightly narrow, width 4.8–7.7% HL; basal length of anal fin 38–42% SL; no scales on chin and pectoral-fin rays, small scales scattered on ventral surface of trunk (Fig. 3A); a short nuchal cirrus present; no cirrus below lateral line; first dorsal-fin spines IX–X (mode IX); second dorsal-fin rays 14–16 (mode 15); anal fin rays 17–18 (mode

17); lateral-line scales 33–35 (mode 34); vertebrae 12+21–23 (mode 12+22)=33–35 (mode 34).

Description. Proportional measurements and counts are given in Tables 1 and 2. Body slender, moderately elongated, cylindrical anteriorly, slightly compressed in caudal region, body depth at origin of first dorsal fin 1.4 (1.0–1.4) in width. Caudal peduncle long, compressed, depth 2.6 (2.4–4.0) in length. Head small, slightly depressed, length 3.4 (3.1–3.4) in SL, depth at base of uppermost preopercular spine 1.2 (1.2–1.4) in width. Snout short, steep, length 3.9 (3.6–4.5) in HL. Eye large, orbital diameter 3.1 (2.7–3.3) in HL. Interorbital space barely concave, slightly narrow, width 5.1 (4.8–6.6) in orbital diameter. Second preopercular spine slightly blunt, directed posteriorly. Third preopercular spine blunt, directed posteroventrally. Lateral line descending in slight arch from vertical through origin of first dorsal fin to vertical through base of fifth spine, then running horizontally along body axis. Small scales with serrated margin covering body above and below lateral line except for bases of dorsal and anal fins. No scales on snout, jaws, chin, and branchiostegal membranes. An unbranched, slender supraocular cirrus present, length equal to half of eye diameter. An unbranched, short nuchal cirrus present. No cirrus below lateral

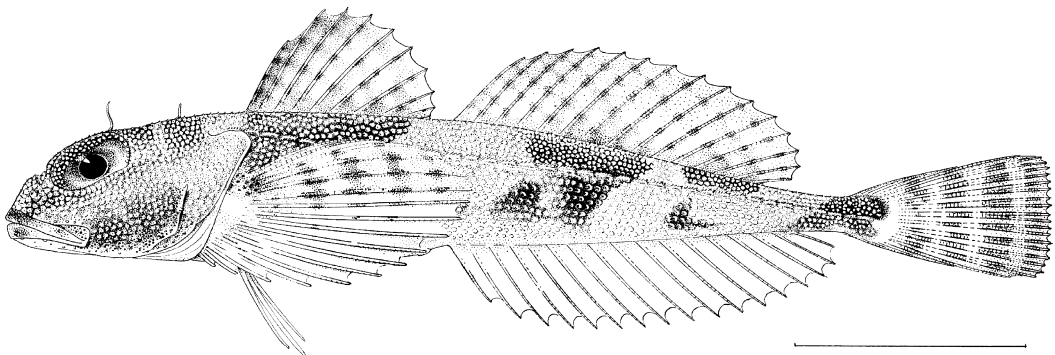


Fig. 2. *Astrocottus leprops* Bolin, 1936, female, 48.0 mm SL. Drawing from Bolin (1936).

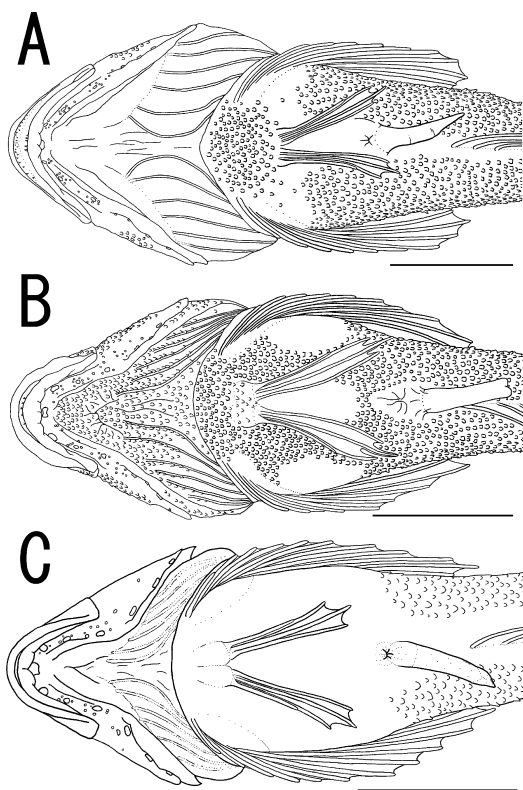


Fig. 3. Ventral views of three species of *Astrocottus*, showing the squamation. A: *Astrocottus leprops*, HUMZ 151966, male, 37.4 mm SL; B: *Astrocottus matsubarae*, HUMZ 191750, male, 25.6 mm SL; C: *Astrocottus regulus* sp. nov., holotype, HUMZ 190094. Bar 5 mm.

line.

Basal length of first dorsal fin 1.7 (1.6–2.3) in that of second dorsal fin. Second dorsal fin originating above 12th (12–13th) lateral-line scale. Anal fin originating at a vertical through origin of second dorsal fin, basal length 0.9 (0.8–0.9) in that of second dorsal fin. Pectoral fin large, length 3.6 (3.4–4.7) in SL, bluntly pointed; base of uppermost ray beneath second lateral-line scale; eighth (seventh or eighth) ray longest; lower 8 (7 or 8) rays slightly thickened. Pelvic fin originating below origin of first dorsal fin. Caudal fin with 6 (5–6) upper and 4 (3–4) lower procurent rays. Urogenital papilla of male large, cylindrical, with hooked appendage at tip (absent in females).

Color in alcohol. Body pale brown, with 4 dark saddles dorsolaterally: under first dorsal fin, under middle and posterior part of second dorsal fin, and on caudal peduncle. Head slightly darker than body; occipital region and lower part of preopercle especially dark. Nostril tube pale. First dorsal fin transparent with some dark irregular blotches. Second dorsal fin transparent, bearing some faint dark bars. Pectoral fin translucent with a dark blotch on upper half. Pelvic fin pale with slightly darker base. Anal fin transparent with a few dark blotches. Caudal fin transparent with some dark horizontal stripes. Urogenital papilla pale.

Distribution. Tsugaru Strait, off Hakodate, Japan (type locality), and off Yamagata Prefecture, Sea of Japan, and off Aomori Prefecture, northwest Pacific (Fig. 4). Sandy and/or cobble bottom in depth of 74–180 m.

Remarks. Although Okada and Matsubara (1938) noted that many specimens of this species were collected from the Seto Inland Sea, the type locality of *A. matsubarae*, there are no other collection records from there. Therefore, it is reasonable to assume that the individuals from the Seto Inland Sea were *A. matsubarae*.

Materials. USNM 94730 (holotype), 102116 (from Tsugaru Straits); SU 135379, 135380 at CAS (from Tsugaru Straits); HUMZ 151707, 151709, 151710, 151965, 151966, 154036 (from off Yamagata Prefecture, Sea of Japan); HUMZ 192570, 195745 (from off Aomori Prefecture, northwest Pacific); NSMT-P 49026 (from off Shimokita Peninsula, northwest Pacific).

Astrocottus matsubarae Katayama, 1942

(Japanese name: Seto-kajika)

(Figs. 3B, 5, Tables 1, 2)

Astrocottus leprops (not Bolin, 1936): Okada and Matsubara, 1938: 321 (in part?, distribution).

Astrocottus matsubarae Katayama, 1942: 334, fig. 1 [original description, holotype, female (61.5 mm TL) and cotype, sex unknown (58.5 mm TL), off Kakogawa, Hyogo Prefecture, Japan, March 1937], 336 (key); Matsubara, 1955: 1140 (key, after original description); Watanabe, 1958: 14 (listed, Japan), 218–221, figs. 71, 72, pl. 4 (lower), 55 (diagnosis, description of inner feature);

Table 1. Comparison of proportional measurements among *Astrocotilus leprows*, *A. matsubarae*, and *A. regulus* sp. nov.

	<i>Astrocotilus leprows</i>			<i>Astrocotilus matsubarae</i>			<i>Astrocotilus regulus</i> sp. nov.		
	Holotype USNM 94730 48.0	Non-types <i>n</i> =22 29.6–54.9	Holotype NSMT-P 18253 48.5	Holotype HUMZ 190094 27.0	Non-types <i>n</i> =11 25.3–38.0	Paratypes <i>n</i> =30 22.5–42.1			
Standard length (mm)									
Measurements (% SL)									
Body depth at first dorsal-fin origin	13.5	12.8–16.9	23.1	20.2–22.7	15.6	12.4–17.1			
Body depth at anal-fin origin	12.5	9.9–13.9	15.5	12.7–15.8	10.7	10.0–13.5			
Body width at first dorsal-fin origin	18.5	13.9–21.0	23.9	16.2–25.6	20.0	14.7–23.1			
Body width at anal-fin origin	12.3	10.1–13.9	11.3	9.1–14.5	12.2	8.4–13.7			
Head length	29.4	29.1–32.2	36.3	35.8–38.4	31.5	30.9–33.2			
Head depth	14.6	13.2–18.1	23.5	20.4–26.2	13.7	13.1–17.4			
Head width	18.1	18.6–22.7	27.4	22.5–29.2	25.9	19.2–28.9			
Predorsal length	28.8	28.9–32.4	34.6	34.2–39.7	33.3	30.7–34.6			
Preanal length	48.1	47.9–51.9	63.7	59.8–65.5	53.3	51.6–56.7			
Prepelvic length	26.3	23.0–32.4	27.8	26.5–31.9	27.4	25.3–29.7			
Length of first dorsal-fin base	20.4	15.2–21.3	23.7	19.7–22.6	17.0	17.6–23.8			
Length of second dorsal-fin base	33.8	31.7–37.1	25.2	25.5–30.4	31.9	28.7–32.8			
Length of anal-fin base	37.5	37.9–42.2	24.7	24.5–28.7	31.5	30.0–34.1			
Length of pectoral-fin base	11.3	10.3–12.8	15.9	12.2–15.6	11.1	9.3–14.6			
Length of caudal peduncle	9.8	8.3–13.4	12.0	12.6–17.0	15.6	14.1–19.6			
Depth of caudal peduncle	3.8	3.0–3.9	5.2	3.2–6.3	4.1	3.6–4.8			
Snout length	7.5	6.8–8.5	9.1	9.2–11.3	7.8	7.3–8.9			
Length of orbit	9.6	9.1–11.4	9.3	8.8–12.2	11.9	9.0–11.6			
Interorbital width	1.9	1.4–2.4	3.5	2.9–3.6	2.2	1.8–2.3			
Length of upper jaw	10.8	10.2–12.3	14.2	12.6–14.7	10.7	8.5–12.5			
Length of mandible	10.6	9.2–11.5	13.2	12.1–14.1	10.0	8.2–11.8			
Postorbital length of head	13.1	12.2–14.2	17.9	16.2–18.9	13.7	13.8–16.5			
Length of longest pectoral-fin ray	broken	23.3–29.7	31.3	30.4–36.8	29.3	24.0–36.6			
Pelvic-fin length	12.7	10.6–14.1	16.1	17.5–19.8	15.2	13.5–20.3			
Caudal-fin length	17.9	15.0–19.7	24.3	21.1–27.7	23.7	19.9–27.1			

Watanabe, 1960: 24 (key), 24–27, pl. 19, fig. 1 [English translation of Watanabe, 1958: 218–221, figs. 71, 72, pl. 4 (lower)]; Watanabe, 1976: 6 (English translation of Watanabe, 1958: 14); Watanabe, 1978: 221–224, figs. 71, 72, pl. 18 (lowermost), after Watanabe, 1960); Watanabe, 1980: 426, pl. 47 (English translation of Watanabe, 1958: 218–221, pl. 55); Watanabe, 1981: 105 (supplements to Watanabe, 1960); Yabe, 1984: 325, pl. 362 (B, C) (diagnosis); Yabe, 1985: 3 (material for phylogenetic analysis of superfamily Cottoidea); Eschmeyer, 1998: 1034 (validity); Nakabo, 2000: 632 (key); Yabe and Maruyama, 2001: 61 (material for phylogenetic analysis of genus *Radulinopsis* and its related genera); Nakabo, 2002: 632 (key).

Diagnosis. A species of the genus *Astrocottus* having the following combination of characters: head slightly large, length 36–38% SL, depth 20–26% SL; interorbital space flat, relatively wide, width 7.8–9.7% HL; basal length of anal fin 25–29% SL; small scales present on pectoral-fin rays except the lowermost; ventral surface of head and trunk widely covered with numerous small scales (Fig. 3B); nuchal cirrus absent; long filamentous cirri scattered below lateral line; first dorsal-fin spines IX; second dorsal-fin rays 12; anal-fin rays 11–12 (mode 12); lateral-line scales 29–31 (mode 31); vertebrae 12+17–19 (mode 12+18)=29–31 (mode 30).

Description. Proportional measurements and counts are given in Tables 1 and 2.

Body relatively short, slightly depressed anteriorly, compressed in caudal region, body depth at origin of first dorsal fin 1.0 (0.8–1.2) in width. Caudal peduncle barely thickly, cylindrical, depth 2.3 (2.4–3.3) in length. Head slightly large, depressed, length 2.8 (2.6–2.8) in SL, depth at base of uppermost preopercular spine 1.2 (1.2–1.5) in width. Upper profile of snout steep, length 4.0 (3.3–3.9) in HL. Eye large, orbital diameter 3.9 (3.1–3.7) in HL. Interorbital space flat, relatively wide, width 1.0 (1.1–1.3) in HL. Second preopercular spine barely slender, directed posteroventrally. Third preopercular spine small, slightly blunt, directed ventrally. Lateral line descending in slight arch below base of first dorsal fin, then running horizontally along body axis. Small scales with serrated margin densely covering body above and below lateral line except for

bases of dorsal and anal fins, ventral surfaces of head, trunk, and caudal peduncle, and branchiostegal membranes. No scales on snout and jaws. A small, unbranched supraocular cirrus present. Nuchal cirrus absent. Long filamentous cirri scattered below lateral line.

Basal length of first dorsal fin 1.1 (1.2–1.5) in that of second dorsal fin. Second dorsal fin originating just above 10th (10th or 11th) lateral-line scale. Anal fin originating a little behind a vertical through origin of second dorsal fin, basal length 1.0 (1.0–1.2) in that of second dorsal fin. Pectoral fin large, length 3.3 (3.0–3.7) in SL, rounded; base of uppermost ray beneath first scale of lateral line; fifth (fifth or sixth) ray longest; lower 7 (6 or 7) rays slightly thickened. Pelvic fin originating a little anterior to vertical through origin of first dorsal fin. Caudal fin with 5 (4–5) upper and 3 (3–4) lower procurent rays. Urogenital papilla of male elongated, conical, shallowly bisected with hooked appendage at the tip (absent in female).

Color in alcohol. Body pale brown, with 2 dark saddles dorsolaterally; anterior inverted trough, and below middle part of second dorsal fin; posterior triangular shape, and on caudal peduncle. Head dark; peripheral part of orbital, cheek, and occipital region especially dark. Nostril tube pale. First dorsal fin transparent with some dark irregular blotches. Second dorsal fin transparent, bearing faint dark bars. Pectoral fin translucent with a dark blotch on base, some dark blotches on each ray. Pelvic fin pale. Anal fin transparent. Caudal fin transparent with some dark horizontal stripes. Urogenital papilla pale.

Distribution. Off Kakogawa, Hyogo Prefecture, Seto Inland Sea, Japan (type locality), and off Minamisanriku and Onagawa, Miyagi Prefecture, northwest Pacific (Fig. 4). Sandy and/or cobble bottom in depth of 10–15 m.

Remarks. The upper drawing of plate 4 in Watanabe (1958), the original drawing of *A. oyamai*, was probably misplaced for the lower one, a drawing of *A. matsubarae*. We conclude this, because a urogenital papilla and a supraocular cirrus are drawn on the lower; the holotype of *A.*

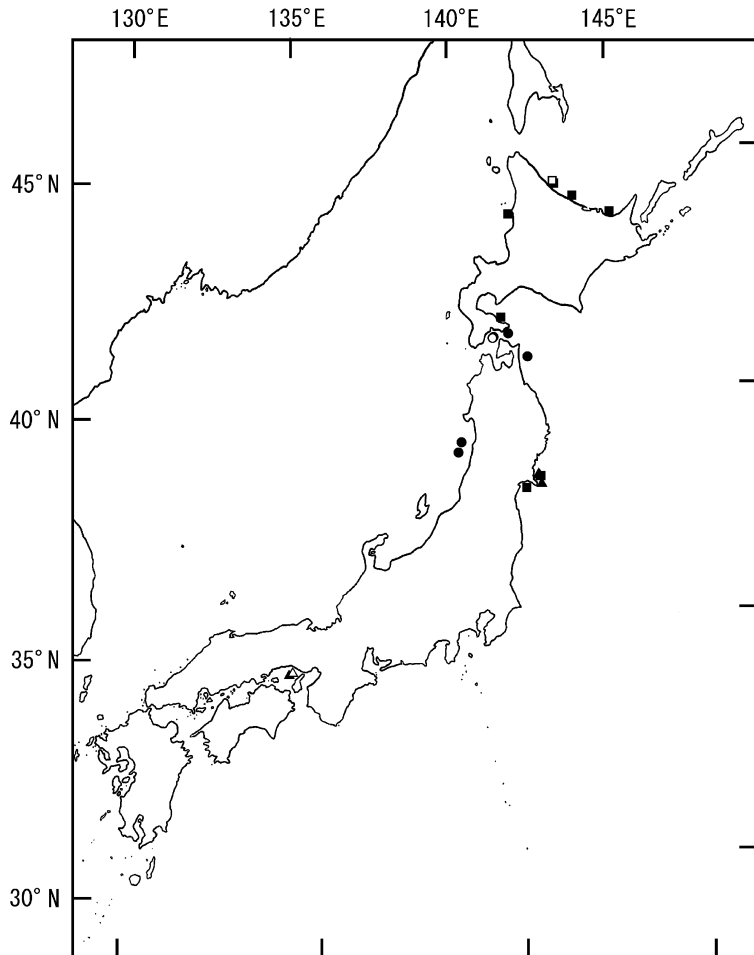


Fig. 4. The locality of the materials used in this study. *Astrocottus leprops*: holotype (open circle); non types (solid circle). *Astrocottus matsubarae*: holotype (open triangle); non types (solid triangle). *Astrocottus regulus*: holotype (open square); paratypes (solid square).

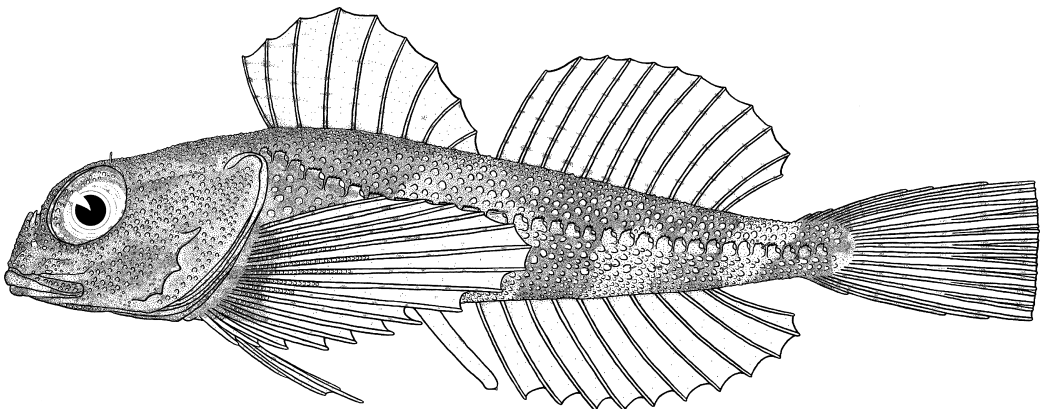


Fig. 5. *Astrocottus matsubarae* Katayama, 1942, HUMZ 191750, male, 25.6 mm SL.

Table 2. Frequency distributions of 7 meristic counts in *Astrocottus leprops*, *A. matsubarae*, *A. regulus* sp. nov., and *A. oyamai*.

	First dorsa- fin spine			Second dorsal-fin rays					
	9	10	11	12	13	14	15	16	
<i>A. leprops</i> (n=23)	16	7 ^a				7	14 ^a	2	
<i>A. matsubarae</i> (n=12)	12 ^a			12 ^a					
<i>A. regulus</i> (n=31)	1	29 ^a	1		11	17 ^a	3		
<i>A. oyamai</i> ^b (n=1)	×					×			
	Anal-fin rays								
	11	12	13	14	15	16	17	18	
<i>A. leprops</i> (n=23)							17 ^a	6	
<i>A. matsubarae</i> (n=12)	2	10 ^a							
<i>A. regulus</i> (n=31)			11	20 ^a					
<i>A. oyamai</i> ^b (n=1)									
	Pectoral-fin rays						Pelvic-fin rays		
	15	16	17	18	19	20	I, 3		
<i>A. leprops</i> (n=23)				3	16	4 ^a	23 ^a		
<i>A. matsubarae</i> (n=12)	2	5	5 ^a				12 ^a		
<i>A. regulus</i> (n=31)			9	18 ^a	4		31 ^a		
<i>A. oyamai</i> ^b (n=1)	×								
	Lateral-line scales								
	27	28	29	30	31	32	33	34	35
<i>A. leprops</i> (n=23)							2	19 ^a	2
<i>A. matsubarae</i> (n=12)			1	3 ^a	8				
<i>A. regulus</i> (n=31)					3	19 ^a	9		
<i>A. oyamai</i> ^b (n=1)	×								
	Vertebrae								
AV+CV	12+17	12+18	12+19	12+20	12+21	12+22	12+23		
<i>A. leprops</i> (n=15)					3 ^a	10	2		
<i>A. matsubarae</i> (n=12)	1	7	4 ^a						
<i>A. regulus</i> (n=31)				12 ^a	14				

AV, abdominal vertebrae; CV, caudal vertebrae.

^aIncluding holotype.

^bFrom Watanabe (1958: p. 223, table 53).

oyamai is female, and a supraocular cirrus exists not in *A. oyamai* but in *A. matsubarae*. We therefore believe that the upper drawing of plate 4 in Watanabe (1958) is *A. oyamai* and the lower one is *A. matsubarae*. This conclusion also applies to Watanabe (1960; 1978) and Yabe (1984), which quoted Watanabe (1958). Nakabo (2000: 632;

2002: 632) also made the same judgment, but without explanation.

Materials. NSMT-P 18253 (holotype); HUMZ 64145, 64146, 64148–64151 (from Seto Inland Sea); HUMZ 191747–191750, 191762 (off Miyagi Prefecture).

Astrocottus regulus sp. nov.

(New Japanese name: Shishi-kajika)

(Figs. 3C, 6, Tables 1, 2)

Holotype. HUMZ 190094, male, 27.0 mm SL, 44°33.89'N, 143°07.10'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 46.0 m depth, 18 Aug. 2004, dredge net, coll. by O. Tsuruoka.

Paratypes. 30 specimens. CAS 225634 (formerly HUMZ 190085, 190087), 1 male and 1 female, 25.0–29.7 mm SL, 44°34.66'N, 143°04.15'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 42.1 m depth, 17 Aug. 2004, dredge net, coll. by O. Tsuruoka. HUMZ 91981, female, 28.7 mm SL, 44°39.95'N, 142°50.70'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 30 m depth, 11 July 1981, dredge net, coll. by T. Miki; HUMZ 91989, female, 31.6 mm SL, 44°40.10'N, 142°50.70'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 40 m depth, 11 July 1981, dredge net, coll. by T. Miki; HUMZ 98614, 98615, 2 females, 36.6, 38.5 mm SL, 44°17'N, 143°40'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 35 m depth, 28 Aug. 1979, dredge net, coll. by S. Maruyama; HUMZ 189828–189830, 3 females, 37.7–42.1 mm SL, 38°0.00'N, 141°11.83'E, off Miyagi Pref., Japan, 42 m depth, 2 June 2004, otter trawl, coll. by O. Tsuruoka; HUMZ 190081–190084, 1 male and 3 females, 28.9–33.8 mm SL, 44°34.66'N, 143°04.15'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 42.1 m depth, 17 Aug. 2004, dredge net, coll. by O. Tsuruoka; HUMZ 191778, male, 22.5 mm SL, 38°26'N, 141°28'E, off Onagawa, Miyagi Prefecture, Japan, 10 m depth, 24 Feb. 2005, hand net, coll. by O. Tsuruoka; HUMZ 192515, female, 38.2 mm SL, 37°53.67'N, 141°15.42'E, off Fukushima Prefecture, Japan, 52.3 m depth, 29 June 2004, otter trawl, coll. by R. Inagawa; HUMZ 195516, male, 28.9 mm SL, 44°32'N, 143°06'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 35 m depth, 28 July 1988, dredge net, coll. by S. Maruyama; HUMZ 195746, female, 28.6 mm SL, 44°10.13'N, 141°35.13'E, off Obira, coast of Sea of Japan, Hokkaido, Japan, 43 m depth, 19 Aug. 1995, dredge net; HUMZ 195747, male, 25.7 mm SL, 44°11.90'N, 141°36.12'E, off

Obira, coast of Sea of Japan, Hokkaido, Japan, 42 m depth, 20 Aug. 1995, dredge net; HUMZ 195748, male, 27.3 mm SL, 41°56'N, 140°57'E, off Usujiri, Hakodate, Hokkaido, Japan, 11 May 1993, dredge net; HUMZ 195749–195753, 1 male and 4 females, 26.1–32.0 mm SL, 43°55'N, 144°29'E, off Koshimizu, Okhotsk coast, Hokkaido, Japan, 35 m depth, 26 June 1979, coll. by S. Maruyama. NSMT-P 76686–76689 (formerly HUMZ 195759–195762), 2 males and 2 females, 24.9–32.8 mm SL, 44°34'N, 143°00'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 35 m depth, 27 July 1978, coll. by S. Maruyama. USNM 384159 (formerly HUMZ 190086, 190088), 1 male and 1 female, 26.1–30.6 mm SL, 44°34.66'N, 143°04.15'E, off Oumu, Okhotsk coast, Hokkaido, Japan, 42.1 m depth, 17 Aug. 2004, dredge net, coll. by O. Tsuruoka.

Diagnosis. A species of the genus *Astrocottus* having the following combination of characters: head small, length 31–33% SL, depth 13–17% SL; interorbital space flat, narrow, width 5.6–7.2% HL; basal length of anal fin 30–34% SL; no scales on pectoral-fin rays and ventral surface of head and trunk (Fig. 3C); nuchal cirrus absent; filamentous cirri on some scales below lateral line; first dorsal-fin spines IX–XI (mode X); second dorsal-fin rays 13–15 (mode 14); anal-fin rays 13–14 (mode 14); lateral-line scales 31–33 (mode 32); vertebrae 12+20–22 (mode 12+21)=32–34 (mode 33).

Description. Proportional measurements and counts are given in Tables 1 and 2.

Body slender, slightly depressed anteriorly, compressed in caudal region, body depth at origin of first dorsal fin 1.3 (1.0–1.6) in width. Caudal peduncle long, compressed, depth 3.8 (3.1–4.3) in length. Head small, depressed, length 3.2 (3.0–3.2) in SL, depth at base of up-

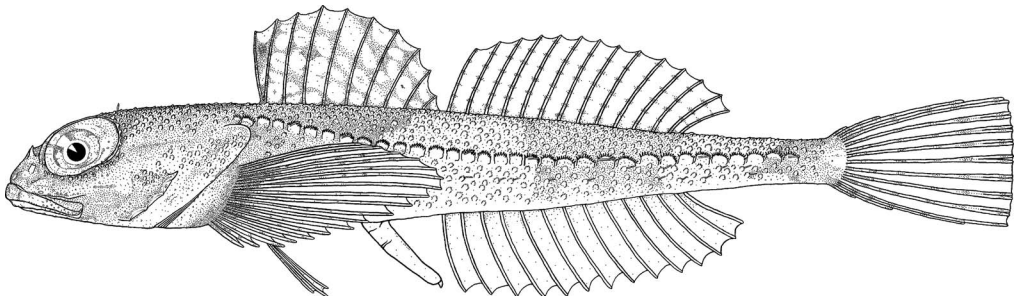


Fig. 6. *Astrocottus regulus* sp. nov., holotype, HUMZ 190094, male, 27.0 mm SL.

permost preopercular spine 1.9 (1.4–2.0) in width. Snout short, steep, length 4.0 (3.6–4.3) in HL. Eye large, orbital diameter 2.7 (2.8–3.6) in HL. Interorbital space flat, narrow, width 5.3 (4.1–6.0) in orbital diameter. Four preopercular spines: uppermost spine slightly stout, unbranched, hooked posterodorsally; second spine slightly blunt, directed posteroventrally; third spine small, directed ventrally; lowermost spine weak, directed anteroventrally, buried under the skin. Lateral line extending in a gradually arched curve to tip of pectoral fin, then running horizontally along body axis. Lateral-line scales with 9–13 rough spines on dorsal margin and a few on posteroventral margin. Small scales with serrated margin densely covering body above lateral line except for dorsal-fin base. Tiny scales with 7–11 spines covering body below lateral line except for anal-fin base. Ventral surface of head and body absolutely naked (Fig. 3C). No scales on snout, jaws, and branchiostegal membranes. A small, unbranched supraocular cirrus present. Filamentous cirri on some scales below lateral line.

Basal length of first dorsal fin 1.9 (1.3–2.0) in that of second dorsal fin. Second dorsal fin originating above 12th lateral-line scale. Anal fin originating at a vertical through origin of second dorsal fin, basal length of fin 1.0 (0.9–1.1) in that of second dorsal fin. Pectoral fin large, length 3.8 (3.1–4.7) in SL, bluntly pointed; base of uppermost ray beneath first scale of lateral line; sixth (sixth or seventh) ray longest, extending posteriorly to vertical below origin of second dorsal fin; lower 7 (6 or 7) rays slightly thickened. Pelvic-fin base narrow, originating on a vertical below origin of first dorsal fin; middle ray barely longer than innermost ray. Caudal fin slightly rounded; 11 rays supported by hypural plates, uppermost and lowermost 2 rays unbranched, middle 7 rays branched; 5 (5–7) upper and 4 (3–5) lower procurrent rays. Urogenital papilla of male large, cylindrical, with hooked appendage at tip (absent in females).

Color when fresh. Ground color of body grayish brown; pectoral axilla and ventral surface

of body whitish. Three dark brown saddles across back: under first dorsal fin, under posterior part of second dorsal fin, and on caudal peduncle. Head cream-white; occipital, suborbital, and preopercle region brown. Nostril tube white. Ground color of first dorsal fin transparent, bearing some irregular black bands; a black blotch on anterior margin. Second dorsal fin transparent, bearing faint black bars. A black blotch on base of pectoral fin. Pelvic fin white with black spots on base. Anal fin transparent with a few black blotches on base. Caudal fin transparent with some black blotches on each ray. Urogenital papilla white.

Color in alcohol. Body pale brown, with 3 dark saddles dorsolaterally. Head darker than body; occipital, suborbital, and preopercle region especially dark. Nostril tube pale. First dorsal fin transparent with some irregular dark bands; a dark blotch on anterior margin. Second dorsal fin transparent, bearing faint dark bars. Pectoral fin translucent with dark blotch on base, some dark blotches on each ray. Pelvic fin pale with slightly darker base. Anal fin transparent with a few dark blotches. Caudal fin transparent with some dark blotches on each ray. Urogenital papilla pale.

Distribution. Okhotsk coast of Hokkaido, off Usujiri, southern Hokkaido, Pacific coast, and off Obira, Hokkaido, Sea of Japan, and off Miyagi and Fukushima Prefecture, Pacific coast, Japan (Fig. 4). Sandy and/or cobble bottom in depth of 10–55 m.

Etymology. The specific name *regulus* is derived from the Latin *regula* meaning “regular,” in reference to being a common species collected frequently in northern Japan. Moreover, *regulus* is also the name of the alpha star of the constellation Leo. This is connected with the genus name *Astrocottus*, meaning “constellation sculpin,” and the collection day of the holotype, 18 Aug. 2004, which is in the sign of Leo.

Comparison. See “Key to Species of the Genus *Astrocottus*.”

**Comments on *Astrocottus oyamai*
Watanabe, 1958**

Astrocottus oyamai was described on the basis of a single specimen, which is apparently lost (K. Matsuura, per. comm.), and additional specimens are not known. Under such a situation, *A. oyamai* has been regarded as a valid species (Watanabe, 1960, 1976, 1978, 1981; Yabe, 1984; Eschmeyer, 1998; Nakabo, 2000, 2002). Although the original description by Watanabe (1958) contains numerous contradictions, we have no other alternative but to discuss *A. oyamai* on the basis of this description. As mentioned in the remarks for *A. matsubarae*, we conclude that Watanabe (1958, 1960, 1978) mistook the figure of *A. oyamai* for that of *A. matsubarae*. In regard to fin ray counts of *A. oyamai*, the value in the original description does not agree with the count on the original figure (Watanabe, 1958; table 53 vs. pl. 4, upper); the table gives a dorsal-fin-ray count of IX-14 and pectoral-fin-ray count of 15, compared to IX-12 and 16, respectively, shown in the plate. Moreover, Watanabe (1958) gave a count of 8 for dorsal-fin spines of *A. oyamai* in his key to the species of *Astrocottus*. He also specified that *A. oyamai* differs from *A. matsubarae* by having no teeth on the palatines (vs. villiform palatine teeth present in *A. matsubarae*), a comparatively high body (vs. low), and a knob-like projection on the upper margin of the orbit (vs. no projection). Among them, the former 2 characters are not available. The present study clarified that all species of the genus including *A. matsubarae* do not have palatine teeth. The body depth (4.1 in SL) of *A. oyamai* is within the range for *A. matsubarae* [3.2–6.0 (mean 4.7) in SL (Watanabe, 1958; table 52); 4.3 (this study; holotype); 4.4–4.8 (mean 4.6) in SL (this study; non-type specimens)]. Looking at the drawing of *A. oyamai* in Watanabe (1958; pl. 4 upper), the third character, a knob-like projection on the upper margin of the orbit, might be available, and is probably a single distinction between both species. Further problems with the original description of *A. oyamai* have already been dis-

cussed herein in the remarks for the genus *Astrocottus*. Because of the many contradictions in the original description of *A. oyamai* and the loss of the type specimen, it is impossible to distinguish *A. oyamai*, and we treat it as a *nomen dubium* in this study.

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