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Okhotsk sculpin *Icelus ochotensis* (Cottiformes: Cottidae) is a complex; redescription of the type series

N.V. Chernova* and A.A. Zorina

Zoological Institute of the Russian Academy of Sciences, Universitetskaya Emb. 1, 199034 Saint Petersburg, Russia; e-mails: chernova@zin.ru; Anna.Zorina@zin.ru

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ABSTRACT

The genus Icelus Krøyer, 1845 includes 18 valid species from shelf and upper slope of the northern Pacific, Arctic and North Atlantic. The taxonomy of the genus is under development. To solve taxonomic problems, there is a need to clarify the diagnostic characters of already known species. As it turned out, information about the composition of the type series of the Okhotsk sculpin I. ochotensis Schmidt, 1927 from different sources is contradictory, and the diagnostic characters in the latest revision of the genus and in the keys for species identification diverge from the original description. The work clarifies the composition of the type series of the Okhotsk sculpin from the ZIN collection (36 specimens), provides a redescription and diagnosis; the Lectotype No. 21898 is designated. Icelus ochotensis, characterized by the presence of only two rows of large scales on the body (dorsal row Dl and lateral line Ll), was included in the group "I. bicornis", along with I. spatula Gilbert et Burke, 1912, I. uncinalis Gilbert et Burke, 1912 and I. stenosomus Andriashev, 1937. Contrary to results of the latest revision of the genus and modern identifying keys, on the top of its head there is not one pair of spines, but two pairs (parietal and nuchal ones), in the form of blunt tubercles hidden in the skin. The dorsal row of scales (Dl) in front is complete (reaches the head); lateral line begins under scales 3rd-4th of the dorsal row and does not extend posteriorly onto caudal fin; scales Ll below the canal pore are immersed in the skin and usually not serrated (one or two tiny spinules may present); supraorbital cirrus (skin appendage) is simple. The urogenital papilla of males is cylindrical, in contrast to the spatulate one in *I. spatula*. Vertebrae 37–40, *D* VII–IX 15–19, *A* 13–16, *P* 17–18, *Ll* 38–40, *Dl* 29–34; axillary scales 6–13. The distribution of the Okhotsk sculpin requires revision, since modern keys for *Icelus* identification contain incorrect characters for this species (one pair of spines on the top of the head).

Key words: Cottidae, Icelus ochotensis, lectotype, Okhotsk sculpin, Sea of Okhotsk, type series, redescription

Охотский ицел *Icelus ochotensis* (Cottiformes: Cottidae) – комплексный вид; переописание типовой серии

Н.В. Чернова* и А.А. Зорина

Зоологический институт Российской академии наук, Университетская наб. 1, 199034 Санкт-Петербург, Россия; e-mails: chernova@zin.ru; Anna.Zorina@zin.ru

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РЕЗЮМЕ

Род *Icelus* Кгøyer, 1845 включает 18 валидных видов из вод шельфа и верхней части континентального склона северной Пацифики, Арктики и Северной Атлантики. Систематика рода находится в стадии

^{*} Corresponding author / Автор-корреспондент

разработки. Для решения таксономических проблем возникает необходимость уточнения диагностических признаков уже известных видов. Как оказалось, сведения о составе типовой серии охотского ицела I. ochotensis Schmidt, 1927 в разных источниках расходятся, а диагностические признаки в последней ревизии рода и в ключах для определения противоречат его первоописанию. В работе уточнен состав типовой серии охотского ицела, хранящейся в ЗИН (36 экз.); приводится переописание и уточненный диагноз; обозначен Лектотип ЗИН № 21898. Icelus ochotensis, характеризуется наличием на теле лишь двух рядов крупных чешуй (дорсальный ряд Dl и боковая линия Ll) и входит в группу "I. bicornis", наряду с I. spatula Gilbert et Burke, 1912, I. uncinalis Gilbert et Burke, 1912 и I. stenosomus Andriashev, 1937. Вопреки результатам последней ревизии рода и современным определительным ключам, оказалось, что на верхней части головы у него не одна пара шипов, а две пары (теменные = parietal spines и затылочные = nuchal spines), в виде тупых бугров, скрытых в коже. Дорсальный ряд чешуй (Dl) впереди полный (доходит до головы); боковая линия начинается под 3-4 чешуйкой дорсального ряда и не заходит на хвостовой плавник; чешуи Ll ниже поры канала обычно полностью погружены в кожу и не зазубрены (могут быть различимы 1-2 спинулы); надглазничный кожный усик (циррус) простой; урогенитальная папилла самцов цилиндрическая (в отличие от лопатовидной у *I. spatula*). Позвонков 37–40, D VII– IX 15–19, A 13–16, P 17–18, Ll 38–40, Dl 29–34; аксиллярных чешуй 6–13. Распространение охотского ицела требует пересмотра, так как современные ключи для определения Icelus содержат неверные признаки этого вида (такие как одна пара шипов на затылке).

Ключевые слова: Cottidae, *Icelus ochotensis*, лектотип, охотский ицел, Охотское море, типовая серия, переописание

INTRODUCTION

Cottid fishes of the genus Icelus Krøyer 1845 are widely distributed on the shelves and upper slope of the North Pacific, Arctic, and North Atlantic (Fedorov 2000; Nelson 1984; Fricke et al. 2021). The genus includes 18 valid species, some of which have only recently been described (Fukuzawa et al. 2022; Kai et al. 2023). The taxonomy of Icelus needs to be developed, since the latest revision of the genus (Nelson 1984) included only 13 species known at that time. In the latter, eleven species were combined into three groups based on similar characters: "I. spiniger" (2 species), "I. euryops" (4) and "I. bicornis" (5) (Table 1). These groups are distinguished, in particular, by the presence or absence of spines on the suborbital process and *lacrimale*, as well as the number of pairs of spines on the back of the head: 2 pairs (parietal and nuchal) or 1 pair (in the absence or parietal spines). The shape of the nuchal spines and the characteristic features of the scales of the dorsal row and lateral line are also different. It is important to note that the presence or absence of parietal spines is one of the significant characters.

The Okhotsk sculpin *I. ochotensis* Schmidt, 1927, which has only 2 rows of large scales on its body (dorsal row *Dl* and lateral line *Ll*), is included in the group "*I. bicornis*", along with *I. bicornis* (Reinhardt, 1840), *I. spatula* Gilbert et Burke, 1912, *I. uncinalis* Gilbert et Burke, 1912, *I. stenosomus* Andriashev, 1937. Two of them, the Atlantic twohorn sculpin *I. bicornis* and the Spatulate sculpin *I. spatula*, were studied by us earlier using materials from the Arctic (Zorina and Chernova 2022a, 2022b). Of these, *I. spatula* occurs both in the Arctic and in the northern part of the Pacific Ocean (Andriashev 1954; Parin et al. 2014). When analyzing the ZIN materials of this fish from the Far Eastern seas, it turned out that some specimens had previously been identified erroneously. In fact, their characteristics correspond to the original description of *I. ochotensis*. To clarify the issue, we examined the type series of the latter, which is stored in the collection of the Zoological Institute of the Russian Academy of Sciences (ZIN).

An analysis of the literature showed that the characters of *I. ochotensis* given in the latest revision of the genus *Icelus* (Nelson 1984) differ from the original description (Schmidt 1927). In particular, the understanding of an important diagnostic feature, – the number of head spines, is different. This was the reason to study this issue, especially since Nelson's incorrect results are included in recent keys for *Icelus* identification (Fedorov et al. 2003; Nakabo 2013; Tohkairin et al. 2015).

The purpose of this work was to clarify the morphological characteristics of the Okhotsk sculpin studying its type series and to identify the differences from related species. During the work several following problems were solved.

1. *Icelus ochotensis* was described from the Sea of Okhotsk from 45 specimens; collection numbers of the syntypes were not given (Schmidt 1927). Since there was a discrepancy between their number in the original description, in the inventory card of the ZIN collection (44+), in the catalog of Cottoidei (24) (Sidelyova et al. 2006) and in the electronic database (24) (Fricke et al. 2022), it was necessary to clarify the number of the types of the Okhotsk sculpin.

2. In the revision of the Far Eastern *Icelus* (Andriashev 1937), the mixed content of the type series of *I. ochotensis* was shown: a few syntypes were reidentified as new taxa, *I. uncinalis crassus* Andriashev, 1937 and *I. spatula bispinis* Andriashev, 1937. Since the type series of the Okhotsk sculpin could presumably include other specimens that do not belong to this, it was necessary to check its homogeneity.

3. Modern identification keys are based on the Nelson's revision (1984), in which the understanding of *I. ochotensis* diverges from the original description (Schmidt 1927). Thus, the objectives of the work included clarifying the diagnostic characters of the species based on the type series.

4. To date, the volume of the genus *Icelus* has increased due to the description of new species, and the complex of taxonomically significant characters has expanded (Tsutsui and Yabe 1996; Tsuruoka et al. 2006; Fukuzawa et al. 2022; Kai et al. 2023); for this reason, a modern description of *I. ochotensis* was necessary.

MATERIAL AND METHODS

The materials of the type series and non-type material of *I. ochotensis* is given in the "Results" section. Below is comparative material on other species of Far Eastern seas from the ZIN collection.

In some cases, in the absence of trawl coordinates on the labels, data from the corresponding hydrobiological stations from the database of the Invertebrates department of ZIN are provided (marked with an asterisk *). The depth of catches, if indicated in fathoms, is converted into meters (1 nautical fathom = 1.83 m).

The radiography was performed on a multifunctional X-ray complex PRDU 2021 "ELTEH-MED" in a Center "Taxon" of ZIN. The anterior pair of spines on the back of the head are parietal, the posterior pair are nuchal ones. The occipital pit is the depression of the roof of the skull behind the orbits. Skin appendages are cirri (plural) or cirrus (singular); their terminology is adopted according to Nelson (1984). Axillary scales are located on the body under the pectoral fin. The terminology of the canals and pores of the seismosensory system was adopted according to A.V. Neelov (1979). The specimens stained for sensory system study are 5 females ZIN No. 34936 (*TL* 124 and 116 mm), No. 34936 (*TL* 116 and 124 mm), No. 44821 (*TL* 118 mm). The vertebral number includes the urostyle.

Designations: Axil tot – number of axillar scales; Dl – dorsal row of scales, Ll – lateral line row of scales, n – number of specimens. A, ID and IID, C, P, V – anal, first and second dorsal, caudal, pectoral and ventral fins or the number of rays in them. Vert (abd, caud and tot) – number of vertebrae (precaudal, caudal and total).

The measurements carried out after modern scheme (Kai et al. 2023): absolute length (TL) – body length from tip of snout to caudal-fin end; standard length (SL) – same to caudal-fin base; head length (HL) – from the tip of the snout to the bony edge of the opercular lobe; head depth is measured at the posterior edge of the orbit; body height (greatest, on the vertical of the anterior ID ray); body width (greatest, between the bases of P); preanal distance – from the tip of the snout to the beginning of A; predorsal distances – the same, to the beginning of *ID* and *IID*; length *P* and *V* – from the fin base to the end of the longest fin ray; A base – length between bases of the first and the last A-rays; length of the caudal peduncle – from the vertical of the base of last *IID*-ray to the base of the middle rays of caudal fin; the height of the caudal peduncle is its smallest height; C length – from the midpoint of the *C*-base to the end of its middle rays; length of 1–3 rays ID – measured from their base to apex; the length of the snout is from its tip to the anterior edge of the orbit; orbit – horizontal diameter, along the bony edge; interorbital width is the shortest, between the bony edges of the orbits; length of the upper jaw - from the jaw symphysis to the end of the *maxillare*; the length of the nuchal tubercle is from its base to apex.

By "card" we mean an archival paper card for recording inventory material in the ichthyological collection of the ZIN, individual for each species, in which all receipts of specimens are consistently

Table 1. Basic charact	teristics of <i>Icelus</i> groups and	l species not included in them	(after Nelson 1984).		
Groups or species	"I. spiniger"	"I. euryops"	"I. bicornis"	I. gilberti	I. armatus
Species in groups	I. spiniger I. cataphractus	I. euryops I. rastrinoides I. canaliculatus I. perminovi	I. bicornis I. spatula I. ochotensis (sensu Nelson 1984) I. uncinalis I. stenosomus		
Suborbutal spines	+ (1 or 2)	+/- (in <i>I. perminovi</i> , in some <i>I. rastrinoides</i>)	I	I	+
Lacrimal spines	- (I. spiniger)/ + (1 or 2, I. cataphractus)	1	1	I	1
Number of spines on the top of the head	1	1	1 or 2	1 or 2	1
Parietal spines	1	I	+/-	-/+ (greatly reduced)	I
Nuchal spines, shape	long, straight and sharp	strongly reduced or short and sharp, directed back- wards	vary significantly	short and blunt, hidden in the skin	present
Superior preopercu- lar spine	forked	simple (straight or curved) or 2–3 vertex	simple or bifurcated	simple (straight or curved)	2-3 vertex
Rows of scales between <i>Dl</i> and <i>Ll</i>	I	– (or 2–3 rows)	- (+/-in I. bicornis)	2-5 rows between Dl and Ll	2-3 rows between Dl and Ll
Rows of scales below <i>Ll</i>	I	-/+	- (+/- in <i>I. bicornis</i> ; if present, one row above <i>A</i>)	I	2–5 rows
Axillary scales	2–17 and 9–21	+(up to 53)	+ (up to 30)	I	numerous, $5-7$ in the top row
End part <i>Ll</i>	goes on C	goes on C	varies	does not go beyond hypurale	goes beyond hypurale
Scales on the caudal peduncle, dorsal (d)/ventral (v)	d+/v+	d+/v+	d+/- v+/-	d +(=scales of Dl)/v –	d+/v+
Scales of the dorsal		Embedded base			Embedded base
row, shape		C Spinous ridge	B	CC	C Spinous ridge
From Nelson 1984:	Fig. 18 D	Fig. 18 C	Fig. 18 B	Fig. 18 B	Fig. 18 C

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Scales of the lateral line, shape		All Assume	man -	"Lateral line scales each with a continuous arc of small spinules along dorsal and posterior margins of lateral scale surface"	Mu -
From Nelson 1984:	Fig. 19 C	Fig. 19 B	Fig. 19 A*	P. 21	Fig. 19 A
Cirri (dermal appendages)	supraocular + parietal +/-	supraocular + parietal+ opercular +/- suborbital stay+/-	supraocular + parietal+ opercular + suborbital stay +/-	supraocular + parietal+ opercular+ suborbital stay+	supraocular parietal+
		maxillary +/- nuchal +/-		maxillary+ nuchal+ preopercular+ on lateral line scales +	maxillary +
Urogenital papilla	spatulated	cylindrical (slightly flattened dorsoventrally in <i>I. rastrinoides, I. euryops</i>), shape unknown in <i>I. per-</i> <i>minovi</i>	cylindrical or spatulate flattened (<i>I. spatula</i>), with a long (<i>I. bicor-nis</i>) or short terminal process	cylindrical, slightly flattened dorsoventrally	cylindrical
* "Occasionally, the 1984:15). <i>Note</i> : preser	posteriorly directed spinules nt (+), absent (–).	below the lateral line pore ar	e absent in <i>I. spatula</i> , particularly ir	n specimens collected in Arctic	Canadian waters" (Nelson

recorded; it also reflects re-identification of materials, if any. The "Catalogue" refers to the Catalogue of the Cottoidei of the collection of the Zoological Institute of the Russian Academy of Sciences (Sideleva et al. 2006).

Abbreviations. GEVO – Hydrographic Expedition of the Eastern Ocean; IOAN – Institute of Oceanology RAS named after P.P. Shirshov; juv – juvenile, coll – collector, spec – specimen, st – station, t_{bot} – water temperature at bottom. Types of vessels: LT – Icebreaking transport; NES – Scientific expedition vessel; RV – Research vessel.

Comparative material

Icelus bicornis (82 spec from 16 st): Arctic seas; see the list in: Zorina and Chernova (2022a).

Icelus spatula (78 spec from 33 st).

Barents, Laptev and East-Siberian seas – 28 spec from 18 st; see the list in: Zorina and Chernova (2022a).

Chukchi Sea – 2 spec from 2 st: ZIN No. 21917 (juv *TL* 23 mm), No. 32204 (of *TL* 65 mm).

Bering Strait – ZIN No. 17788 (of TL 60 mm).

Bering Sea – 21 spec from 9 st Bay of Anadyr: ZIN No. 17789 (2 juv *TL* 41–42 mm), No. 21919 (2 juv *TL* 32–35 mm), No. 29560 (*o TL* 69 mm, *q TL* 83 mm), No. 29563 (3 *o TL* 48.5–50 mm), No. 33425 (*q TL* 79 mm). Open sea: No. 29571 (2 *o TL* 51–57 mm, 3 *q TL* 49–55 mm), No. 33422 (2 *o TL* 49–52 mm), No. 33423 (*o TL* 60 mm, *q TL* 73 mm), No. 33424 (2 juv *TL* 34 mm).

Kamchatka – 26 spec from 3 st: ZIN No. 27971 (7 of *TL* 55–67 mm, 17 of *TL* 58–89 mm), No. 33630 (of *TL* 70 mm), No. 33631 (of *TL* 64.5 mm).

Icelus spatula bispinis (14 spec from 8 st).

Sea of Okhotsk, 6 spec from 3 st (reidentified from syntypes of *I. ochotensis*): ZIN No. 56957 (from No. 21898), 2 \circ *TL* 81 and 68 mm, near Cape of Alevin, 58°48.5'N, 151°18.5'E, depth 55 m, August 23, 1913; NES "Okhotsk", st 11, t_{bot} +3.85°C, ground – stones, GEVO. ZIN No. 56959 (from No. 21902), 1 juv o' *TL* 43 mm, 54°12.5'N, 140°25.5'E [northwest of Sakhalin Bay], July 23, 1917; NES "Okhotsk", st I No. 4, GEVO. No. 37486 (3 spec from ZIN No. 21901), 53°56'N, 138°10'E [Bay of Academia], August 17, 1917; NES "Okhotsk", st III No. 17, GEVO. [Detailed information about the stations is taken from: Shiryaev 1914 and ZIN database. For these lots, LT "Vaigach" in the Catalog (2006) is erroneous indication]. Kamchatka: 8 spec from 5 st Reidentified from I. spatula spatula: ZIN No. 23672 (σ TL 60 mm, φ TL 72 mm), No. 57032 (from No. 33631) (3 φ TL 71.5–81 mm), No. 57037 (from No. 33423) (φ TL 104 mm). Reidentified from I. uncinalis uncinalis: No. 57033 (from No. 32695) (σ TL 62 mm), No. 43993 (φ TL 93 mm).

Icelus uncinalis (13 spec from 7 st). Kamchatka – 10 spec from 5 st: ZIN No. 27961 (*J TL* 79 mm), No. 27967 (*FL* 77 mm), No. 32695 (*J TL* 74 mm), No. 33599 (*J J TL* 79–82 mm, juv *TL* 51 mm), No. 33601 (*J FL* 81–120 m). Commander Islands – *J spec from* 2 st: No. 33430 (*FL* 76 mm), No. 33602 (*J TL* 57 mm, *FL* 67 mm).

Icelus uncinalis crassus (from type series): ZIN No. 21900 (*o TL* 106 mm, reidentified from syntypes of *I. ochotensis*), Sea of Okhotsk, 57°36'N, 140°34'E, August 14, 1918; depth 97 m, st 9, GEVO.

RESULTS

1. Composition of a type series

The species *I. ochotensis* has been described from 45 (mostly young) syntypes from the northern part of the Okhotsk Sea ($53^{\circ}56-58^{\circ}48.5$ 'N, $13^{\circ}32 - 151^{\circ}18.5$ 'E) at depth of 30-53 fathoms (55-97 m) (Schmidt 1927). The greatest length was *TL* 121 mm (female) and 106 mm (male) (Schmidt 1927).

Discrepancies in number. Collection numbers were not indicated by P. Schmidt. The inventory card for this taxon in the ZIN collection was created later, during the work of A.P. Andriashev on his revision of the genus *Icelus* (Andriashev 1937). It was registered as a subspecies "*I. spatula ochotensis* Schmidt"; and for the first group of numbers in the "Identification" column it is indicated: A.P. Andriyashev.

The card originally contained 8 lots, in total 44+ specimens: ZIN Nos 21898 (1), 21899 (2); 21900 (1), 21901 (6); 21902 (16); 21903 (6); 21904 (6); 22019 (6+). These lots were later marked as "syntypes" (in a different handwriting).

The Catalog of Cottoidei (Sideleva et al. 2006, I: 75; II: 330) provides partly different information about the types of *I. ochotensis*; 6 numbers are listed (in total 24 specimens): ZIN Nos 21898 (1), 21899 (2), 21901(3), 21902(6), 21903(6) and 21904(6). Thus, this series did not include the ZIN Nos 21900 (1), 21901 (3), 22019 (6+); and 6 specimens (instead of 16) were listed in the Lot No. 21902. The same 6 lots were listed in the electronic database (Fricke et al. 2022): ZIN 21898–99 (1, 2), 21901–04 (3, 6, 6, 6). As we can see, information about the syntypes of *I. ochotensis* differs markedly.

Actual type lots and number of fishes. Analysis of copyright labels by P.Yu. Schmidt (with his handwriting identifications) showed that the type series of *I. ochotensis* originally included 7 numbers. By the beginning of our work, the actual number of fish in them was 60 specimens, and not in all lots the fish number corresponded to the inventory card: ZIN No. 21898 (4 specimens, but not 1, as in the card), No. 21899 (1, but not 2), No. 21900 (1), No. 21901 (10, but not 6), No. 21902 (16), No. 21903 (16, but not 6), No. 21904 (12, but not 6). That is, in four lots there was more fish than indicated earlier, and in No. 21899 one of the two specimens mentioned in the card was missing (lost).

Specimens No. 22019 (11), marked on the card as "syntypes", are not syntypes, since the author's label in the jar does not belong to P.Yu. Schmidt, but was written by A.P. Andriyashev ("*I. spatula ochotensis*") and dated 1935 (not 1927).

The total number of actually existing fish (60 spec) was greater than in the original description (45 spec). This can be explained by the fact that P.Yu. Schmidt did not include juveniles in the type series (nor were they removed from the jars).

Syntypes in foreign museums. Judging by the labels, 2 specimens (obviously syntypes) of *I. ochotensis* from ZIN No. 21903 were donated by A.P. Andriyashev to other museums: 1 spec in the United States to ichthyologist R.L. Bolin (in January 14, 1936), and 1 spec "to the British Museum in exchange" (in 1964).

2. Heterogeneity of the type series

The mixed content of the original type series of the Okhotsk sculpin was revealed by A.P. Andriyashev, when some of the syntypes were reidentified by him as new taxa. The specimen No. 21900 (1), redefined as "*I. uncinalis crassus* Andriashev, 1937", was included in the type series of the latter (Andriashev 1937) [which is permitted by the ICZN (1999: 72.6)]. Also in 1964, judging by the labels, he redefined 3 syntypes of *I. ochotensis* from lot No. 21901 as "*I. spatula bispinis* Andriashev, 1937" (new No. 37486).

Our work confirmed the assumption of a mixed composition of the type series of *I. ochotensis*. Specimen No. 21900 (1) in its characters actually corre-

Lots indicated as syntypes in the inventory ZIN card	Specimens reidenti- fined by A.P. Andri- yashev, lost or sent in other museums	The actual number of specimens at the beginning of our study	Reidentified in this study	Final number	Syntypes (juveniles excluded)
No. 21898 (1)		4	2 spec <i>TL</i> 81 and 68 mm are <i>I. spa-</i> <i>tula bispinis</i> (new No. 56957)	2 spec <i>TL</i> 92 mm and <i>TL</i> (–), <i>SL</i> 57 mm	2 syntypes <i>TL</i> 92 mm; <i>TL – / SL</i> 57 mm
No. 21899 (2)	1 spec lost	1		1 spec TL 122	1 syntype TL 122 mm
No. 21900 (1)	It is <i>I. uncinalis</i> crassus	1*	I. uncinalis cras- sus, confirmed	excluded	
No. 21901 (6)	3 spec are I. spatula bispinis (new No. 37486)	10		7 spec <i>TL</i> 57–75 mm and 3 juv <i>TL</i> 41–53 mm	7 syntypes TL 57–75 mm
No. 21902 (16)		16	1 juv TL 43 mm is I. spatula bispinis (new No. 56959)	9 spec <i>TL</i> 58–77 mm and 6 juv <i>TL</i> 48– 55 mm	9 syntypes TL 58–77 mm
No. 21903 (6)	2 spec sent to USA and British Museum	16		14 spec <i>TL</i> 61–75 mm and 2 juv <i>TL</i> 47–48 mm	14 syntypes <i>TL</i> 61–75 mm [and 2 in museums of USA, Britain (?)]
No. 21904 (6)		12		3 spec <i>TL</i> 57–60 mm and 9 juv <i>TL</i> 34–49 mm	3 syntypes TL 57–60 mm
No. 22019 (6+)		Not types		Not types	
Total number 44+		60 (adult and juv)	2 adults, 1 juv	56 spec (36 spec <i>TL</i> 57–122 mm and 20 juv <i>TL</i> 34–53 mm)	
			Final decision		
Syntypes, 45 according to origi- nal description	minus 7 specimens		minus 2 adults		36 syntypes <i>TL</i> 57–122 mm [and 2 in museums of USA and Britain (?)]

Table 2. Composition of the type lots of *I. ochotensis* in the ZIN collection.

* By the beginning of our work, this lot was listed among the types of *I. ochotensis*.

sponds to Andriashev's *I. uncinalis crassus*. Another 3 specimens belong to *I. spatula bispinis* according to their characters: 2 (out of 4 adults) of lot No. 21898 (new ZIN number is No. 56957) and 1 juv *TL* 43 mm (out of 16 specimens) of No. 21902 (new No. 56959). The remaining 56 specimens from the type lots correspond to the original description of *I. ochotensis* (Table 2).

3. Illustrations

The original figure "*I. ochotensis* sp. nov." of Schmidt (1927) was used by Andriashev (1937) for the drawing of his "*I. uncinalis crassus* subsp. nov.". We have determined (by length and appearance) that this is male No. 21900. As mentioned above, it really does not belong to the Okhotsk sculpin.

4. Number of syntypes

Analysis show that of the 45 type specimens indicated in the original description (to which Schmidt apparently included only adult fish), 36 should remain by now (Table 2), since 2 specimens were sent to foreign museums, 1 spec lost and 6 adults were reidentified (1 spec No. 21900, 3 spec from No. 21901 and 2 from No. 21898). This is consistent with the observed length distribution of *I. ochotensis* from the type lots: out of 56 specimens, 20 spec are juveniles *TL* 34–53 mm and 36 have a *TL* length 57–121 mm (that is, these are adult fish).

The female ZIN No. 21899 was caught at a depth 121 m (66 fathoms) which is outside the range indicated in the original description (55–97 m); but it is

included among the syntypes because it was caught within the type locality; and in addition, this is the only specimen in the series, the size of which corresponds to the longest length indicated by P. Schmidt for the types (*TL* 121 mm).

Thus, the syntypes of *I. ochotensis* in the ZIN collection include 36 specimens *TL* 57–121 mm: No. 21898 (2), No. 21899 (1), No. 21901 (7), No. 21902 (9), No. 21903 (14) and No. 21904 (3) (Table 2). Two syntypes are likely to be in museums in the United States and Great Britain. Juveniles from mentioned lots (20 spec *TL* 34–53 mm) should be considered "author's" specimens (that is, identified by the author of the species P.Yu. Schmidt).

5. Preliminary taxonomic comments

Number of spines on the top of the head. For Icelus, the presence and location of spines is used in diagnostic. Recent papers treats *I. ochotensis* as a species with a single pair of spines on the back of the head (Nelson 1984 et auctorum). We have found it is in contradiction with reality. In the original description of *I. ochotensis*, the presence of 2 pairs of spines there is clearly indicated: "The occipital spines are strong, but short and rounded on the end, directed more upward than backward, especially the first pair" (Schmidt 1927: 4). Thus, by "occipital" spines the author understands 2 pairs of spines on the top of the head, which corresponds to the parietal and nuchal spines of modern authors.

The presence of two pairs of spines on the back of the head of the Okhotsk sculpin is clearly indicated also by A.P. Andriashev in his revision of the Far Eastern Icelus: "Es sind stets 2 Paar Nackendornen vorhanden" (Andriashev 1937: 268). He examined 76 specimens of the latter, both types (No. 21898–99) and 21901-04) and non-types (No. 17644, 21447 and 22019), in connection with the description of three new taxa, I. uncinalis stenosomus Andriashev, 1937, I. uncinalis crassus Andriashev, 1937 and I. spatula bispinis Andriashev, 1937. At the same time, single specimens of the last two were reidentified by him from the type series of the Okhotsk sculpin. In particular, male No. 21900, from the Okhotsk syntypes, was assigned to I. uncinalis crassus. One of the diagnostic characters of the latter is the presence of only one pair of tubercles (nuchal ones) on the top of the head: "Das vordere Paar Nackenchöcher fehlt; das hintere Paar sehr niedrig, hockerig oder in Form eines abreguneten, nach oben und hinten gerichteten Kegels" [The anterior pair of occipital tubercles is absent; the tubercles of the posterior pair are very low, squat or in the form of a cone directed upward and backward] (Andriashev 1937: 265). Thus, the Okhotsk sculpin is characterized originally by the presence of two pairs of tubercles, parietal and nuchal. Specimens with one pair of tubercles (in the absence of parietal ones) do not belong to it. This is confirmed by our study of the type series.

Erroneous interpretation of the characters. Current understanding of the *I. ochotensis* is based on the latest revision of the genus (Nelson 1984). In the latter, both the diagnosis and the key for identification indicate that the Okhotsk sculpin has only one pair of spines on the top of its head (no parietal spines). This contradicts to the original text description. One reason for the confusion was probably that he relied not on the text, but on a drawing from the original description of I. ochotensis (Schmidt 1927, figs. 1, 2), which in fact does not belong to it (ZIN No. 21900). Another reason was that D. Nelson did not see the type series of *I. ochotensis*, stored in the ZIN collection; that is why he misunderstood the characters (Nelson 1984, fig. 42). The 4 specimens he examined (as he believed to be of this species) from the Sea of Japan, Sakhalin and Kamchatka do not belong actually to *I. ochotensis*, since they do not have parietal spines (it is clear from his description). Following Nelson, incorrect characters were used in species diagnostics and identification keys by subsequent authors (Fedorov et al. 2003; Nakabo 2013; Parin et al. 2014; Tohkairin et al. 2015; Fricke et al. 2022). This makes the task of revising the "Okhotsk sculpin" and the entire group of related species urgent.

Status of Andriyashev's taxa. Three new taxa have been described at the rank of subspecies: I. uncinalis stenosomus, I. uncinalis crassus, and I. spatula bispinis (Andriashev, 1937); Okhotsk sculpin was also accepted there at the same rank -I. spatula ochotensis. Subsequently A.P. Andriyashev, in personal conversations (with N.Ch.), noted the practice that existed in his time of assigning the rank a subspecies to new species "out of caution"; the rank of the species was confirmed or not by subsequent researchers. In particular, at present the species status of *I. ochotensis* is not disputed, and *I. stenosomus* is accepted as a species. Two other taxa, I. u. crassus and I. s. bispinis, after the work of Nelson (Nelson 1984 et auctorum), are reduced to synonyms, which, in our opinion, requires revision. It should be noted

that P.Yu. Schmidt, famous by his book "Fishes of the Seas of the Russian Empire" (1904), accepted the results of Andriyashev's revision. In his next monograph, on the ichthyofauna of the Sea of Okhotsk (Schmidt 1950), all three *I. spatula ochotensis*, *I. spatula bispinis* and *I. uncinalis crassus* are included there as valid. Although the latter two are not currently considered valid (Nelson 1984 et auctorum), we believe that the systematic status of these taxa clearly deserves reconsideration. At least in the materials we studied, there are specimens whose characteristics correspond to *I. spatula bispinis* and *I. uncinalis crassus*. Among recent authors, we also found that Fedorov (2000) listed *I. spatula bispinis* for the waters of Northern Kuril Islands.

Below we present the first results of the group's revision, a description of the type series of *I. ochotensis* with clarification of diagnostic characters.

Family Cottidae Bonaparte, 1831

Genus Icelus Krøyer, 1845

Icelus ochotensis Schmidt, 1927 sensu stricto

(Fig. 1-8)

Icelus ochotensis Schmidt 1927: 4 (part [mixed material]; *D* VIII–IX 17–20, *A* 13–15, *P* 17–19, *Ll* 38–40). Soldatov and Lindberg 1930: 178 (after Schmidt, 1927).

Icelus spatula ochotensis: Andriashev 1937: 268, Taf. 6, fig. 4 (ZIN No. 17644, 21447, 21898–99, 21901–904, 22019, a total of 76 spec from the Shantar Islands, Iona Island, off Cape Alevina; depth 55-110 m, temperature to -1.6° C. Counts of 20 spec: *D* VIII–IX(X) 17–19, *A* 13–15(16), *P* 16–18, *Ll* 38–40, *Dl* 29–34; measurements of 13 adults, in % *TL*: head length (*HL*) 28.6–31.8, head depth 16.0–17.5, caudal peduncle length 15.4–18.1 (its depth 23.8–32.5 % of its length); in % *HL*: eye diameter 32.2–38.1; length of nuchal tubercles 5.7–9.4; interorbit-al width 4.0–5.9, urogenital papilla length 24.4–30.0%). Schmidt 1950: 137 (northwest of the Sea of Okhotsk, at depths of 55–110 m, on rocky, silty and sandy grounds).

Lectotype (herein designated): ZIN 21898, female *TL* 92 mm, *SL* 77 mm, Sea of Okhotsk, near cape Alevina, 58°48.5'N, 151°18.5'E, August 23, 1913, depth 55 m, NES "Okhotsk", st 11, large beam trawl, stones, bottom temperature +3.85°C, coll. N.G. Shiryaev, GEVO. [Station data taken from: Shiryaev 1914. In the Catalog (2006), LT "Vaigach" is erroneous indication].

When designating a lectotype, preference should be given to the syntype whose illustration has been published (ICZN 1999: 74B), that is, the figured specimen of "*I. ochotensis* sp. nov." (Schmidt 1927, fig. 1) is the most preferred lectotype. The reason we did not selected it is that the characters of the specimen depicted (male No. 21900) do not correspond to the original diagnosis and textual description of *I. ochotensis* (Schmidt 1927). Andriyashev (1937) had reidentified it as a new nominative *I. uncinalis crassus*. We consider the optimal solution to be the choice of another specimen as the lectotype, namely



Fig. 1. Icelus ochotensis, female, ca. 8 cm; area of the Shantar Islands (from: Andriashev 1937, Taf. 6, fig. 4).



Fig. 2. Icelus ochotensis, lectotype ZIN No. 21898, female TL 92 mm (A) and radiograph of the lectotype (B).

female ZIN 21898. Although this fish was once dried, all the characteristics of the species are clearly present. In the ZIN inventory card, in the notes to the entry ZIN No. 21898 (1), it is written in Andriyashev's hand: *"I. spatula ochotensis"* and marked: "Type". The label "Type" is also inside the jar. This designation has not been published and is therefore not a valid lectotype designation; this is a reason to do it in the present manuscript.

Sample ZIN No. 21898 initially contained 2 fishes, and we isolated the second (smaller) specimen (now ZIN No. 56960).

Paralectotypes (35 spec, Sea of Okhotsk, *TL* 57–121 mm): ZIN No. 21899, female *TL*121 mm, *SL* 100 mm, close to Iona Island, 56°24'N, 143°23'E, June 26, 1914, depth 121 m, NES "Okhotsk", st 3 no. 3, coll. G.R. Meder, GEVO. ZIN No. 21901,

7 spec TL 57-75 mm, SL 48-62 mm, 53°56'N, 138°10'E, Bay of Academia, August 17, 1917, NES "Okhotsk", st 3 No. 17, GEVO. ZIN No. 21902, 9 spec TL 58-77 mm, SL 48.5-66 mm, 54°12.5'N, 140°25.5'E, north-west of Sakhalin Bay, July 23, 1917, NES "Okhotsk", st I No. 4, GEVO. ZIN No. 21903, 14 spec. TL 61-75 mm, SL 53-63 mm, 56°21'N, 138°17'E [south-east of Cape Ayan], August 3, 1916, NES "Okhotsk", st 5 No. 16, GEVO. ZIN No. 21904, 3 spec. TL 57-60 mm, SL 48-50 mm, 55°31'N, 137°32'E [north of the Shantar Islands], August 13, 1918, st 8 No. 6, GEVO. ZIN No. 56960 (from No. 21898), male TL – SL 57 mm, caught with the lectotype. [Station data taken from: Meder 1916, and from the ZIN database of the invertebrate department. For all lots, LT "Vaigach" (Catalog 2006) is erroneous indication].

Non-type material (50 spec from 10 st). Sea of *Okhotsk* – 47 spec from 8 st: ZIN No. 22019 (12 spec TL 48-110 mm, SL 40-93 mm), between Okhotsk and Iona Island, 57°27'N, 143°15'E, August 28, 1913, depth 95 m, Border guard cruiser «Commander Bering», st 28, ground - silt, sand, coll B.A. Geineman. ZIN No. 34936 (3 9 TL 55–124 mm), close to Iona Island, 56°24'N, 143°23'E, June 26, 1914, depth 121 m, NES "Okhotsk", st 3 No. 3, coll. G.R. Meder, GEVO. ZIN No. 40588 (6 of TL 52-74 mm, 5 9 TL 53–92 mm, 4 juv TL 48–51 mm), 54°53'N, 136°57'E, August 25, 1916, st 6, GEVO. ZIN No. 44821 (2 9 TL 75-118 mm), Cape Lantarskiy, 56°01.5'N, 137°44'E*, August 10, 1978, depth 60 m, NPS "Poseidon", st 158, scallop dredge, coll E. Tabunkov. ZIN No. 44822 (2 9 TL 80 mm), Ulbansky Bay, 53°43.5'N, 137°55.5'E*, August 21, 1978, depth 25 m, NPS "Poseidon", st 228, scallop dredge, coll B.N. Koblikov. ZIN No. 44823 (5 9 TL 93-99 mm), Cape Litke, 54°28.5'N, 139°37'E*, August 27, 1978, depth 62 m, NPS "Poseidon", st 268, scallop dredge, coll B.N. Koblikov. ZIN No. 44824 (5 of TL 52–77 mm, 2 9 TL 75–90 mm), Iona Island, 56°42.3'N, 143°16'E*, July 22, 1978, depth 110 m, NPS "Poseidon", st 99, Sigsby boat trawl, coll B. Pavlyuchkov. ZIN No. 44925 (9 TL 101 mm), Cape Litke, 54°28.5'N, 139°37'E*, August 27, 1978, depth 62 m, NPS "Poseidon", st 268, Sigsby boat trawl, coll B.N. Koblikov.

Bering Sea, Olyutorsky Bay – 3 spec from 2 st (redefined from "*I. spatula spatula*"): ZIN No. 33633 (*d TL* 59 mm), 59°12.8'N, 167°10.5'E*, June 26, 1952, depth 73 m, RV "Vityaz", st 1590, Sigsby trawl, IOAN. ZIN No. 33426 (2 *d TL* 51–52 mm), at Cape Olyutorsky, 60°00'N, 170°30.5'E, September 15, 1950, depth 72 m, RV "Vitjaz", st 596, Sigsby trawl, IOAN.

Etymology. The name *ochotensis* comes from the name of the Sea of Okhotsk.

Updated diagnosis. There are no additional rows of plate-like scales on the body except for the dorsal row (Dl) and lateral line (Ll). The scales of the dorsal row are armed with small spinules at edge (Fig. 6A), large sharp conical spines, serrated on the sides or smooth (Table 1), are not developed on them) – "*I. bicornis*" group. There are parietal and nuchal pairs of spines on the top of the head, in the form of tubercles, rounded at the ends and covered with skin. Occipital pit is present. Supraorbital dermal appendage (cirrus) unbranched. The dorsal row of scales reach-



Fig. 3. *Icelus ochotensis*, side view of head (A) and a section of the radiograph (B); a - supraorbital cirri, b - parietal tubercles, c - nuchal tubercles, d - first scale of the dorsal row, e - first scale of the lateral line.

es the head (anterior scales are above the base of the opercular lobe). The lateral line (*Ll*) begins under the 3–4th scales of the dorsal row and reaches back to the edge of the hypural plate (but does not extend to the rays of the caudal fin). Scales *Ll* below the pore of the sensory canal are embedded in the skin and not serrated (Fig. 6B–D) (the scales of the precaudal part may have 1 or 2 tiny spinules). Urogenital papilla cylindrical (not flattened or spatulate), with a short claw-like terminal appendage. Vertebrae 37–40, *D* VII–IX 15–19, *A* 13–16, *P* 17–18, *Ll* 38–40, *Dl* 29–34; axillary scales 6–13.

Description of the lectotype (Fig. 2A, 3A).

Body is high at the beginning of ID (depth 3.5 times in SL). Preanal distance is more than a half of SL (52.6%). Head large (2.6 times in SL), deep at occiput. Snout (when viewed from above) is



Fig. 4. Icelus ochotensis, paralectotypes: A - female TL 121 mm (ZIN no. 21899); B - male TL 74 mm (ZIN No. 21902-4).

rounded, its length is 1.1 times the orbit diameter. Eye 3.5 times in head length. The interdorsal distance less than pupil diameter, concave. Supraorbital ridge present, with a simple dermal appendage (cirrus). The occipital pit is deep. Nasal spines sharp, directed upwards and slightly backwards. Nostrils of anterior pair tubular; nostrils of posterior pair with elevated margins. Occipital spines in the form of blunt tubercles, 2 pairs, rounded at apex and hidden in skin. The parietal tubercles are shorter than the nuchal ones; the latter are no longer than the pupil, directed up- and backward. Preopercular spines 4, pointed; upper spine bifurcated and upwards directed; second one directed backwards, third and lowest ones backwards and downwards. Upper jaw reaches vertical of posterior margin of orbit. Lower jaw included. Fine papillae and tiny spinules are scattered over dorsolateral part of head, including snout and upper side of the eye, extending in a stripe along the bases of the dorsal fins, and extending onto anterior rays of ID. The skin between the dorsal row of scales and the lateral line (and under it) is bare; the head underside and belly naked.

Dorsal row of scales (Dl) is complete anteriorly (it begins above the base of the opercular lobe); posteriorly it does slightly not reach the end of the caudal peduncle. The first lateral line scale (Ll) is located under the 3rd–4th scale of *Dl*; behind it reaches the base of the caudal fin, the last scale does not extend beyond the edge of the hypural plate. The scales of the dorsal row are rounded or triangular, finely serrated along the edge, bearing up to 7-10 small spinules. Lateral-line scales rounded, serrated along upper margin (up to 7-8 small spinules); below the pore of the canal, they are embedded in skin (no spinules; on some, may 1 or 2 be present). On the caudal peduncle, in front of the base of caudal fin there is one scale above the lateral line; no scales below *Ll*. There are 9 axillary scales under the pectoral fin on the right, 10 on the left side (in 4 rows, from top to bottom 4/5, 3, 1 and 1 scales). No scales along the anal-fin base.

Counts and measurements are given in Tables 3 and 4.

Radiograph (Fig. 2B, 3B). Like other *Icelus* (Nelson 1984), the first vertebra has a shortened neural

	Lectotype ¹		Paralect	otypes			
Characters	No. 21898	No. 21899	Lim ²	М	SD		
TL, mm	92	122	71–77				
<i>SL</i> , mm	77	100	59 - 66				
Sex	ę	ę	5 ç 6 ơ				
		In % <i>SL</i> :					
Head length (HL)	38.2	39.0	33.9-37.9	36.2	1.3		
Greatest body depth	28.3	27.4	25.5 - 27.9	26.8	0.9		
Body width between <i>P</i> -fin bases	22.2	21.3	18.3 - 22.0	20.2	1.3		
Preanal length	52.6	54.8	53.1 - 58.1	55.0	1.9		
Predorsal <i>ID</i> length	39.6	37.1	35.2 - 37.9	36.5	0.9		
Predorsal <i>IID</i> length	53.6	57.3	51.6 - 55.6	53.7	1.7		
Pectoral-fin length	18.8	28.0	27.5 - 30.5	28.7	1.1		
Ventral-fin length	18.2	18.3	16.1 - 20.3	17.7	1.4		
Length of anal-fin base	14.3	11.0	11.0 - 15.3	13.4	1.3		
Caudal peduncle length	15.8	18.5	16.1 - 19.7	18.0	1.2		
Depth of caudal peduncle	6.0	6.5	5.5 - 6.3	6.0	0.3		
Caudal-fin length	19.5	19.4	19.4 - 24.4	21.0	1.5		
Length of 1st ray of ID	9.1	10.0	5.9 - 13.3	9.0	2.2		
Length of 2nd ray of ID	7.8	12.0	5.8 - 14.2	9.5	2.4		
Length of 3rd ray of ID	8.4	13.5	6.1 - 13.2	9.4	2.3		
In % HL:							
Head depth	68.0	61.5	66.5 - 78.9	70.2	4.3		
Snout length	32.3	35.6	29.6 - 41.0	33.5	3.8		
Orbit diameter	28.2	28.2	32.0-37.1	35.3	1.7		
Interorbital width	6.8	5.6	5.5 - 9.3	7.2	1.5		
Upper jaw length	59.5	57.7	52.3 - 60.9	57.5	3.1		
Nuchal tubercle length	9.2	6.2	10.0-13.6	11.6	1.2		
	In %	of caudal peduncle	length				
Depth of caudal peduncle	37.7	35.1	31.0 - 35.5	33.0	1.6		

Fable 3. Morphometry	of type sp	pecimens	of I.	ochotensis.
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¹ The lectotype was once dried up, but all the characteristics of the species are clearly present.

² Data are given for 9 specimens (*TL* 71–77 mm): ZIN Nos 21901 (3); No. 21902 (2), No. 21903 (4).

Abbreviations. Lim – limits, M – average, SD – standard deviation.

process. The two anterior rays of D are close together and sit on the first pterygiophore; the latter is in front of the first elongated neural process. Vertebrae 38 (precaudal 12, caudal 26, including the urostyle). The first ray of *IID* is between vertebrae 9 and 10. The anal fin begins under the 2nd ray of *IID*. There are 2 precaudal rays A; 11 principal rays C.

Paralectotypes (35), large female TL/SL 121/100 mm (Fig. 4A) and young specimens TL 57–77 mm, SL 48–66 mm (Fig. 4B, Fig. 5). Measurements are given separately (Table 3). The tubercles on head usually look like those of the lectotype, 2 pairs, bluntly rounded and covered with skin; nuchal tuber-

cles are longer than parietal ones and directed backwards. The only exception is the female *TL* 121 mm (No. 21899), whose parietal tubercles are somewhat smaller than usual and more smoothed. The teeth on jaws, vomer and palate are conical, small, in several rows. The gill rakers on the outer side of the first arch 7–10 in number (average 8.4, n=10); they are oval, flattened, studded with small spinules; on the inner side of the first arch and the remaining arches the rakers are tuberculate. Supraorbital cirri are simple (unbranched), blackish in color. The dorsal row of scales reaches forward to the head. The lateral line begins under scales 3–4 of the dorsal row and does

Characters	Loototupo	Type series ¹					
Characters	Lectotype	Lim	Mean	SD			
TL, mm	92	57-122					
SL, mm	77	48-100					
Sex	ę	13 q, 23 ď					
		Number of vertebrae:					
Precaudal	12	11-13	11.8	0.6			
Caudal	26	25 - 29	26.3	0.8			
Total	38	37 - 40	38.1	0.6			
		Number of rays:					
ID	9	7 - 9	8.4	0.6			
IID	15	15-19	17.0	1.0			
A	14	13-16	14.2	0.6			
Р	17	17-18	17.3	0.5			
С	11	11-12	11.6	0.2			
	Number of scales:						
Ll	39	38-40	39.6	0.7			
Dl	29	29-34	31.8	1.2			

Table 4. Counts of Icelus ochotensis.

¹ Data for 36 specimens: lectotype ZIN No. 21898 and paralectotypes No. 56960, No. 21899 (1), No. 21901 (7); No. 21902 (9); No. 21903 (14), No. 21904 (3).



Fig. 5. *Icelus ochotensis*, head of a young female *TL* 77 mm (ZIN No. 21902, paralectotype): a - supraorbital cirrus on the supraorbital ridge; b - parietal tubercles; c - nuchal tubercles; d - first scale of the dorsal row; e - first scale of the lateral line.

not extend onto the caudal fin. The scales of the lateral line, bearing small spinules along the upper edge, below the canal pores are usually immersed in the skin entirely and are not armed; only 1 or 2 spinules may be barely noticeable. On the caudal peduncle at the base of *C* there is one scale above the lateral line (n=35), and in 6% of specimens there is also one scale below *Ll*. Axillary scales 6–13 (average 8.8, n=12), in the upper row there are 2–5 of them. The pectoral fin, without a notch, reaches 4–5 rays *A*, its 8th ray from below is usually the longest. The ventral fin reaches the anus, *V* rays I 3. The urogenital papilla of males is cylindrical (not flattened), with a short claw-like process at the apex.

Radiograms as in lectotype. The first pterygiophore of *IID* is between vertebrae 9 and 10 or 10 and 11. Precaudal rays A 2. Primary rays C usually 11 (6+5), less often 12 (6+6) (in 2 out of 36 specimens).

Color (after alcohol). There are 3 dark indistinct spots on the body, obliquely elongated; a spot at the base of the caudal fin present; supraorbital cirri black-ish. The underside of body is light yellowish.

Sexual dimorphism. No differences were found between the sexes in terms of diagnostic characters. Males are distinguished by presence of urogenital papilla, 10.0-13.3 (average 11.4) % SL in length (n=8, TL 63-76 mm).

Additional materials

In addition to juveniles, specimens of *I. ochotensis* from the Sea of Okhotsk were studied (n=47, from 8 st). No differences from the type specimens were found in diagnostic characters. The exception is, in 2 specimens *TL* 80 and 83 mm (out of 12, No. 22019), parietal tubercles are somewhat smaller than usual, and more smoothed; otherwise there are no discrepancies. In other respects these fish do not differ from others. Scales of *Dl* and *Ll* as described above (Fig. 6).

The seismosensory system (Fig. 7) does not differ in plan from the system of Myoxocephalinae, Artediellinae (Neelov 1979), as well as from the pore scheme of *I. rastrinoides* (Kai et al. 2023). Numbers of terminal pores are: nasal 2, supraorbital 5, infraorbital 8, postorbital (=temporal) 6, preoperculo-mandibular 10; coronal 1, occipital 3; some of them have additional tiny pores on the canals or skin canaliculi.

The nasal canal has two pores $(n \ 1-2)$; the anterior pore may have one additional tiny pore. There are 5 pores in the supraorbital canal (so 1-5); of these, so 1 and 2 (only on the left- or right-side canal) may each have one additional small pore; the pore so 4 can be single or double; the pore so 5 can be represented by one pore or a group of 2-3 small openings. The infraorbital canal has 8 large terminal pores (io 1-8) and two rows of tiny additional pores along the io canal (from 7 to 10, and from 10 to 12 in a row; 17–20 in total). In the postorbital (=temporal) canal, (counting from the junction of the supraorbital and infraorbital canals to the first segment of canal *Ll*), there are 6 pores (t 1–6). The pores t1 to t5 may have 0 to 3 additional tiny pores. Preoperculo-mandibular canal has 10 terminal large pores $(pm \ 1-10)$ of which the pores 5-10 may have additional tiny pores; the right and left *pm*-canals do not connect at the jaw symphysis. In the coronal commissure, the coronal pore is double, anterior (ca) and posterior (cp). In the occipital commissure, the central occipital pore (occ) is double and opens at the ends of the anterior and posterior canaliculi (occa and occp); the central lateral (occl) and lateral (ocl) pores are also double, with anterior (occla and ocla) and posterior (occlp and oclp) pores.

Cirri. In addition to the supraorbital cirri, there may present maxillar (simple or short flattened plate), suborbital (simple or trapezoid plate), opercular (simple) and a few lateral-line (simple) cirri. Some males also have tiny simple cirri sitting on the tops of the parietal tubercles.



Fig. 6. *Icelus ochotensis*, scales of the dorsal row (A) and lateral line: in the trunk region (B) and in the caudal region (C, D).

Main characters of the species are clear even in fry TL 34–49 mm. But compared to larger fishes, the both scale rows are slightly shorter; Ll does not

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Fig. 7. Seismosensory system of *Icelus ochotensis*; c – coronal pore (double: anterior and posterior); *io* 1–5 and *io* 6–8 – terminal pores of the infraorbital canal, with 2 rows of additional canal pores; Ll 1 is the first pore of the lateral line canal; n 1–2 – nasal pores, pm 5–10 – pores of the preoperculo-mandibular canal; *so* 1–5 – supraorbital pores (*so* 5 is represented by 2 pores); t 1 (triple), t 2–4 and t 5–6 – pores of the temporal canal (t 2 is double, medial and lateral; pores t 3–4 are triple); in the occipital commissure, double pores (anterior and posterior): central – *occ*, and (right, left) central lateral – *occl* and lateral – *ocl*.

reach the end of the hypural plate by the length of one scale, Dl by a distance equal to approximately 4 scales. Plate scales of Dl and Ll have fewer spinules: in the precaudal part there are 3–4 of them per scale, on the caudal peduncle there are two and even one. Small spinules on the head and back above Dl are less numerous. In juvenile males TL 34–42 mm long, the urogenital papilla is somewhat shorter (7.4–9.3% SL, average 8.4%) (n=4). Males are already smaller than females, TL 34–42 mm (average 43.5 mm) and TL39–49 mm (44.6 mm) respectively (n=6, each sex). Fish of the next age group (1+) have a length of *TL* 57–60 mm, *SL* 48–50 mm. In our samples, there are 1.7 times more males than females, in the proportion of 33:19 (n=52).

Length. The largest specimens are *TL* 124 mm (female No. 34936) and 77 mm (male No. 44824).

Comparative notes

After synonymizing I. toyamensis (Matsubara et Iwai, 1951) with I. rastrinoides Taranetz, 1936 (Taranetz 1936; Kai et al. 2023:16), the genus includes 18 valid species (Fricke et al. 2022). The Okhotsk sculpin is in the group "I. bicornis", which, in addition to the nominal species, includes I. spatula, I. uncinalis and I. stenosomus. In this group, it was considered the closest to I. spatula (Andriashev 1937; Schmidt 1950). Most noticeable sign of the latter is the spatulate shape of the urogenital papilla of adult males, flattened and widens at the end (it is clearly visible in the holotype USNM-74367 (see link in references: USNM 2023). In I. ochotensis, the urogenital papilla is cylindrical (not flattened or widened towards the end) (Fig. 4B). In addition, I. ochotensis differs in the extent of *Dl*; in front it is complete (reaches the head), while in *I. spatula* it is incomplete (begins under *ID*) or interrupted (with one, rarely two small scales behind the head and continuous behind the beginning of ID). The Okhotsk sculpin has more axillary scales, overall 3–18 (average 9.1) vs. 2–9 (5.1); other counts are similar (Table 5). In I. ochotensis, the supraorbital cirri are longer on average, 21.6 (12.5-27.3)% of eye diameter vs. 13.6 (4.5-28.6)%. The shape and length of the occipital tubercles is different: the nuchal tubercles in I. ochotensis are blunt and short 32.3 (21.8-40.0) % of eye diameter, while in *I. spa*tula they are pointed and longer 36.8 (27.3-46.2)% of eye. The parietal tubercles in I. ochotensis are usually elongated, slightly shorter than the nuchal ones, while in *I. spatula* they are bump-shaped.

I. spatula bispinis is well distinguished by the shape and size of the nuchal spines; they are conical, sharp and noticeably elongated, 38.3 (31.3–46.7)% of eye diameter *vs.* 32.3 (21.8–40.0)% in *I. ochotensis* (other differences see in: Andriashev 1937).

Icelus ochotensis differs from *I. uncinalis* in the shape of head spines (in the former they are blunt and hidden in the skin; in the latter the spines of both pairs are sharp). The supraorbital cirri in *I. ochotensis* are simple, while in *I. uncinalis* the cirri are multified (widen from a narrow base and divided at the

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Counts	I. spatula	I. s. bispinis	I. uncinalis	I. u.crassus ²	I. ochotensis
n	28	8	14	1	39
ID	$\frac{8{-}10}{9.0/0.4}$	$\frac{8-9}{8.9 / 0.4}$	$\frac{8-9}{8.6 / 0.5}$	8	$8.\overline{4 / 0.6}$
IID	$\frac{17-20}{19.0 \ / \ 0.9}$	$\frac{18-20}{19.0 \ / \ 0.8}$	17–20 18.3 / 1.0	20	$rac{15-19}{17.0 \ / \ 1.0}$
Α	$\frac{14-18}{15.8 \ / \ 0.9}$	$\frac{15{-}17}{15.6/0.8}$	$rac{14-16}{15.1 \ / \ 0.9}$	16	$rac{13-16}{14.2/0.6}$
С	$\frac{11-12}{11.6 \ / \ 0.5}$	$\frac{11-12}{11.8 / 0.5}$	$\frac{11-12}{11.5 \ / \ 0.5}$	11	$\frac{11-12}{11.6/0.2}$
Vert abd	$\frac{11-13}{12.0 \ / \ 0.3}$	$\frac{10-12}{11.8 \ / \ 0.7}$	$\frac{11-13}{12.1 \ / \ 0.6}$	12	$\frac{11-13}{11.8 / 0.6}$
Vert caud	$rac{26-30}{28.4/0.8}$	$rac{27-28}{27.6/0.5}$	$rac{26-29}{26.8/0.9}$	26	$rac{25-29}{26.3\ /0.8}$
Vert tot	$rac{38-42}{40.5/0.8}$	$rac{38{-}40}{39.4/0.7}$	$rac{38{-}40}{38{.}9/0{.}5}$	38	$rac{37{-}40}{38.1/0.6}$
Dl	$\frac{20-36}{29.6 / 3.4}$	28–34 31.8 / 2.5	$rac{28-34}{31.4/2.1}$	29	$rac{25-34}{30.5/2.5}$
Ll	$\frac{33-43}{41.2/2.6}$	42	$\frac{40-43}{41.4 \ / \ 0.8}$	41	$\frac{38-43}{40.5/1.3}$
Axil tot	$\frac{2-9}{5.1 / 1.6}$	$\frac{2-15}{8.5 / 4.6}$	$\frac{9-23}{13.4 \ / \ 3.5}$	11	$\frac{3-18}{9.1 \ / \ 3.9}$

Table 5. Counts of *Icelus* according to our data¹.

 1 Lim in the numerator, mean / SD in the denominator.

² The specimen No. 21900.

apex). The lateral line in the first does not extend onto the caudal fin, in the second it extends with one scale to the *C*. There is a scale at the base of the caudal fin above the lateral line (absent in *I. uncinalis*). The number of axillary scales in the Okhotsk sculpin is on average fewer, 9.1 (3–18) vs. 13.4 (9–23).

Icelus ochotensis differs from I. uncinalis crassus in the presence of parietal tubercles (absent in the latter), as well as *Dl*, complete anteriorly (vs. incomplete *Dl*). The status of crassus requires separate consideration; there is no sufficient reason to consider it conspecific with I. ochotensis, as some authors do (Nelson 1984 et auctorum).

Unlike *I. bicornis*, whose characteristic feature is the shape of the urogenital papilla with an elongated appendage at the end, the Okhotsk sculpin has short appendage, claw-shaped. Lateral line in adult *I. ochotensis* is complete at the end and reaches the base of *C*-fin (*vs.* does not reach *C* base). The scales *Ll* are embedded into the skin below the pores of the canal and are not serrated (or 1–2 spinules hardly visible), whereas in *I. bicornis* they bear numerous spinules below the pores (Jensen and Volsøe 1949; Zorina and Chernova 2022a), see also the Table 1. Icelus ochotensis differs from *I. stenosomus* in the presence of parietal tubercles (in the latter they are absent), the nuchal tubercles are blunt and hidden in the skin (sharp and directed backward in the latter); the body is quite high (low and slanted in *I. stenosomus*, its height on the vertical of the posterior edge of the orbit is less than 15% *SL*), the occipital pit is present (vs. absent).

As for the other two groups of species, "I. spiniger" and "I. euryops", as well as I. gilberti and I. armatus, the differences between the Okhotsk sculpin and them are given in the Table 1, compiled on basis of a revision of the genus (Nelson 1984).

The differences from the later described species that were not included in the Nelson's table are clear. By the presence of 2 pairs of spines on the head, *I. ochotensis* differs from *I. mandibularis* Yabe in Amaoka et al., 1983, *I. hypselopterus* Fukuzawa, Mori, Matsuzaki et Kai, 2022 and *I. sekii* Tsuruoka, Munehara et Yabe, 2006, since these species lack parietal spines (Yabe 1983; Tsuruoka et al. 2006; Fukuzawa et al. 2022). *Icelus ochotensis* differs from *I. ecornis* Tsutsui et Yabe, 1996 in the number of axillary scales (6–13 vs. 26–48) and the absence of



Fig. 8. Records of *Icelus ochotensis*; 1 – lectotype, 2 – paralectotypes, 3 – additional material. Map: https://www.google.com/maps/search

nuchal cirri (Tsutsui and Yabe 1996). The species *I. mororanis* (Jordan et Seale, 1906), described in the genus *Stelgistrum* Jordan et Gilbert, 1898 and transferred to the genus *Icelus* (Tsuruoka et al., 2009), is characterized by the absence of both parietal and nuchal spines; this distinguishes it from other *Icelus* species, including *I. ochotensis*.

Distribution. Specimens of the type series *I. ochotensis* were collected in the Sea of Okhotsk, in the area of the Shantar Islands, Iona Island, north to the Koni Peninsula (Cape Alevina) at depths of 55–121 m on rocky grounds (Fig. 8). Additional materials came mainly from the Sea of Okhotsk, from depths of 25–120 m. An analysis of the species' range based on the revision of the entire extensive ZIN collection is beyond the scope of this work, but 3 specimens of Okhotsk sculpin, reidentified from "*I. spatula*" were caught in the Olyutorsky Bay of the Bering Sea (72–73 m).

Distribution of "*I. ochotensis*", accoding to published information, is extensive and should be revised. It is recorded in the high-boreal Asian waters, the Sea of Okhotsk and off southeastern Kamchatka, depth 10–210 m (Sheiko and Fedorov 2000). According to other reports, the range is wide-boreal and includes also the northern part of the Sea of Japan, the northern Kuril Islands (Parin et al. 2014), the waters of Korea (Fricke et al. 2022). It is obvious, however, that the range needs to be clarified, since in modern keys the species is interpreted according to Nelson (1984), and included specimens (with one pair of spines on the head) that do not belong to it.

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