ISSN 1063-0740, Russian Journal of Marine Biology, 2020, Vol. 46, No. 2, pp. 81–87.

ORIGINAL PAPERS

The Distribution of Adult Males of the Siberian Lumpsucker *Eumicrotremus asperrimus* (Tanaka, 1912) (Cyclopteridae) off the Northern Primorsky Krai Coast, Sea of Japan, and Remarks on the Reproduction of this Species

V. V. Panchenko[a, b], * **and A. A. Balanov**[b], **

[a] *Pacific Branch, Russian Federal Research Institute of Fisheries and Oceanography, Vladivostok, 690091 Russia*

[b] *Zhirmunsky National Scientific Center of Marine Biology, Far Eastern Branch, Russian Academy of Sciences, Vladivostok, 690041 Russia*

**e-mail: vlad-panch@yandex.ru*

***e-mail: abalanov@imb.dvo.ru*

Received February 7, 2019; revised April 10, 2019; accepted May 30, 2019

Abstract—In northern Primorsky Krai, males of the Siberian lumpsucker *Eumicrotremus asperrimus* (Tanaka, 1912) with much reduced or missing bony tubercles occur almost all along the coastline. The lack or significant reduction of bony tubercles in males is a secondary sexual characteristic of this species indicating that such males can participate in breeding. Three main stages are distinguished in the breeding cycle of males of *E. asperrimus*: occupation of a spawning substrate, spawning proper, and guarding of eggs. In waters off northern Primorsky Krai, *E. asperrimus* spawn in the shelf zone during spring and fall, with a peak in spring. The most favorable depths for spawning are from 60 to 100 m. The fish use abandoned shells of large gastropods as the spawning substrate. Clutches of fertilized eggs are guarded by males.

Keywords: *Eumicrotremus asperrimus*, *Cyclopteropsis lindbergi*, *C. bergi*, males, Primorsky Krai, bony tubercles, distribution, size composition, spawning season

DOI: 10.1134/S106307402002008X

INTRODUCTION

Lumpsuckers of the genus *Eumicrotremus*, which belong to the family Cyclopteridae, are common inhabitants of the temperate and cold seas of the Northern Hemisphere [5, 10, 13]. In the Russian waters of the Sea of Japan, three members of this genus are found: *Eumicrotremus asperrimus*, *E. pacificus*, and *E. taranetzi* [22]. Of these, only the Siberian lumpsucker *E. asperrimus* forms a relatively high biomass and abundance [11]. Its seasonal spatial distribution in this region was studied quite in detail [1], and a low number of sexually mature males in catches was noted. Subsequent experimental [16] and genetic [17] studies have shown that *C. lindbergi* Soldatov, 1930 and *C. bergi* Popov, 1929, which were previously considered as independent species of the genus *Cyclopteropsis*, are, in fact, males of *E. asperrimus*. Regarding *C. lindbergi*, this conclusion is likely to be accepted as true, since both species (*E. asperrimus* and *C. lindbergi*) were described from the Sea of Japan and their ranges in this sea and in the southern Sea of Okhotsk completely overlap. *C. bergi* was described from the northern Sea of Okhotsk, where *E. asperrimus* has never been found. We may assume that *C. bergi* is actually the males of one of the species belonging to the genus *Eumicrotremus* that inhabits the northern Sea of Okhotsk. Obviously, the species from the Sea of Japan and the southern Sea of Okhotsk that fits the description of *C. bergi* should be considered as *C.* cf. *bergi*.

Members of the genus *Cyclopteropsis* have been common species in bottom trawl catches from the northern Sea of Japan and were clearly identified [10, 11]. Approximately 70% of the fish attributed to the genus *Cyclopteropsis* were identified as *C. lindbergi*, and the rest as *C.* cf. *bergi*. This study is based on an analysis of distribution of individuals previously attributed to *C. lindbergi* and *C.* cf. *bergi*.

Hatano et al. [16] noted that after reaching 17 months of age males of *E. asperrimus* with a body length of 63–85 mm *SL* (estimated *TL* = 80–100 mm) with complete or partial lack of bony tubercles did not grow, were aggressive, and competed for a spawning substrate (empty buccinid shells), i.e., they were ready to participate in reproduction. No information is available on the ecology of males of *E. asperrimus* at this stage of their life cycle.

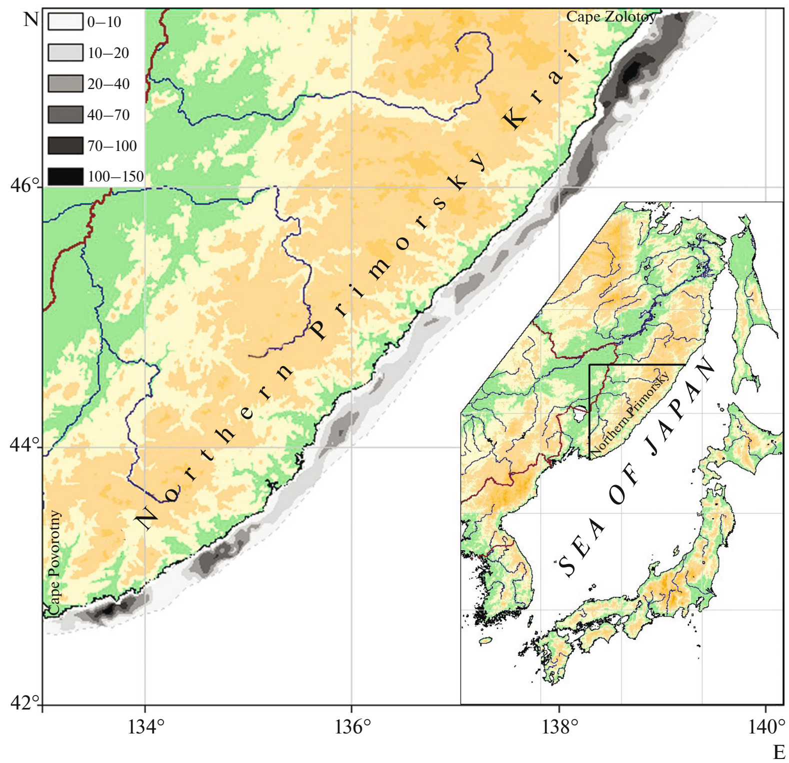

Fig. 1. The study area and spatial distribution (fish/km^2) of adult males of *Eumicrotremus asperrimus* off the northern Primorsky Krai coast in the spring–fall period.

The goal of the present study is to describe the vertical and horizontal distribution of adult males of *E. asperrimus* and discuss some aspects of reproduction of this species.

MATERIALS AND METHODS

The authors refer to males of *Eumicrotremus asperrimus* with a complete or an almost complete lack of bony tubercles at different stages of their breeding cycle, that is, occupation of the spawning substrate, spawning proper, and guarding of eggs, as adult males. No histological studies and dissection have been carried out to identify the stages of gonad maturity.

The present study is based on materials collected during the bottom trawl surveys in the Russian waters of the Sea of Japan aboard the vessels of the Pacific Research Fisheries Center (TINRO-Center). *E. asperrimus* in the northwestern Sea of Japan mainly inhabits the waters off the northern Primorsky Krai coast in the area bounded by Cape Povorotny in the southwest and by Cape Zolotoy in the northeast [1]. In this regard, we analyzed data obtained in the waters off northern Primorsky Krai to study the distribution patterns of adult males of *E. asperrimus* (Fig. 1). In our study, we used the results of bottom trawl surveys conducted on the shelf and continental slope at a depth from 10 to 935 m in late March to early December in 2004–2018. Catches were made with a DT/TV 27.1/24.4 bottom trawl equipped with a soft groundrope, a 10-mm fine-mesh liner in the cod end, and a horizontal opening of 15–16 m. The trawling speed varied from 2.2 to 3.5 kn (mean, 2.8 kn). Data from a total of 1919 trawl catches were analyzed, of which most (1778) were accompanied by measurements of the near-bottom water temperature. A total of 463 individuals were measured (*TL*). During mass measurements, the measurement accuracy was to 1.0 cm; measurements of single individuals were accurate to 0.1 cm. The frequency of occurrence was calculated as the ratio of the number of successful trawl hauls to their total number in a certain bathymetric range, expressed in term of percentage. The density of the fish distribution was estimated based on catches using the formula:

$$P = B/S,$$

where P is the density, fish/km^2; B is the catch size, fish; and S is the area of trawling, km^2.

When analyzing the seasonal distribution of *E. asperrimus*, we determined the hydrological seasons according to Zuenko's classification [2]: the winter period includes January and February; spring, March and April; summer, June–September; fall, November and December. May was a transitional month between the spring and summer seasons; October, between the summer and fall seasons. Since the distribution of benthic fishes off the northern Primorsky Krai coast in May is more similar to that in the spring [11], this month was attributed to the spring season. In October, studies were conducted only in the second half of the month, which allowed us to attribute the month to the fall period. According to this classification, most trawl hauls (1264) were performed in the spring; 494 trawl hauls, in the summer; and 161, in the fall.

The spatial distribution analysis was carried out using the CHARTMASTER software package. The distribution map was composed using the method of spline approximation with a smoothing factor equal to 1.

RESULTS

The analysis of the spatial distribution of adult males of *Eumicrotremus asperrimus* has shown their aggregations to be quite stable. Off the northern Primorsky Krai coast, such males were found almost everywhere, with the highest concentrations recorded from the northeast and southwest of the study area. Local spots of lower density were also observed in some other areas (Fig. 1).

The narrowest bathymetric range of habitat of adult males was in the period of hydrological summer. At this time, they occurred at a depth of 65 to 128 m. The frequency of occurrence of fish was the highest at depths of 60–80 and 80–100 m, and decreased with increasing depth (Fig. 2a). A similar pattern was observed for mean density as well (Fig. 2b). In the fall and spring, as in the summer period, adult males of *E. asperrimus* concentrated mainly at a depth of 60–100 m, but the bathymetric range of their habitat was wider (Fig. 2). In the fall, the minimum depth where fish were found, as in the summer, was 65 m, while the maximum depth reached 241 m. The expansion of the bathymetric range of adult males in the spring occurred mainly to the zone of shallow depths (up to 25 m); the maximum depth of their habitat was 162 m. In the spring period, the density and frequency of occurrence of *E. asperrimus* were higher than in the fall and summer periods (Fig. 2).

The water temperature at the time of the captures of adult Siberian lumpsucker males varied from –1.0 to 4.4°C, while at the depths of their habitat the water temperature in the spring period ranged from –1.2 to 4.6°C; in the summer, from 1.1 to 4.9°C; and from 0.8 to 3.3°C in the fall. In the spring, adult males were found at temperatures from –0.1 to 3.5°C; a higher frequency of their occurrence was recorded at negative temperature values (Table 1). In the summer, as the water became warmer, the minimum temperature at which adult males were caught, was 1.1°C; the maximum, reached 4.4°C and was associated with the shallowest depth of 65 m. At the time of other trawl hauls, the water temperature did not exceed 2.6°C. In the fall, adult males concentrated within a narrow temperature range of 2.6–3.3°C; a capture of one male

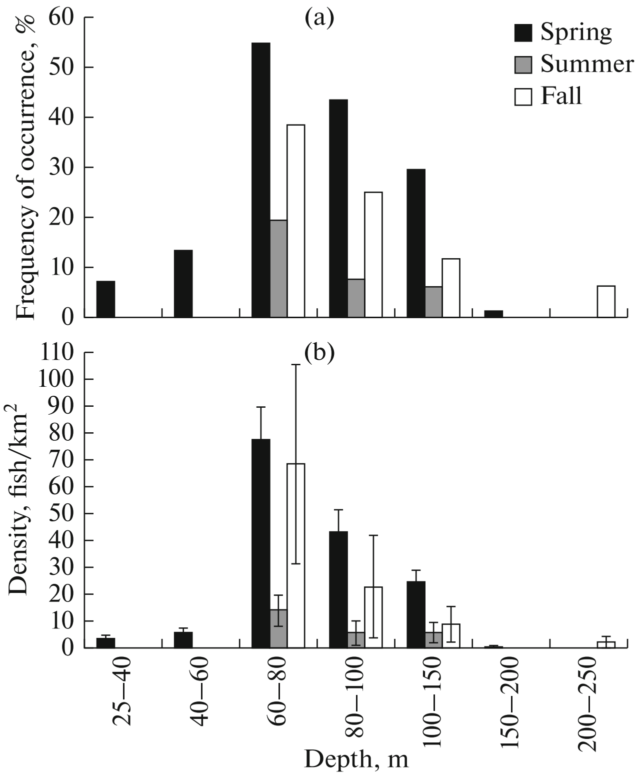

Fig. 2. The frequency of occurrence (a) and mean density (b) of adult males of *Eumicrotremus asperrimus* in waters off northern Primorsky Krai in the spring, summer, and fall seasons. Vertical bars are error of the mean.

was recorded from a depth of 241 m at a temperature of 0.9°C (Table 1).

The minimum body length of adult males of *E. asperrimus* was 5.0 cm *TL*; the maximum length was 9.0 cm (Table 2). To date, it has been known that in natural conditions the maximum size of males, which were previously attributed to *Cyclopteropsis lindbergi* and *C.* cf. *bergi*, is no greater than 7 cm *TL* [4, 7]. Individuals with the minimum and maximum sizes were found in the spring period. In the summer, the body size of fish varied from 5.5 to 7 cm; in the fall, from 5.2 to 7.5 cm *TL*.

In the spring, males with minimum sizes (approximately 5 cm *TL*) were found at all the surveyed depths, except for depths greater than 150 m. Fish with maximum sizes were caught at depths of 40–60 and 60–80 m (Table 2), with the mean size of caught fish being higher in the former depth range. When the depth decreased or increased, the mean size of fish tended to decrease, but at a depth of 100–150 m their body length increased. The length of an individual caught from a depth of 200–250 m was almost 8 cm. In the summer, both the minimum and maximum sizes of adult males of *E. asperrimus* were similar between all the three depth ranges where they were found, with the mean body length of fish slightly increasing with depth

Table 1. The frequency of occurrence (%) of adult males of *Eumicrotremus asperrimus* off the northern Primorsky Krai coast depending on the near-bottom water temperature in different seasons

Season	Temperature, °C										
	–1 to –0.5	–0.5–0	0–0.5	0.5–1	1–1.5	1.5–2	2–2.5	2.5–3	3–3.5	3.5–4	4–4.4
Spring	54.5	44.4	33.3	22.4	29.8	38.7	16.7	13.5	16.0	0	0
Summer	–	–	–	–	33.3	7.1	8.6	33.3	0	0	33.3
Fall	–	–	–	33.3	0	0	0	77.8	50.0	–	–

"–", data unavailable.

Table 2. The minimum (min), maximum (max), and mean (*M*) sizes (cm) of adult males of *Eumicrotremus asperrimus* in bottom trawl catches from different depths off the northern Primorsky Krai coast in the study seasons

Depth, m	Spring					Summer					Fall				
	min	max	*M*	±	*n*	min	max	*M*	±	*n*	min	max	*M*	±	*n*
25–40	5.0	7.5	5.9	0.26	13	–	–	–	–	–	–	–	–	–	–
40–60	5.0	9.0	6.9	0.21	15	–	–	–	–	–	–	–	–	–	–
60–80	5.1	9.0	6.0	0.04	205	5.5	6.8	5.8	0.18	13	5.2	7.5	5.7	0.10	25
80–100	5.0	7.6	5.9	0.06	84	5.6	7.0	6.3	0.38	4	5.3	6.7	6.0	0.20	6
100–150	5.2	7.7	6.1	0.07	82	5.5	7.0	6.4	0.26	8	5.5	6.5	6.3	0.15	6
150–200	8.0	8.0	8.0	–	1	–	–	–	–	–	–	–	–	–	–
200–250	–	–	–	–	–	–	–	–	–	–	6.0	6.0	6.0	–	1

"±", error of the mean; *n*, number of measured specimens.

(Table 2). During the fall period, the smallest and largest individuals were caught at a depth of 60–80 m; the mean size of fish increased to the 150-m isobath. The length of an individual caught at a depth of 200–250 m was 6 cm (Table 2).

Females of Siberian lumpsucker laid eggs in the cavity of abandoned buccinid shells. Adult males guarding egg clutches were found in all the seasons. Thus, on April 9, 2007, a male with a length of 67 mm *TL* (52 mm *SL*) with no bony tubercles was caught from a depth of 100 m. It was firmly attached by suction to the aperture of an empty shell of the gastropod *Neptunea lyrata* (Gmelin, 1979), covering the clutch of developing eggs inside with its body (Fig. 3). It should be noted that the male remained "on duty" even after the catch was shaken out on the deck. However, apparently not all males are able to stay in the shell after being captured by a trawl. As an example, on April 5, 2009, during sorting out a trawl catch from a depth of 36 m, a shell was found with a clutch of developing eggs but without the male. Adult males were also found in empty shells without eggs. Thus, on July 4, 2007, during sorting out a trawl catch from a depth of 128 m, three adult males of *E. asperrimus* of 6–7 cm *TL* were found, of which one was in a shell filled with a clutch of eggs, the second was in an empty shell, and the third was without a shell; on November 4, 2010, several males of 5–6 cm *TL* in buccinid shells with laid eggs were found at a depth of 75 m.

Fig. 3. A sexually mature male of *Eumicrotremus asperrimus* guarding an egg clutch. The spawning substrate is a shell of the gastropod *Neptunea lyrata* (Gmelin, 1979).

DISCUSSION

The collected data on the spatial distribution and temperature range of habitat of adult males of *E. asperrimus* off the northern Primorsky Krai coast generally agree with the published data [1], except for information about the depths of densest aggregations. According to Antonenko et al. [1], the main concentrations of *E. asperrimus* were confined to depths of

100–300 m. Nevertheless, we have shown that in the summer–fall period, adult males concentrated at depths of 60–100 m. It should be noted that Antonenko et al. [1] referred to only individuals fully covered by bony tubercles as *E. asperrimus*. The strong and dense armament with bony tubercles is one of the characteristic traits of this species [4, 5, 22]. Experimental data of Hatano et al. [16] made it clear that the material used in the work of Antonenko et al. [1] consisted of females of all ages and immature males. In the spring there were more females than males in trawl catches, and almost all males were immature. A similar pattern was reported for *Eumicrotremus spinosus* from the North Atlantic, where the proportion of females in trawl catches was larger than that of males [14]. This difference in distribution can obviously be explained by the fact that adult males aggregate in areas where breeding is to occur, which do not coincide with the feeding grounds of females and immature males.

The biology of *E. asperrimus* is poorly studied. In the northern Sea of Japan, this species was reported to spawn in the summer [7] or spring–summer period [1, 22]. An analysis of data about the spatial and seasonal distribution of adult males of *E. asperrimus* allows us to suggest the main grounds, the season, and the depth of spawning of this species. It is known that males of *E. asperrimus* with a partial or complete lack of bony tubercles are preparing for breeding and can participate in spawning [16]. Among externally indistinguishable adult males, there may be males occupying the spawning substrate (the males caught in empty shells evidently occupied spawning sites and were waiting for females to arrive), spawning, and guarding eggs.

It is difficult to identify adult males in the spawning phase when based solely on data on their distribution, as they can occupy spawning sites (and get into trawl nets) long before spawning. As an example, males of the Atlantic lumpsucker *Cyclopterus lumpus* arrive at spawning grounds a month earlier than females [3, 15]. However, judging by the fact that males of *E. asperrimus* guarding clutches were found in the spring, summer, and fall seasons, this species spawns with varying intensity during the spring–fall period. Data on prespawning and spawning females would clarify the duration of the spawning season and its intensity in different months. However, there is very little data on the period of captures of spawning females of *E. asperrimus* (with an egg diameter of 3–4 mm and a high gonadosomatic index, GSI) from the Sea of Japan (and throughout the species range). Ueno [22] reported the capture of four large females with mature oocytes from the waters of the La Perouse Strait in mid-May; eggs with a maximum diameter (4 mm) were found in a female of 89 mm *SL*. In the Tatar Strait, females in the pre-spawning phase with an egg diameter of up to 3 mm and a GSI of up to 90% were caught in April and May 2007 [1]. Lindberg and Legeza [5] reported about one sexually mature (?) female of 80 mm *SL* caught on June 29, 1932. There is a lack of information about findings of females of *E. asperrimus* with mature eggs in fall and winter.

In the northwestern Sea of Japan, catches of adult males of *E. asperrimus* were at a maximum (Fig. 2) and their size structure was the widest in the hydrological spring (March–May) (Table 2). The most mature females of this species were encountered during the same period. The collected data suggest that the main spawning activity of *E. asperrimus* in this area occurs mainly at a depth of 60–100 m in March–May. The analysis of the spatial distribution of adult males of *E. asperrimus* indicates two main spawning grounds off the Primorsky Krai coast: north of Cape Povorotny and south of Cape Zolotoy (Fig. 1).

As the mass spawning occurs in spring, it is logical to assume that maturation and, consequently, loss of the external armament in males of *E. asperrimus* occur mainly in the preceding cold season, i.e., in fall and winter. This assumption is confirmed by data on the seasonal dynamics of size structure, occurrence, and catches. A characteristic “drop” in the values of occurrence and density of adult males of *E. asperrimus* in catches were recorded in the summer period, when they were at a minimum (Fig. 2). With the main spawning in spring, such situation could have only occurred if spawning males died after fry hatching and if a weak or residual (the male began to guard eggs in the spring) spawning occurred in the summer. In this case, the relatively high catches of adult males of *E. asperrimus* in November and December can be explained by the recruitment of maturing fish of the following spawning year. During the fall period, some adult males were found at a depth of 200–250 m, which may indicate where maturing individuals occur.

Observations of captive individuals in tanks have shown that metamorphosis in males of *E. asperrimus* (after they stop growing) is completed at an age of approximately 1.5 years [16]. The minimum body length of individuals by this time is 6.3 cm *SL* and the maximum is 8.5 cm *SL*, which, according to the estimated data, corresponds to 8 or more 10 cm *TL*. However, when kept in a tank, fish grow faster than in natural conditions due to the regular feeding and a higher water temperature (6–10°C). The minimum and maximum sizes of adult males of *E. asperrimus* in their natural habitats are much smaller (Table 2).

Males with the maximum sizes (up to 9 cm) were encountered in the spring period; their absence in the other seasons can be explained by their death after spawning. The mortality of most males after spawning has been described for *Aptocyclus ventricosus* [12, 21]. The low post-spawn mark-recapture rate in *C. lumpus* (only 10%) in the waters of Iceland could be caused by a high mortality of individuals of both sexes after spawning [18]. According to published data, the mortality rate of females of *E. asperrimus* may also be high.

This probably explains the low abundance of older females of *E. asperrimus* [1].

In the southeastern Sea of Japan, off the coast of Honshu Island (Japan), spawning of *E. asperrimus* was recorded from the deep-sea zone. Three egg clutches of this species (with an egg diameter of 4.3–4.7 mm) were raised from a depth of 340 m in October, and subsequently offspring were obtained from them by incubation [16]. Deep-sea spawning of *E. asperrimus* is probably related with the hydrological features in this part of the Sea of Japan. In this area, the water temperature at depths of up to 200 m is too high [6]; therefore, species of the boreal complex migrate to greater depths than in the northern part of the sea [9, 19, 20].

As known, *E. asperrimus* use abandoned buccinid shells as a spawning substrate [16]. We also found males of *E. asperrimus* guarding eggs laid in shells of large buccinids such as *Neptunea lyrata* (Fig. 3). Judging by the distribution of live mollusks [8], the Siberian lumpsucker in the northern part of the study area should use mainly shells of *Buccinum bayani* (Jousseam, 1883) as a spawning substrate; in the southern part they use shells of common species of the genus *Neptunea*.

CONCLUSIONS

In conclusion, we should note that in northern Primorsky Krai males of *E. asperrimus* that participate in breeding are distributed almost all along the coast, with their highest concentrations formed in the northeast and southwest of the study area. During the summer–fall period, aggregations of males of this species were recorded from depths of 60–100 m.

The lack of bony tubercles or their significant reduction in males of *E. asperrimus* is a secondary sexual characteristic that indicates that the males can participate in breeding. The following stages of the breeding cycle in males of *E. asperrimus* have been identified: occupation of a spawning substrate, spawning proper, and guarding of eggs. Off the northern Primorsky Krai coast, there are two major spawning grounds of the Siberian lumpsucker: north of Cape Povorotny and south of Cape Zolotoy. *E. asperrimus* spawns in the shelf zone in the spring–fall period with a peak in spring; the timing of spawning is associated with a weakly positive water temperature. *E. asperrimus* tends to depths of approximately 60–100 m as the most suitable for spawning. Individuals of this species use abandoned shells of large gastropods as a spawning substrate. Clutches of fertilized eggs are guarded by males.

ACKNOWLEDGMENTS

We are sincerely grateful to V.V. Gul'bin (Zhirmunsky National Scientific Center of Marine Biology, Far Eastern Branch, Russian Academy of Sciences) for identifying the gastropod shells, as well as to the researchers D.V. Antonenko, S.F. Solomatov, P.V. Kalchugin, and M.I. Boyko from the Pacific Research Fisheries Center for their assistance in collecting the material.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interests. The authors declare that they have no conflict of interest.

Statement on the welfare of animals. All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

REFERENCES

1. Antonenko, D.V., Pushchina, O.I., and Solomatov, S.F., Seasonal distribution and some features of the biology of spiny lumpfish *Eumicrotremus asperrimus* (Cyclopteridae, Scorpaeniformes) in the northwestern part of the Sea of Japan, *J. Ichthyol.*, 2009, vol. 49, no. 8, pp. 674–681.
2. Zuenko, Yu.I., Types of thermal stratification of waters on the Primorsky Krai shelf, in *Kompleksnye issledovaniya morskikh gidrobiontov i uslovii ikh obitaniya* (Comprehensive Studies of Marine Organisms and Their Habitat Conditions), Vladivostok: TINRO, 1994, pp. 20–39.
3. Kudryavtseva, O.Yu., *Pinagor Barentseva morya i sopredel'nykh vod* (The Lumpsucker of the Barents Sea and Adjacent Waters), Moscow: Nauka, 2008.
4. Lindberg, G.U. and Krasyukova, Z.V., *Ryby Yaponskogo morya i sopredel'nykh chastei Okhotskogo i Zheltogo morei* (Fishes of the Sea of Japan and Adjacent Parts of the Sea of Okhotsk and the Yellow Seas), Leningrad: Nauka, 1987, part 5.
5. Lindberg, G.U. and Legeza, M.I., Overview of the fish genera and species of the subfamily Cyclopterinae (Pisces), *Tr. Zool. Inst., Akad. Nauk SSSR*, 1955, vol. 18, pp. 389–458.
6. Luchin, V.A., Seasonal variability of water temperature in the active layer of the Far Eastern seas, in *Dal'nevostochnye morya Rossii. Kn. 1: Okeanologicheskiye issledovaniya* (The Far Eastern Seas of Russia, vol. 1: Ocean Research), Moscow: Nauka, 2007, pp. 232–252.
7. Novikov, N.P., Sokolovsky, A.S., Sokolovskaya, T.G., and Yakovlev, Yu.M., *Ryby Primorya* (Fishes of Primorsky Krai), Vladivostok: Dal'rybvtuz, 2002.
8. Repina, E.M., Zuenko, Yu.I., and Sedova, L.G., Buccinidae mollusks distribution at Primorye coast (Japan Sea), *Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr.*, 2011, vol. 165, pp. 74–88.
9. Saveliev, P.A., Balanov, A.A., Kalchugin, P.V., et al., Spatial distribution and thermal regime of habitation of two representatives of the genus *Lycodes* (Perciformes: Zoarcidae) in Russian waters of the Sea of Japan, *J. Ichthyol.*, 2014, vol. 54, no. 1, pp. 30–40.
10. Sokolovsky, A.S., Dudarev, V.A., Sokolovskaya, T.G., and Solomatov, S.F., *Ryby rossiiskikh vod Yaponskogo morya: annotirovannyi i illyustrirovannyi katalog* (Fishes of the Russian Waters of the Sea of Japan: An Annotated and Illustrated Catalog), Vladivostok: Dal'nauka, 2007.

11. Solomatov, S.F., The characteristics of marine ichthyofauna of northern Primorye (Japan Sea), *Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr.*, 2004, vol. 138, pp. 205–219.

12. Ul'chenko, V.A. and Orlov, A.M., Ichthyofauna in the littoral zone of the Sea of Okhotsk coast of Urup Island (Kuril Islands), in *Tezisy mezhdunarodnoi konferentsii po biologicheskim osnovam ustoichivogo razvitiya pribrezhnykh morskikh ekosistem* (Proc. Int. Conf. on the Biological Bases of Sustainable Development of Coastal Marine Ecosystems), Murmansk: PINRO, 2001, pp. 245–247.

13. Fadeev, N.S., *Spravochnik po biologii i promyslu ryb severo-zapadnoi chasti Tikhogo okeana* (A Reference Book on Biology and Harvesting of Fishes in the Northwestern Pacific Ocean), Vladivostok: TINRO-Tsentr, 2005.

14. Berge, J. and Nahrgang, J., The Atlantic spiny lumpsucker *Eumicrotremus spinosus*: life history traits and the seemingly unlikely interaction with the pelagic amphipod *Themisto libellula, Pol. Polar Res.*, 2013, vol. 34, no. 3, pp. 279–287.

15. Goulet, D., Green, J.M., and Shears, T.H., Courtship, spawning, and parental care behavior of the lumpfish, *Cyclopterus lumpus* L., in Newfoundland, *Can. J. Zool.*, 1986, vol. 64, no. 6, pp. 1320–1325.

16. Hatano, M., Abe, T., Wada, T., and Munehara, H., Ontogenetic metamorphosis and extreme sexual dimorphism in lumpsuckers: *Eumicrotremus asperrimus, Cyclopteropsis bergi* and *Cyclopteropsis lindbergi*, may be synonymous, *J. Fish Biol.*, 2015, vol. 86, no. 3, pp. 1121–1128.

17. Kai, Y., Stevenson, D.E., Ueda, Y., et al., Molecular insights into geographic and morphological variation within the *Eumicrotremus asperrimus* species complex (Cottoidei: Cyclopteridae), *Ichthyol. Res.*, 2015, vol. 62, no. 4, pp. 396–408.

18. Kasper, J.M., Bertelsen, B., Ólafsson, H.G., et al., Observations of growth and postspawning survival of lumpfish *Cyclopterus lumpus* from mark-recapture studies, *J. Fish Biol.*, 2014, vol. 84, no. 6, pp. 1958–1963.

19. Nishimura, S., The zoogeographical aspects of the Japan Sea. Part III, *Publ. Seto Mar. Biol. Lab.*, 1966, vol. 13, no. 5, pp. 365–384.

20. Nishimura, S., The zoogeographical aspects of the Japan Sea. Part IV, *Publ. Seto Mar. Biol. Lab.*, 1968, vol. 15, no. 5, pp. 329–352.

21. Zhukova, K., Maznikova, O.A., and Orlov, A.M., Gonadal maturation of the female smooth lumpsucker (*Aptocyclus ventricosus*), *Fish. Bull.*, 2018, vol. 116, no. 2, pp. 153–160.

22. Ueno, T., *Fauna Japonica: Cyclopteridae (Pisces)*, Tokyo: Acad. Press of Japan, 1970.

Translated by E. Shvetsov