

Review Article

Some Rare and Insufficiently Studied Snailfish (Liparidae, Scorpaeniformes, Pisces) in the Pacific Waters off the Northern Kuril Islands and Southeastern Kamchatka, Russia

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Spatial and vertical distributions, size-weight compositions, age, and diets of 10 rare or poorly known snailfish (Liparidae) from the Pacific off the southeastern Kamchatka and the northern Kuril Islands are described. The species include blacktip snailfish *Careproctus zachirus*, Alaska snailfish *C. colletti*, blacktail snailfish *C. melanurus*, proboscis snailfish *C. simus*, falcate snailfish *C. cypselurus*, big-disc snailfish *Squaloliparis dentatus*, longtip snailfish *Elassodiscus obscurus*, slender snailfish *Paraliparis grandis*, gloved snailfish *Palmoliparis beckeri*, and stout snailfish *Allocareproctus jordani*. These species inhabit a wide range of depths. *Careproctus melanurus*, *C. cypselurus*, *E. obscurus*, *P. grandis*, and *C. colletti* are the deepest; *C. simus* and *S. dentatus* occur mostly between 300 and 600 m; the three other species seldom occur at depths of 150–200 m. The life span of these species is 10–13 years, and specimens of age classes 2–5 constitute the bulk of catches. All except *A. jordani* are benthophages that eat small crustaceans, shrimps, hermit crabs, and amphipods. *A. jordani* consumes crustaceans and also polychaete worms, sea snails, octopi, brittle stars, juvenile fish, and fishery offal.

1. Introduction

The family Liparidae is one of the most diverse and abundant fish families in polar and deep-sea habitats [1] and includes species that occur from littoral to ultra-abyssal depths [2]. There are about 50 species in this family in Pacific waters off Kamchatka and the northern Kuril Islands, constituting almost 10% of the total number of fish species inhabiting this area [3–7]. These fish are relatively abundant in number and biomass on the lower part of the continental shelf as well as on the upper continental slope (100–800 m) in most areas of the Far Eastern Seas [3, 4, 8–11]. They are food for and potential food competitors of commercial fish species in groundfish communities. However, until now, snailfish have been poorly studied even in terms of their taxonomy [1]. Published information regarding occurrence, spatial-bathymetric distribution, and biology of most snailfish in the North Pacific as a whole and in waters adjacent to

the Kuril Islands and Kamchatka in particular is extremely limited. The majority of papers containing information on the North Pacific liparids [12–20] are dealing mostly with their taxonomy, geographic and bathymetric ranges, new records, and eventually contain limited information on general biology.

In 1993–2002, in a program to study poorly known and underexploited fish of the continental slope of the Far Eastern Seas in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka (the area from 47° 50' to 52° 00' N, depths of 83–850 m), the Russian Federal (VNIRO), Kamchatka (KamchatNIRO), and Sakhalin (SakhNIRO) Research Institutes of Fisheries and Oceanography jointly carried out more than 60 fishery research cruises onboard Japanese trawlers specially equipped for bottom trawling in areas of the continental slope with rugged topography, in the course of which new data on snailfish distribution and biology were collected.

TABLE 1: Number of specimens examined in this study.

Species	Measured	Length-weight	Aged	Stomach content
<i>Allocareproctus jordani</i>	127	83	10	10
<i>Careproctus zachirus</i>	159	86	32	32
<i>C. colletti</i>	67	16	5	5
<i>C. cypselurus</i>	100	97	97	100
<i>C. melanurus</i>	192	34	—	5
<i>C. simus</i>	16	24	—	—
<i>Elassodiscus obscurus</i>	153	72	72	100
<i>Palmoliparis beckeri</i>	27	19	8	10
<i>Paraliparis grandis</i>	105	55	55	55
<i>Squaloliparis dentatus</i>	30	51	—	—

We provide information in this paper regarding occurrence, spatial-bathymetrical distribution, size-age composition and diets of 10 rare or insufficiently studied snailfishes in Pacific waters off the northern Kuril Islands and southeastern Kamchatka, including Alaska snailfish *Careproctus colletti* Gilbert, 1896, blacktip snailfish *C. zachirus* Kido, 1985, black-tail snailfish *C. melanurus*, Gilbert, 1892, proboscis snailfish *C. simus*, Gilbert, 1896, falcate snailfish *C. cypselurus* (Jordan and Gilbert, 1898), big-disc snailfish *Squaloliparis dentatus* (Kido, 1988), longtip snailfish *Elassodiscus obscurus* Pitruk et Fedorov, 1993 (new common English name proposed), slender snailfish *Paraliparis grandis* Schmidt, 1950, gloved snailfish *Palmoliparis beckeri* Balushkin, 1996 and stout [7] or cherry [21] snailfish *Allocareproctus jordani* (Burke, 1930).

2. Material and Methods

Data for this paper are based on analysis of catches of approximately 11,000 bottom-trawl hauls at depths of 83–850 m (near-bottom temperatures were measured for most hauls) carried out in April–December 1993–2002 aboard the Japanese trawlers “*Tomi-Maru-53*,” “*Tomi-Maru-82*,” and “*Tora-Maru-58*” under the VNIRO-SakhNIRO-KamchatNIRO joint program (hereafter referred to as the 1993–2002 survey). Hauls were made 24 hours a day using bottom trawls with vertical opening of 5–7 m and horizontal opening of 25 m (the parameters of the trawl openings were checked by equipment) at an average speed of 3.6 knots. Because trawl duration varied from 0.5 to 10 hours, all the catches were later normalized to a standard one-hour haul. Distributions of individual species by depth and bottom temperature were analyzed by frequency of occurrence (in percent), calculated based on average catch per hour.

Snailfish were identified to species using keys and descriptions by Gilbert and Burke [22], Burke [23], Hart [24], Stein [25], Kido [26–28], Masuda et al. [29] Pitruk and Fedorov [30–32], Amaoka et al. [33] and Balushkin [34].

To study size-age composition, length measurements and biological analyses of the 10 snailfish species studied were used (datasets for each of the species are given in Table 1).

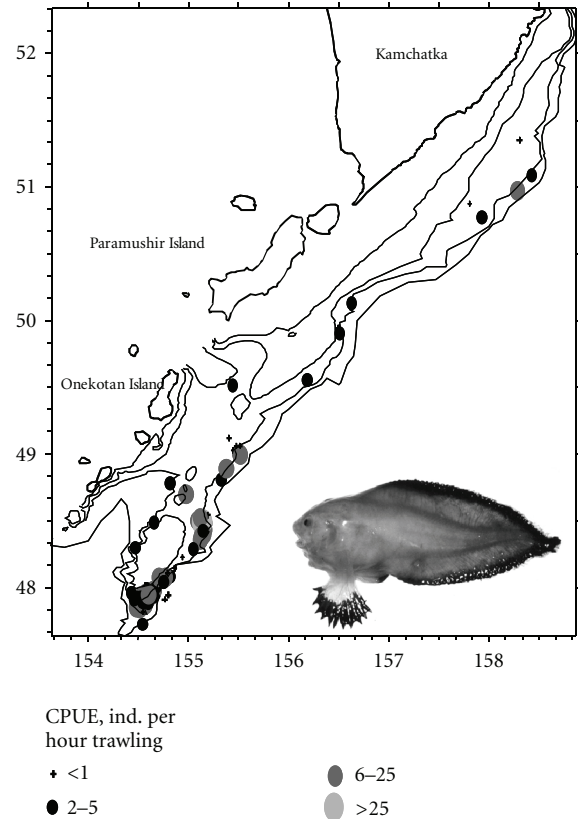


FIGURE 1: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Careproctus zachirus* in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002 (numbers are maximum catches; thin lines are isobaths at 100, 200, 500, and 1000 m).

Age was determined by otoliths using the “break and burn” technique. We assumed annuli were annual. Diet was determined from the results of field analyses made in August–December 1996–2002.

3. Results and Discussion

3.1. Occurrence and Bathymetry

Blacktip Snailfish *Careproctus zachirus*. First described in 1985 from the Bering Sea [27]. It is a high-boreal Asiatic species, from the northern part of the Sea of Okhotsk, off the northern Kuril Islands, eastern Kamchatka, and in the western part of the Bering Sea off the western Aleutian Islands [5–7, 11, 35, 36]. The 1993–2002 survey observed it between 47° 50′ to 51° 30′ N, with maximum catches (>25 specimens/h) from the southern part of the surveyed area, preliminarily from the continental slope of the northern Kuril Islands (Figure 1).

C. zachirus is a mesobenthic species inhabiting depths of 214–850 m [6, 7]. This species was caught at depths of 150–800 m with near-bottom temperatures of 3.0–3.6°C and concentrated mainly in 400–500 m where more than 56% of the specimens were observed (Table 2).

TABLE 2: Bathymetric distribution (percentage of relative abundance within certain depth range) of different snailfish species off the northern Kuril Islands and southeastern Kamchatka.

Species	Depth, m						
	101–200	201–300	301–400	401–500	501–600	601–700	701–800
<i>C. zachirus</i>	0.3	7.2	17.8	56.2	16.0	2.1	0.4
<i>C. colletti</i>	0.0	0.0	1.1	29.5	53.2	16.2	0.0
<i>C. melanurus</i>	0.0	0.2	4.3	12.0	41.4	25.4	16.7
<i>C. simus</i>	0.0	8.7	34.0	49.4	7.9	0.0	0.0
<i>C. cypselurus</i>	0.0	0.0	5.7	33.0	38.6	16.4	6.3
<i>E. obscurus</i>	0.0	0.1	1.6	17.7	49.4	13.4	17.8
<i>P. grandis</i>	0.0	0.1	7.9	8.2	44.0	37.6	2.2
<i>S. dentatus</i>	0.0	39.1	60.7	0.1	0.1	0.0	0.0
<i>P. beckeri</i>	0.0	7.7	26.9	38.5	9.6	10.3	7.0
<i>A. jordani</i>	3.5	5.3	27.1	60.0	1.2	2.6	0.3

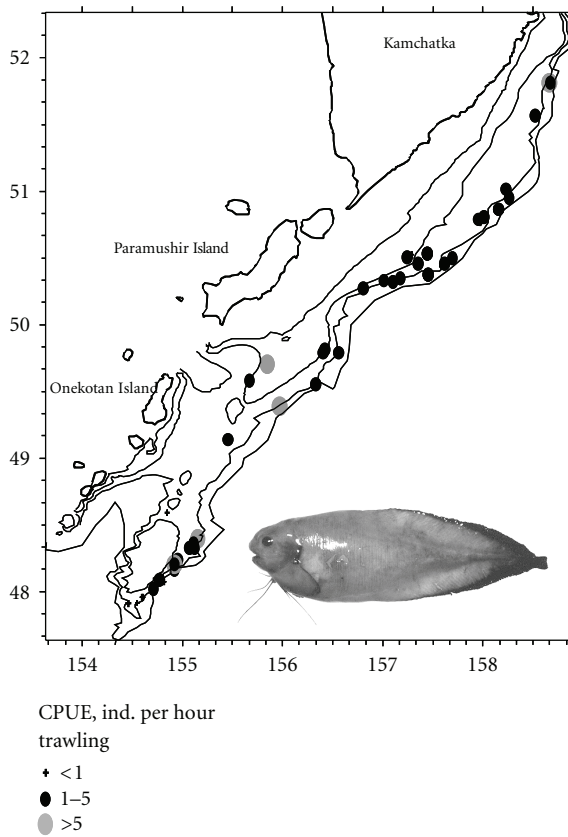


FIGURE 2: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Careproctus colletti* in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002.

Alaska Snailfish Careproctus colletti. This is a boreal Asiatic species widely distributed in the northern part of the Sea of Japan, Sea of Okhotsk, and Bering Sea [7, 37], and in Pacific waters off Hokkaido [33], northern Kuril Islands, southeastern Kamchatka [5, 6, 11, 35], and the Gulf of

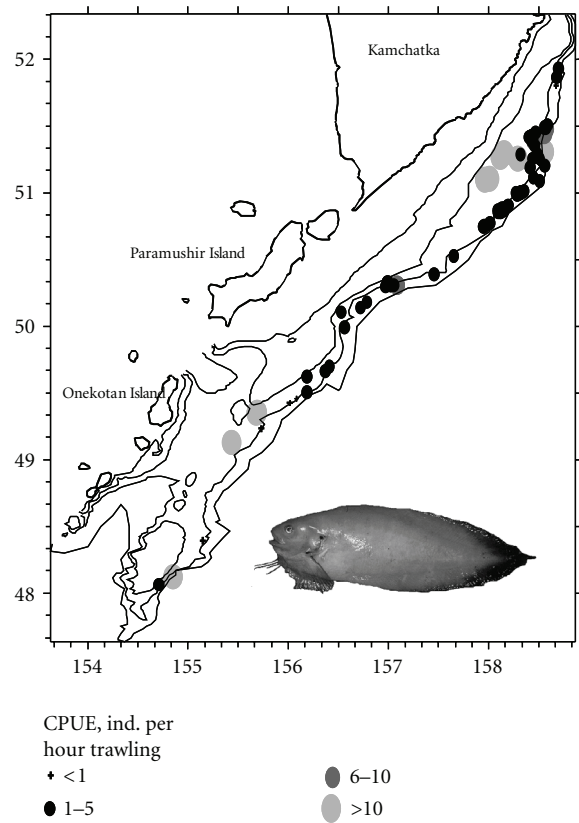


FIGURE 3: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Careproctus melanurus* in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002.

Alaska [36]. We found *C. colletti* throughout the survey area with maximum catches (>5 specimens/h) recorded in its northernmost and southernmost parts (Figure 2).

C. colletti is a part of the mesobenthic community and is known from depths of 64–1,350 m [6, 7]. We found it at

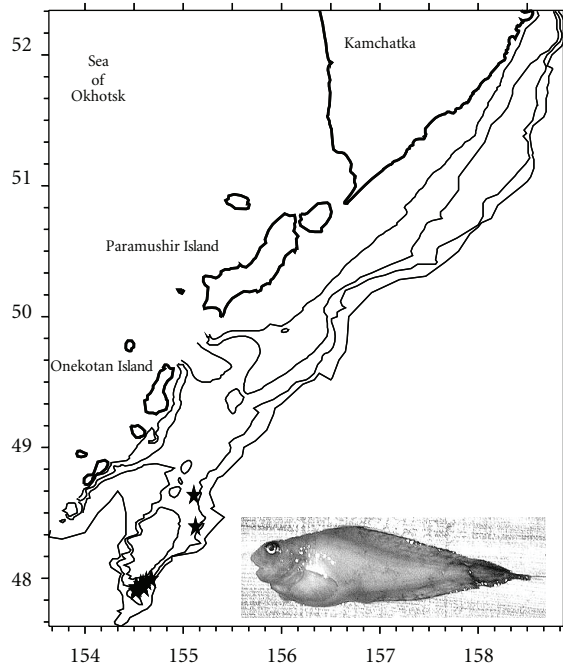


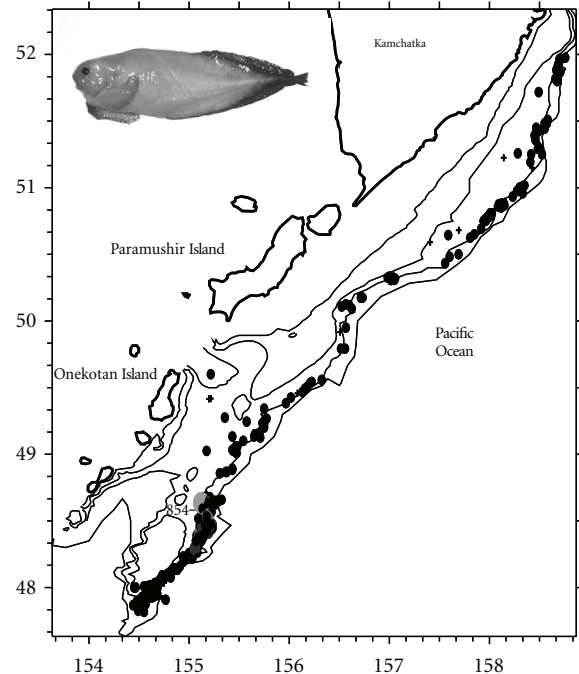
FIGURE 4: Capture sites (*) of *Careproctus simus* off the northern Kuril Islands, August–December 1998–2002.

360–700 m at near-bottom temperatures of 3.0–3.6°C. The majority of specimens (about 83%) were caught between 400 and 600 m (Table 2).

Blacktail Snailfish *Careproctus melanurus*. This is a boreal Pacific species widely distributed in the north Pacific from the Bering Sea to the Sea of Japan, and along the Pacific coast of Japan in the west to California in the east [7, 36]. Until recently, *C. melanurus* was known primarily from the American coast from British Columbia to California [23, 24, 38–41]. In Asian waters, it is known from the Bering Sea [42, 43], the Pacific off southeastern Kamchatka, the northern Kuril Islands [5, 6, 43], and off Japan [44]. Previous information regarding its distribution off the Pacific coast of Kamchatka and the northern Kuril Islands was limited [35, 43]. We found it in the Pacific coast from 48° 00' to 52° 00' N (Figure 3). Most catches were recorded in the central and northern parts of the survey area, although one catch of maximum size (>10 specimens/h) was from the south on the eastern slope of underwater plateau.

Unlike *C. zachirus* and *C. colletti*, *C. melanurus* is a bathybenthic species known from depths of 89–2,286 m, but primarily between 500 and 1,600 m [6, 7, 45]. Our data showed this species occurred at depths from 285 to 800 m, with near-bottom temperatures of 3.0–3.6°C, but most specimens (over 66%) were caught in 500–700 m (Table 2).

Proboscis Snailfish *Careproctus simus*. This species is boreal Asiatic, widely distributed in the northern part of the Pacific Ocean between 45° N and 60° N including the Sea of Japan, the Sea of Okhotsk off Hokkaido and southeastern Sakhalin,



CPUE, ind. per
hour trawling

+ 0–1

● 2–50

● 51–100

● 101–500

● 501–1000

FIGURE 5: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Careproctus cypselurus* in the Pacific waters off northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002.

the Bering Sea, the Aleutian Islands, and the northern Kuril Islands [7, 27, 36, 46]. However, data on its spatial-bathymetric distribution is limited by capture depths. In our studies, only 1–2 specimens/h were registered in catches in August–December 1998–2002 in the southernmost part of the surveyed area, along the eastern slope of the northern part of the outer Kuril chain (Figure 4).

Data from Chernova et al. [36] suggest that *C. simus* is a rare mesobenthic species known from depths of 380–800 m. Our data from catches in the Pacific off the northern Kuril Islands in August–December showed it occurs at depths from 370 to 630 m at near-bottom temperatures of 3.4–3.6°C, with most (>83%) caught at 400–600 m (Table 2).

Falcate Snailfish *Careproctus cypselurus*. This is a boreal Pacific species pervasive in the northern Pacific Ocean from the Bering Sea to the Sea of Japan and the Pacific coast of Japan in the west to British Columbia and the states of Washington and Oregon in the east [36, 37], and off the northern Kuril Islands and southeastern Kamchatka [5, 6, 11]. Our studies confirm its occurrence throughout the area (Figure 5). However, it was observed most frequently to the southeast (47° 50' N to 48° 50' N), where maximum number of *C. cypselurus* (854 specimens) was caught, although usually catches were fewer than 30–50 specimens/h.

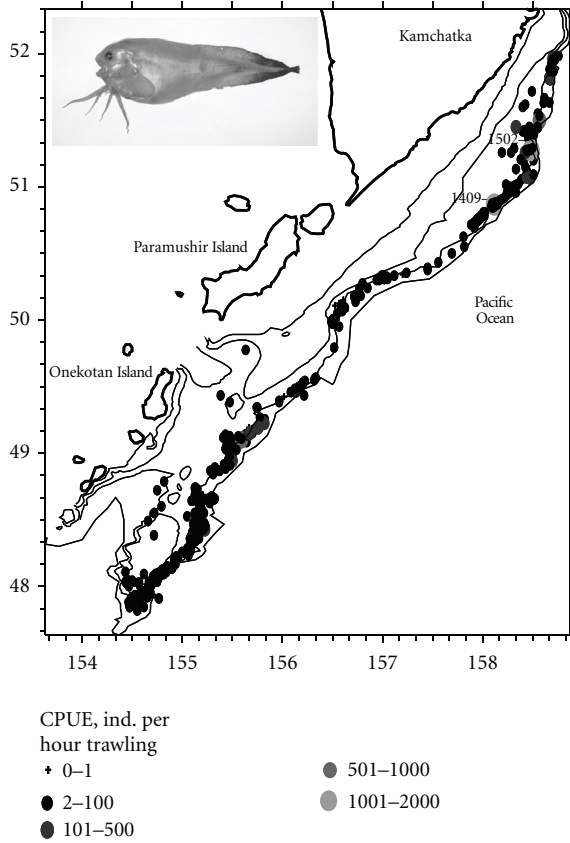


FIGURE 6: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Ellassodiscus obscurus* in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002.

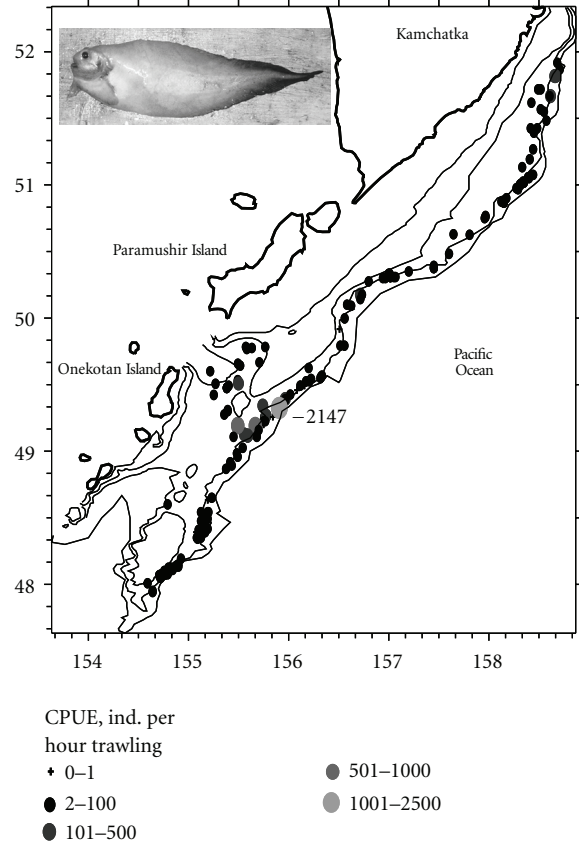


FIGURE 7: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Paraliparis grandis* in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002.

C. cypselurus is a bathybenthic species known from depths of 35–1,993 m, but inhabiting mainly depths of 450–1,500 m [6, 7, 36]. We found this snailfish at depths of 330–800 m, but most were at 400–600 m (Table 2), where 72% were caught.

Longtip Snailfish Ellassodiscus obscurus. This species was described from the southern Sea of Okhotsk [30] and is as a wide-boreal Asiatic species distributed in the Sea of Okhotsk off southwestern Kamchatka, in the Pacific off Kamchatka and the Kuril Islands [6, 7, 36], and in the eastern [47] and western Bering Sea (60° 48.9' N, 179° 03.7' E, 660–665 m, 1 specimen; 61° 32.6' N, 177° 52.1' E, 460–450 m, 9 spec.; 61° 33.5' N, 178° 04.8' E, 320 m, 1 spec.; 60° 21.3' N, 171° 46.0' E, 670–675 m, 1 spec. Our data). We found that *E. obscurus* is a common and rather abundant species on the Pacific side of the northern Kuril Islands and the southeastern coast of Kamchatka [5, 11].

E. obscurus occurred on the continental slope of the entire Pacific coast survey area (Figure 6). However, maximum catches (up to 1,400–1,500 specimens/h) came from southeastern Kamchatka (from 50° 50' N to 51° 30' N).

E. obscurus is a mesobenthic species inhabiting depths of 161–1,773 m, but predominantly occurring in 550–1,200 m [6, 7]. This snailfish occurred at depths of 260–800 m (Table 2) with near-bottom temperatures of 0.4–3.7°C, with about 50% caught in 500–600 m.

Slender Snailfish Paraliparis grandis. First described in 1950 based on a single specimen caught in the northern Sea of Okhotsk at a depth of 592 m [48]. It is known to be widely distributed in the Sea of Okhotsk and the western Bering Sea [7, 26, 28, 49, 50]. In Pacific waters off the northern Kuril Islands and southeastern Kamchatka, *P. grandis* is common and even rather abundant [5, 6, 11].

Similar to *E. obscurus*, *P. grandis* is pervasive throughout the area (Figure 7). However, its maximum catches (>1,000 specimens/h) were abeam the Fourth Kuril Strait, southeast of Paramushir Island.

It is a mesobenthic species known from 105–1,995 m, but inhabiting mainly depths of 450–900 m [6, 7]. We caught it at depths of 260–800 m with near-bottom temperatures of 2.6–3.7°C, although approximately 82% were caught between 500 and 700 m (Table 2).

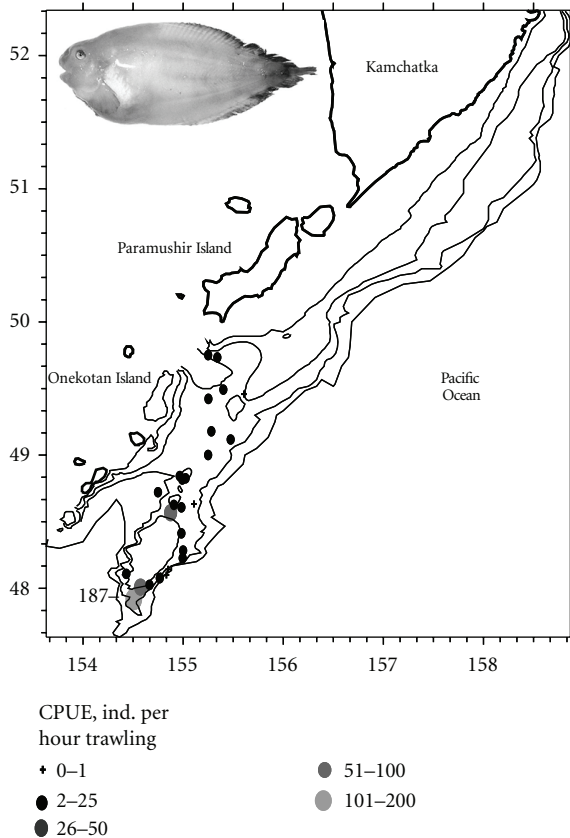


FIGURE 8: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Squaloliparis dentatus* in the Pacific waters off the northern Kuril Islands, July–November, 1995–2002.

Big-Disc Snailfish *Squaloliparis dentatus*. First described from the Sea of Okhotsk waters off the Hokkaido as *Careproctus dentatus*, [28], it is now placed in the genus *Squaloliparis*, [31]. It is fairly common and widely distributed in the bathyal of the Sea of Okhotsk as well as in the Pacific off the northern Kuril Islands and southeastern Kamchatka [6, 7, 11, 31, 36]. We captured it only to the south from 47° 50' N to the Fourth Kuril Strait (Figure 8), with the maximum catches (the largest with 187 specimens/h) registered on the slopes of the underwater elevation.

S. dentatus is a mesobenthic species known from depths of 120–900 m [6, 7, 31]. In the Sea of Okhotsk, most specimens were caught in 400–500 m [31]. Catches from Pacific waters off the Kuril Islands were at depths from 260 to 570 m, with near-bottom temperatures of 1.6–3.4°C. About 61% were from 300–400 m (Table 2).

Gloved Snailfish *Palmoliparis beckeri*. Described from the Pacific off the northern Kuril Islands [34] and subsequently characterized as a rare, widely distributed boreal Asiatic species from off the Kuril Islands and southeastern Kamchatka [6, 7, 36]. All known specimens (about 30) were caught in Pacific waters off the northern Kuril Islands in the area to the south of the Fourth Kuril Strait [11, 34, 35, 51]. Our data show *P. beckeri* occurring only along the

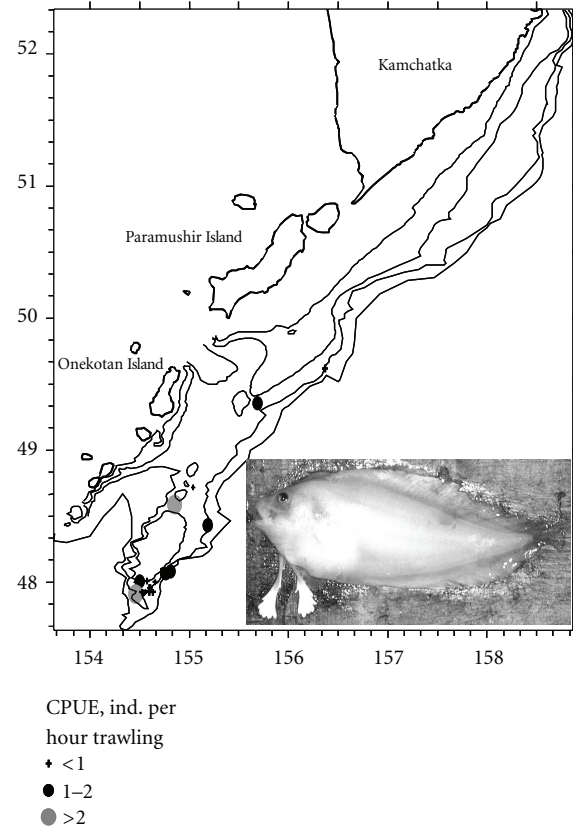


FIGURE 9: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Palmoliparis beckeri* in the Pacific waters off northern Kuril Islands, April–December 1995–2002.

continental slope from 47° 50' N to the Fourth Kuril Strait, with maximum catches >2 specimens/h (Figure 9).

P. beckeri is a mesobenthic species inhabiting depths of 200–800 m [7]. Our specimens were collected from that depth range, with near-bottom temperatures of 2.0–3.8°C. Most specimens (>65%) were from depths of 300–500 m (Table 2).

Stout or Cherry Snailfish *Allocareproctus jordani*. Originally described as *Careproctus gilberti* based on the holotype and only specimen caught in the Pacific off Honshu [52], Burke [23] later described it as *Careproctus jordani*. It was subsequently allocated to the genus *Allocareproctus* [32]. Sheiko and Fedorov [7] consider the species to be a junior synonym of *Allocareproctus pycnosoma*, [22], although Orr and Busby [21] consider *A. jordani* as valid. *A. jordani* is a widely distributed boreal Asiatic species occurring in the Pacific off Japan (Sagami Bay), eastern Sea of Okhotsk, the Kuril Islands and eastern Kamchatka, eastern Bering Sea, and central and eastern Aleutian Islands [5–7, 11, 21, 32, 35, 36]. We collected it from 47° 50' to 51° 00' N (Figure 10), but maximum catches (>10 specimens/h) were obtained from the slopes of underwater plateau and off the Fourth Kuril Strait. To the north, only a few specimens were caught.

TABLE 3: Weight composition (number of fish within certain weight range) of different snailfish species off the northern Kuril Islands and southeastern Kamchatka.

Species	Weight, kg													Sample size
	<0.1	0.1-0.2	0.2-0.3	0.3-0.4	0.4-0.5	0.5-0.6	0.6-0.7	0.7-0.8	0.8-0.9	0.9-1.0	1.0-1.1	1.1-1.2	>1.2	
<i>C. zachirus</i>	10	47	28	5	1	0	0	0	0	0	0	0	0	91
<i>C. colletti</i>	2	2	4	7	1	1	0	0	0	1	0	1	0	19
<i>C. melanurus</i>	1	0	0	3	4	6	5	4	4	2	3	1	1	34
<i>C. cypselurus</i>	0	1	19	42	22	10	4	2	0	0	0	0	0	100
<i>E. obscurus</i>	9	25	36	24	3	3	0	0	0	0	0	0	0	100
<i>P. grandis</i>	0	18	24	11	1	1	0	0	0	0	0	0	0	55
<i>A. jordani</i>	36	20	13	4	1	3	5	3	0	1	0	0	0	86
<i>P. beckeri</i>	1	5	3	5	5	2	3	2	0	1	0	0	0	27

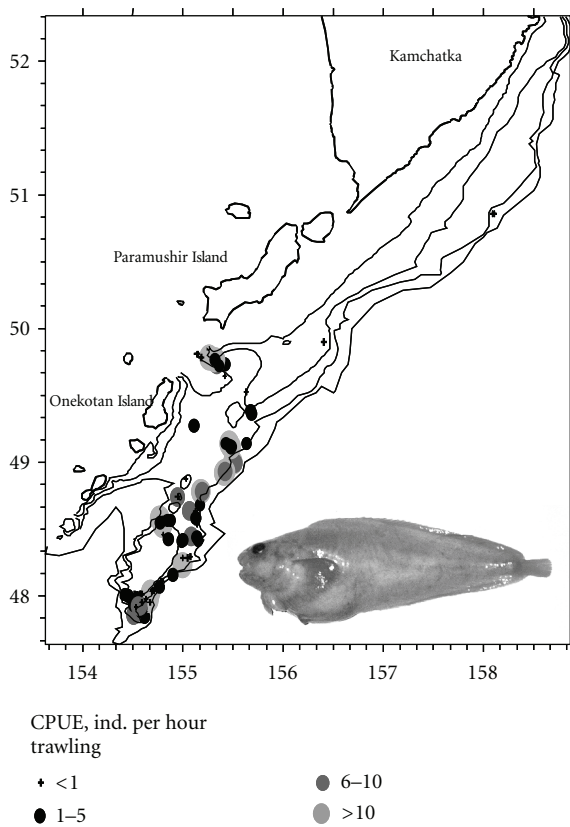


FIGURE 10: Distribution and relative abundance categorized by CPUE (specimens per hour trawling) of *Allocareproctus jordani* in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, April–December 1993–2002.

This species is a mesobenthic species known from depths of 75–700 m [7]. We caught it between 130–750 m, with near-bottom temperatures of 1.3–3.6°C (Table 2), although most specimens (>87%) were caught in 300–500 m.

3.2. Length and Weight. Of the five species of *Careproctus* considered here, *C. melanurus* and *C. colletti* reach maximum size in Pacific waters off southeastern Kamchatka and the northern Kuril Islands.

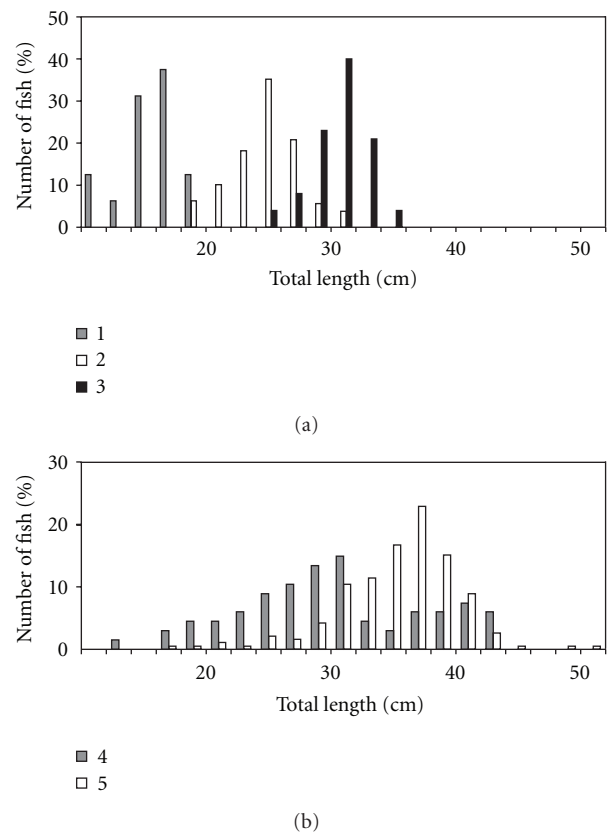


FIGURE 11: Size compositions of *Careproctus simus* (1), *C. zachirus* (2), *C. cypselurus* (3), *C. colletti* (4), and *C. melanurus* (5) in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, 1993–2002.

Careproctus melanurus were 18–51 cm (35.4 cm average) in length and 100–1,700 g (728 g average) in weight; *C. colletti* were 14–44 cm (30.1 cm average) and 70–1,200 g (381 g average; Figure 11, Table 3), although specimens of *C. melanurus* of 30–40 cm (77%) and 450–900 g (68%) and *C. colletti* 23–32 cm (54%) and 200–400 g (58%) were more abundant. Maximum length of *C. melanurus* in American waters is estimated to be 26 cm [53], although on the Oregon slope specimens of up to 31.2 cm have been caught [54]. Our data

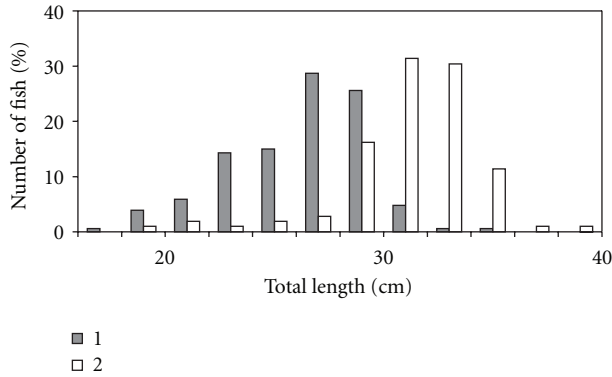


FIGURE 12: Size compositions of *Ellassodiscus obscurus* (1) and *Paraliparis grandis* (2) in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, 1993–2002.

suggested that *C. melanurus* is significantly larger off the Asian coast; in the western Bering Sea it reaches 54 cm length [43].

Both *C. zachirus* and *C. cypselurus* are smaller than *C. melanurus* and *C. colletti*, with maximum lengths of only 32 and 36 cm, respectively [35, 55]. In our data, *C. zachirus* ranged from 19 to 32 cm (24.7 cm average) and 80 to 500 g (194 g average); *C. cypselurus* ranged from 26 to 36 cm (30.6 cm average) and 100 to 800 g (291 g average). Smaller *C. zachirus* of 24–28 cm (56%) and 100–300 g (>82%) and *C. cypselurus* of 28–34 cm (84%) and 100–400 g (83%) were more common (Figure 11, Table 3).

The maximum known length of *C. simus* is 18.6 cm [46]. Off the northern Kuril Islands, individuals of 12–19 cm (15.6 cm average) (Figure 11) weighing 30–100 g (75 g average) occurred in trawl catches, but fish of 15–18 cm in length (69%) dominated.

Tokranov [55] recorded the maximum sizes of *Ellassodiscus obscurus* and *Paraliparis grandis* in the Pacific off the southeastern Kamchatka and northern Kuril Islands at 35–40 cm and 0.6 kg. Our *E. obscurus* were represented by fish of 17–35 cm (26.2 cm average) and 100–600 g (250 g average); *P. grandis* were 19–40 cm (31.3 cm average) and 120–600 g (250 g average). However, *E. obscurus* of 22–30 cm (84%) and 100–400 g (85%) and *P. grandis* 28–36 cm (>89%) and 100–400 g (about 96%; Figure 12, Table 3) formed most of the catches.

In the literature, *S. dentatus* reaches 34.6 cm [31] and *P. beckeri* and *A. jordani* 38 cm and 1 kg [34, 35]. We collected *S. dentatus* of 20–39 cm (29.6 cm average) and 100–1,300 g (680 g average); *P. beckeri* of 15–38 cm (28.9 cm average) and 60–1,000 g (414 g average), and *A. jordani* of 10–38 cm (21.6 cm average) and 50–1,000 g (210 g average; Figure 13, Table 3). However, *S. dentatus* of 26–34 cm (54%) weighing 500–900 g (over 65%), *P. beckeri* of 26–36 cm (78%) and 100–500 g (about 67%), and *A. jordani* of 16–24 cm (54%) weighing less than 200 g (65%) occurred most frequently.

Length-weight relationships were obtained for all snailfish species considered here (Table 4). The values of param-

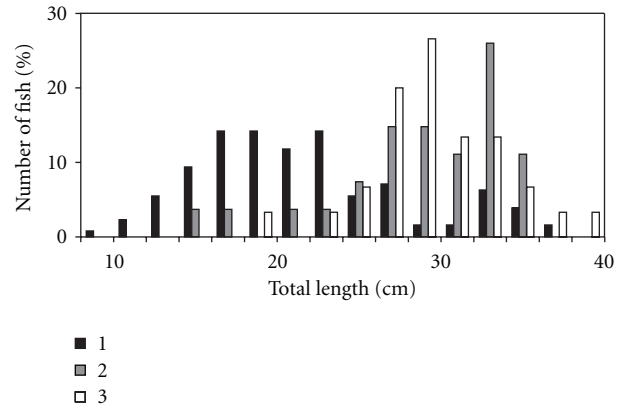


FIGURE 13: Size compositions of *Allocareproctus jordani* (1), *Squaloliparis dentatus* (2), and *Palmoliparis beckeri* (3) in the Pacific waters off the northern Kuril Islands and southeastern Kamchatka, 1995–2002.

TABLE 4: Parameters and coefficient of determination (R^2) of equation of total length- (TL-) weight (W) relationship $W = aTL^b$ in different snailfish species off the northern Kuril Islands and southeastern Kamchatka.

Species	a	b	R^2
<i>Allocareproctus jordani</i>	9.2×10^{-3}	3.1722	0.810
<i>Careproctus zachirus</i>	7.4×10^{-2}	2.4269	0.458
<i>C. colletti</i>	1.9×10^{-3}	3.5819	0.886
<i>C. cypselurus</i>	8.5×10^{-3}	3.1222	0.641
<i>C. melanurus</i>	7.0×10^{-3}	3.1953	0.828
<i>C. simus</i>	3.174	1.8968	0.692
<i>Ellassodiscus obscurus</i>	6.8×10^{-3}	3.2048	0.817
<i>Palmoliparis beckeri</i>	1.015	2.4522	0.811
<i>Paraliparis grandis</i>	0.176	2.1032	0.522
<i>Squaloliparis dentatus</i>	5.1×10^{-3}	3.4012	0.873

eter b for the majority of the species examined (with the exception of *C. simus* and *P. grandis*) were generally within the normal range (2.5–3.5) for fish [56], indicating isometric growth during their life span [57]. Species with similar values of parameters a and b are *C. cypselurus*, *C. melanurus*, *E. obscurus*, and *S. dentatus*, indicating similar growth in these species.

3.3. Age and Age Composition. Based on our age determinations from otoliths and on the sizes of the specimens we collected, we conclude that the maximum age of the species considered here and of species of this family is less than 10–13 years [35, 55], and that specimens of 2–5 age classes (Table 5) constitute the main part (73–97%) of the catch of each species (Figure 14).

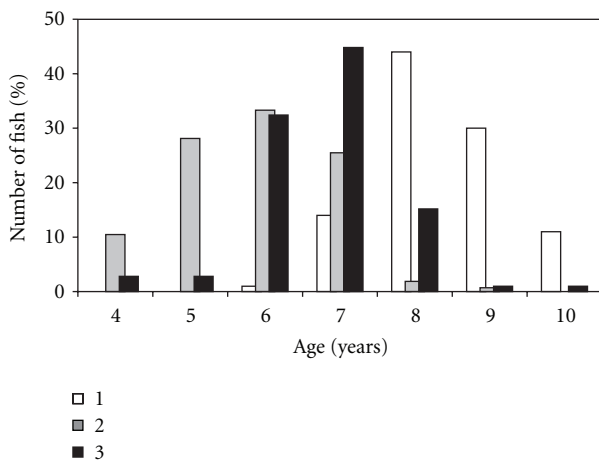
3.4. Diet. We found that all the species we studied are benthophages feeding mainly on bottom and near-bottom organisms, primarily crustaceans [20, 35, 58]. The four

TABLE 5: Lengths (cm) and weights (g) of seven snailfish species related to age off the northern Kuril Islands and southeastern Kamchatka (numerators: mean total lengths \pm standard error, range is given in parentheses, sample size is marked by asterisk; denominators: mean body weights \pm standard error).

Species	Age, years										
	3	4	5	6	7	8	9	10			
<i>E. obscurus</i>	—	20.0 \pm 0.4 (18–22, 11*) 103 \pm 14 (60–190)	24.0 \pm 0.2 (23–26, 25*) 197 \pm 9 (130–280)	29.9 \pm 0.2 (26–29, 16*) 258 \pm 11 (180–330)	29.1 \pm 0.2 (29–31, 18*) 353 \pm 9 (300–410)	32 (1*) 600	—	—	—	—	—
<i>P. grandis</i>	—	22 (2*) 160 (130–190)	25 (24–26, 2*) 160	29.5 \pm 0.2 (28–32, 21*) 213 \pm 12 (120–320)	32.3 \pm 0.2 (32–34, 22*) 269 \pm 12 (170–340)	34.8 \pm 0.4 (34–37, 7*) 340 \pm 20	—	—	—	40 (1*) 560	—
<i>C. cypselurus</i>	—	—	—	24.5 (1*) 270	27.0 \pm 0.4 (25–29, 13*) 260 \pm 13 (180–350)	30.1 \pm 0.1 (29–32, 43*) 342 \pm 7 (240–450)	32.1 \pm 0.1 (32–34, 29*) 456 \pm 17 (280–700)	34.0 \pm 0.2 (34–36, 11*) 577 \pm 36 (350–800)	—	—	—
<i>A. jordani</i>	14.5 (1*) 60	—	22.3 (2*) 195 (150–240)	27.3 \pm 0.7 (26–28, 3*) 358 \pm 44 (210–430)	31.8 \pm 0.2 (31–32, 3*) 592 \pm 44 (510–660)	34 (1*) 730	—	—	—	—	—
<i>P. beckeri</i>	—	—	—	26.6 \pm 0.7 (25–27, 4*) 263 \pm 24 (220–310)	29.7 \pm 0.9 (28–31, 3*) 358 \pm 60 (290–480)	31 (1*) 540	—	—	—	—	—
<i>C. zachirus</i>	—	19.5 (1*) 110	22.5 \pm 0.6 (21–24, 6*) 147 \pm 4 (135–160)	25.4 \pm 0.2 (24–27, 17*) 199 \pm 13 (120–300)	27.0 \pm 0.2 (26–28, 8*) 243 \pm 14 (200–300)	—	—	—	—	—	—
<i>C. colletti</i>	—	24 (1*) 180	28.3 (28–29, 2*) 265 (260–270)	30.5 (29–31, 2*) 385 (380–390)	—	—	—	—	—	—	—

TABLE 6: Frequency of occurrence of food items in stomachs of eight snailfish species off the northern Kuril Islands and southeastern Kamchatka.

Dietary component	Species							
	<i>C. zachirus</i>	<i>C. colletti</i>	<i>C. melanurus</i>	<i>C. cypselurus</i>	<i>E. obscurus</i>	<i>P. grandis</i>	<i>P. beckeri</i>	<i>A. jordani</i>
Anthozoa	—	20.0	—	—	—	—	—	—
Polychaeta	3.1	—	—	—	—	3.6	—	20.0
Ostracoda	—	—	—	—	—	—	10.0	—
Cumacea	—	—	—	—	3.0	—	—	—
Amphipoda	25.0	—	20.0	25.0	65.0	56.4	10.0	10.0
Euphausiacea	—	—	—	1.0	—	—	—	—
Decapoda	65.6	40.0	80.0	37.0	61.0	—	90.0	30.0
Bivalvia	3.1	—	—	—	—	—	—	—
Gastropoda	—	—	—	—	—	—	—	10.0
Octopoda	—	—	—	—	—	—	—	10.0
Ophiuroidea	—	—	—	—	—	—	—	10.0
Pisces	—	—	—	5.0	3.0	—	10.0	20.0
Fish eggs	3.1	—	—	—	—	—	—	—
Fishery offal	—	—	—	—	—	—	—	10.0
Unidentified organic material	—	20.0	—	—	—	—	—	—
Number of fish examined	32	5	5	100	100	55	10	10
Percent of empty stomachs	21.9	20.0	20.0	41.2	48.4	48.0	—	20.0

FIGURE 14: Age compositions of *Careproctus cypselurus* (1), *Elasdiscus obscurus* (2), and *Paraliparis grandis* (3) in the Pacific off northern Kuril Islands and southeastern Kamchatka, 1993–2002.

species of genus *Careproctus* (*C. zachirus*, *C. colletti*, *C. melanurus*, *C. cypselurus*) and also *E. obscurus*, *P. grandis*, and *P. beckeri* eat a rather limited food spectrum consisting of 2–5 groups of invertebrates and fish (Table 6). However, small shrimps (mainly of family Hippolytidae), hermit crabs *Pagurus* spp., and amphipods (total occurrence greater than 80–90%) are their main diet. *A. jordani* has a significantly broader diet of crustaceans (40%), polychaete worms, sea snails (Gastropoda), octopi (Octopoda), brittle stars (Ophiuroidea), as well as juvenile fish and fishery offal.

4. Conclusion

The results of research conducted in 1993–2000 allowed us to conclude that proboscis snailfish, big-disc snailfish, and gloved snailfish occur only in a limited part of the Pacific continental slope off the northern Kuril Islands south of the Fourth Kuril Strait; the maximum catches of all these three species have been recorded exclusively in the area of the underwater elevation in the northern link of the outer ridge of the Kuril chain. The range of stout snailfish and blacktip snailfish is somewhat wider: the former was found up to 51° 00' N; the latter at up to 51° 30' N, though their greatest catches tended to be taken near the underwater elevation and Fourth Kuril Strait too. Unlike them, the falcate snailfish, blacktail snailfish, longtip snailfish, slender snailfish, and Alaska snailfish were observed throughout the entire area surveyed during the period of study. However, while the largest catches of the former species occurred mostly in the southern part of that area, the biggest catches of the blacktail, longtip, and slender snailfish were, in contrast to that, recorded in the northern and central parts. The Alaska snailfish used to be caught in about equal numbers both in the north and in the south of the area examined on the Pacific side of the northern Kuril Islands and southeastern Kamchatka.

All the snailfish surveyed inhabit a broad bathymetric range between April and December, though the deepest species of them are the blacktail, falcate, longtip, slender, and Alaska snailfish whose upper range limit does not rise over 260–300 m; those fish stay mostly at bottom temperatures over 3°C. The proboscis snailfish and big-disc snailfish are

found mostly within 300–600 m. Unlike these fish, the other three species, especially stout and blacktip snailfish, occur sporadically at 150–200; the gloved and stout snailfish can fairly often be found at much lower bottom temperatures.

The life span of all the snailfish examined, as in most of the other representatives of this family, does not exceed 10–13 years while the catches of each of them taken in the Pacific off the northern Kuril Islands and southeastern Kamchatka basically (73–97%) comprise individuals aged 2–5 years.

The body length-weight relationship analysis of the snailfish studied shows that despite the differences in body shape most of them have isometric pattern of growth.

All the snailfish examined except stout snailfish are benthophagous with rather narrow food ranges. Their major dietary components are various small bottom or near-bottom crustaceans (shrimp, hermit crabs *Pagurus* spp., and amphipods). Unlike them, the diet of stout snailfish is much wider; in addition to crustaceans, it includes polychaet worms, sea snails Gastropoda, bivalves Bivalvia, brittle stars Ophiuroidea, as well as young fish and fishery offal.

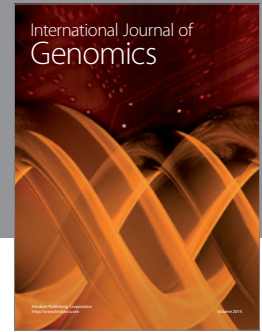
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