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RESEARCH PAPER

Distribution, Biological and Ecological Characteristics of Alien Species *Pomatoschistus Bathi* Miller, 1982 (Gobiidae) in the Black Sea

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Abstract

In this study, the ecological and biological characteristics of the invasive goby *Pomatoschistus bathi* on coastal habitats of an area of the Crimean peninsula were investigated. Growth and lenght-weight relationships are characteristic for fish with short life cycles. The minor morphological differences of males from females were identified as a result of the morphometric study. Expansion of the areal and increasing the number of fish was observed in recent years. Large flocks of these fish are concentrated in the shallow water in the spring and autumn months. Fish are actively involved in trophic chains due to their high abundance. Samplings in two common coastal habitats were used to investigate feeding of this species. *Pomatoschistus bathi* encompasses a broad trophic niche. In this study, a karyotype of this species and its early ontogenetic stages first reported.

Keywords: *Pomatoschistus bathi*, morphology, karyotype, food objects, fertility

Introduction

Out of all recent invaders of the Black Sea, fishes of the family Gobiidae were the most successful in invading new areas. Nine invasive species were reported off shore Crimea. So far, four species - *Gammogobius steinitz*i, *Chromogobius zebratu*s, T*ridentiger trigonocephalus* and *Millerigobius microcephalu*s, were found along the coastal zone of Crimean peninsula (Kovtun and Manilo, 2013; Boltachev and Karpova, 2014; Kovtun and Karpova, 2014). *Chromogobius quadrivittatus* individuals have been observed occasionally near the coast and in salt lakes of the North Caucasus, Bulgaria and in the Odessa Bay (Ukraine). *Pomatoschistus bathi* has been observed near Abkhazia, Russia (Vasil'eva and Bogorodsky, 2004), and Bulgaria (Vassilev *et al*., 2012). *Gobius cruentatus*, and *Zebrus zebrus* were reported for the coast of Turkey (Engin *et al.,* 2007; Kovačić and Engin, 2009) and *Gobius xanthocephalus* – was found along the coastal zone of Abkhazia (Vasil'eva and Bogorodsky, 2004).

Most of these gobies belong to a group of cryptobenthic species which has reclusive behaviour, accompanied by a small size (up to 4 - 7 cm, except *G. cruentatus* which reaches a length of 18 cm). Gobies inhabit rocky and stony biotopes with a great number of coverts. Only one species, *Pomatoschistus bathi* Miller, 1982 belongs to the group of sand gobies, along with other representatives of this genus. This species is poorly studied, due to the difficulty of its detection and catching.

Our paper was aimed at morphometric and biological analysis of *Pomatoschistus bathi.* For the first time ever, the karyotype, feeding habits, expansion, localization, behavior and naturalization process are described.

Materials and Methods

Samples were collected from 2007 to 2014, in the coastal zone of Crimea, from the cape Tarkhankut to Karadag, including firth Donuzlav and bays in the area of Sevastopol (Figure 1).

Nets with a diameter of 25 - 30 cm and the mesh size 2 mm) were used to sample depths from 0.5 to 8 m. Manuals of Miller (2004), Vasil'eva (2007) and Pravdin (1966) were used in species identification, biological and morphometric analyses. Sampled specimens were measured within the accuracy of the tenth of a millimeter (for the length) and hundredths of a gram (for the weight).

We used the following symbols: *TL* - the total length; *SL* - standard length (from the tip of the snout to the end of urostyle - kink on the caudal peduncle);

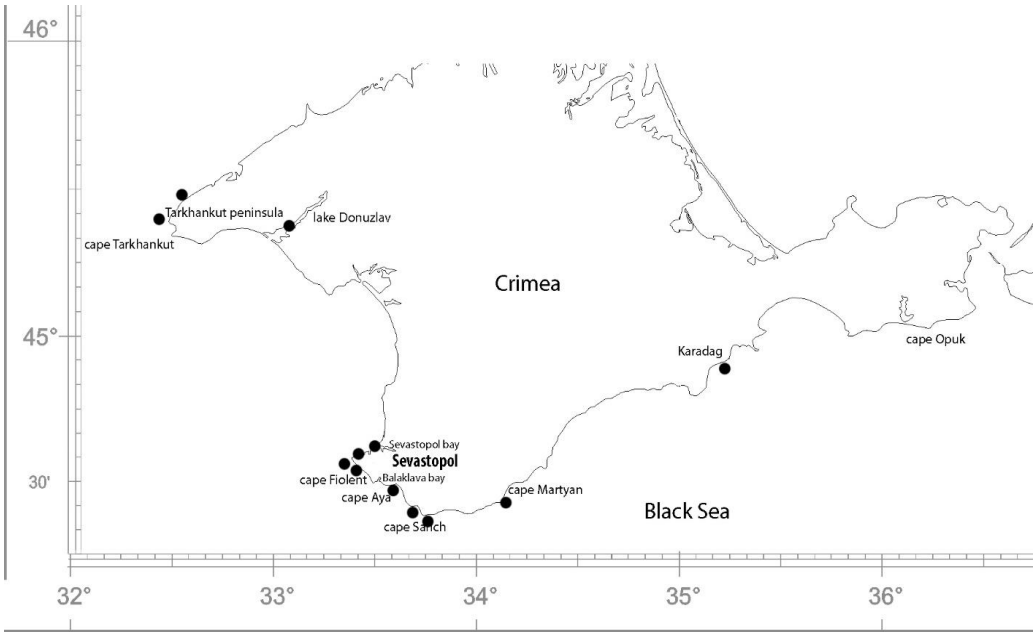

Figure 1. Map of the study area with sampling points.

W - total weight.

Biological analysis of 76 species, morphometric analysis of 40 species and genetic characteristics of 8 species were carried out. The number of yolk oocytes of the IV stage of maturity were determined for 19 females.

Feeding of gobies was studied by the method of Duka and Sinyukova (1976). The identification of consumed food items was performed by the Determinant of fauna of the Black and Asov Seas (Vodyanitsky, 1969). Samples were collected in June 2013 (in the area of biological station, Karadag) and in June 2014 (Kazachya bay, Sevastopol). From the first area, seven samples were used to estimate the feeding of mature gobies (with TL 34-36 mm, W 0.2-0.32 g of the first area). For the second area, 12 samples (with TL 15-35 mm and W 0.2 – 0.26 g) were analyzed. Photos of gobies were taken both in the aquarium and natural conditions. All samples are currently kept in the collection of IMBR (№№ AB-0161, 0162, 0163, 0490, 0523, 0637, 0644, 0674).

To get karyotypes, fish was kept in the aquarium in the state of rest for 1 to 2 days. After that, specimens were injected intramuscularly with 0.1 - 0.5% solution of colchicine, 1 ml per 100 g of body weight. After 5 - 6 hours a pronephros was taken out of fish, kept for 30 minutes in a hypotonic solution of 0.56% KCl, fixed in a mixture of glacial acetic acid and ethyl alcohol (1: 3). Dried preparations were made and colored in 5% Giemsa solution in phosphate buffer with pH 6,8 (Vasil'ev, 1978). Photos of metaphase plates were taken with Konus biorex-3 microscope with a camera DCM 510. Overall, 22 metaphase plates of eight specimens of *Pomatoschistus bathi* have been investigated.

Results

Since 2000 *P. bathi* have been observed by us in the bays near Sevastopol (the south-western Crimea), in small groups accounting from 5-6 to 10-15 specimens, although underwater observations were carried out by us since 1996. Near the west coast of the Crimea, according to our observations, these fish while absent. Later on, during the 2008 expedition, we got some samples with *P. bathi* from the firth Donuzlav connected to the sea. In 2011, we found these species coastal waters of Tarkhankut peninsula. In the same period, *P. bathi* was rarely found along the southern coast of Crimea, near Capes of Laspi, Foros and Sarich. This species is observed in coastal zone of nature reserves "Cape Marian" and "Karadag" (the southern coast of Crimea), in which it was a common species since 2013. According to visual observations, the abundance of fish in areas of previous detections increased from year to year.

Our samples showed that *P. bathi* has maximum *TL* of 35.5 mm, *SL* of 31.1 mm and *W* of 320 mg. The correlation between total and standard lengths was linear (Figure 2a), while the relationship between body mass and standard length has slightly curved shape with a large fragment of the parabolic form (Figure 2b). This relationship implies quite high growth rate at the early stages of ontogeny, as well as a rapid growth rate of the weight.

The body of *P. bathi* goby is elongated, thin, and covered with large ctenoid scales while the nape, predorsal area and breast are naked. The sensory system has a sub-orbital row and one transverse row. Meristic characters are as follows: D1 VI-VII, D2 I 12–13, A I(II) 10-12, P 14-16. The numbers of transverse rows of scales are ranged from 32 to 38.

The body color is yellowish, with coarse dark reticulation and yellowish-white ventral side. Along the back, there are five light saddle-shaped spots without reticulation. Along the middle of the sides, there are five black triangle spots, with small black spots between them, which all together form a broken line. There is another black spot at the end of the caudal peduncle, widening at the base of the caudal fin rays. Fins are transparent; there are diagonal stripes with accumulations of small dark spots with different color intensity on dorsal fins, while tail fins have vertical lines of brown spots. There is a γ-shaped red-brown pattern on operculum (Figure 3). Females have a pigmented throat while males have pigmented throat and breast.

After fixation in 4% formaldehyde solution, body becomes nontransparent and yellowish-white. Dark triangular spots are still observed, as well as small spots along the middle of the sides and γ-shaped dark pattern on the operculum, reticulation and light spots along the middle of the back become almost invisible.

According to the analysis of plastic and meristic features of *Pomatoschistus bathi*, males differ from females by a larger height of caudal peduncle, length of D2 and interorbital distance, and by a smaller antedorsal distance (Table 1).

In spring, *P. bathi* begins to be observed near the coast, when the water temperature exceeds 10 °C. When temperature is 13 °C and higher (at the depth from 0.5 to 1 m), fish schools begin to form. These schools contain tens to hundreds individuals that may be mediated by spawning behavior. The number of males is significantly lower than female numbers in schools. The ratio of males and females in the catches ranged from 1: 2 to 1: 4.

Overall, a permanent increase of the *P. bathi* abundance has been observed, during the last decade. In some areas of Sevastopol bays, the abundance has reached tens of individuals per square meter, while it was much lower in offshore waters. In regions of high *P. bathi* occurrence, the salinity varied from 13.13 to 18.25 ppm. *P. bathi* tends to occur in groups favoring shell, sandy bottom, and near the stones covered with *Cystoseira* or *Zostera*. Juveniles and adults tend to accumulate at depths of 10 - 50 cm above the bottom and move by short spurts. In the case of danger, *P. bathi* can quickly dig into the sand.

In early spring *P. bathi* comes to the shore by using a preferable depth range from 1.5 to 3 m in bays and firths and up to 10 - 12 m in offshore waters. According to our data, the reproduction period of *P. bathi* in the coastal zone of Crimea lasts from May to August. During this period, mature oocytes are

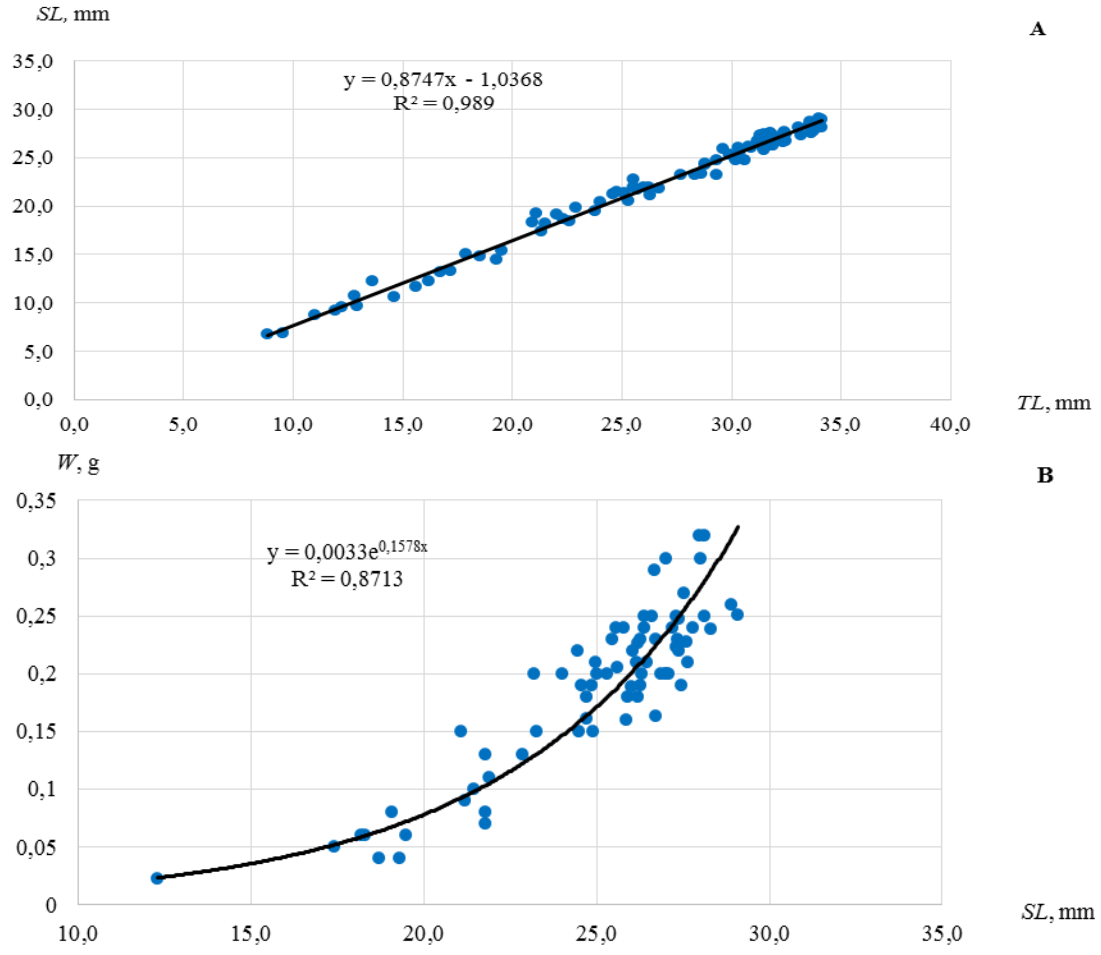

Figure 2. Relationships between total and standard lengths (A) and body mass and standard length (B).

Figure 3. Male (A) and female (B) of *Pomatoschistus bathi*.

Table 1. Morphometric characters of *Pomatoschistus bathi*

Characters	*Pomatoschistus bathi*			
	♂ (n = 15)	♀ (n = 25)	M_{diff}	♂♀ (n = 40)
Standard length	24.6 – 27.8	22.9 – 28.1		22.9 – 28.1
	25.9 ± 1.59	26.1 ± 2.00		26.0 ± 0.25
	in % of Standard length			
Maximum body height	12.0 – 14.8	13.0 – 17.2	2.0	12.0 – 17.2
	13.7 ± 0.60	15.0 ± 0.27		14.8 ± 0.26
Minimum body height	7.6 – 8.8	6.0 – 8.0	3.4	6.0 – 8.8
	8.0 ± 0.22	7.2 ± 0.10		7.3 ± 0.10
Maximum body depth	10.8 – 13.2	10.5 – 15.9	2.8	10.5 – 15.9
	11.6 ± 0.42	13.2 ± 0.37		12.9 ± 0.33
Minimum body depth	1.1 – 2.4	1.0 – 2.9	0.3	1.0 – 2.9
	1.6 ± 0.22	1.7 ± 0.12		1.7 ± 0.10
Pre-dorsal distance	33.5 – 36.3	34.5 – 40.0	4.2	33.5 – 40.0
	34.7 ± 0.51	37.1 ± 0.26		36.7 ± 0.28
Post-dorsal distance	47.1 – 51.6	44.6 – 52.7	1.1	44.7 – 52.7
	48.8 ± 0.78	47.9 ± 0.41		48.0 ± 0.37
Pre-pectoral distance	27.2 – 29.9	26.8 – 31.8	0.1	26.8 – 31.8
	28.3 ± 0.45	28.4 ± 0.20		28.4 ± 0.18
Pre-ventral distance	28.6 – 31.7	27.4 – 31.9	0.7	27.5 – 31.9
	29.5 ± 0.56	29.9 ± 0.24		29.9 ± 0.22
Pre-anal distance	55.5 – 57.7	52.8 – 62.0	1.7	52.8 – 62.0
	56.8 ± 0.45	57.8 ± 0.35		57.6 ± 0.31
Distance between pectoral and ventral fin	10.2 – 11.7	9.0 – 12.5	0.0	9.0 – 12.6
	10.9 ± 0.26	10.9 ± 0.18		10.9 ± 0.16
Distance between ventral and anal fin	27.9 – 31.9	27.4 – 33.4	0.9	27.4 – 33.4
	29.4 ± 0.68	30.1 ± 0.33		30.0 ± 0.30
Caudal peduncle length	23.4 – 27.0	21.9 – 27.8	0.5	21.9 – 27.8
	25.3 ± 0.75	25.7 ± 0.29		25.7 ± 0.27
First dorsal fin length	10.1 – 14.1	12.3 – 17.0	2.1	10.1 – 17.0
	12.6 ± 0.72	14.2 ± 0.26		13.9 ± 0.26
Maximum height first dorsal fin	9.9 – 15.8	7.5 – 15.0	0.2	7.5 – 15.8
	11.9 ± 1.04	11.6 ± 0.34		1.7 ± 0.32
Distance between dorsal fins	3.7 – 6.3	3.3 – 7.0	0.2	3.3 – 7.1
	4.7 ± 0.49	4.8 ± 0.15		4.7 ± 0.14
Second dorsal fin length	18.1 – 20.0	15.2 – 17.8	6.4	15.2 – 20.0
	18.7 ± 0.33	16.4 ± 0.15		16.8 ± 0.21
Maximum height second dorsal fin	9.9 – 19.0	10.4 – 18.2	0.6	9.9 – 19.0
	14.2 ± 1.62	13.2 ± 0.42		13.3 ± 0.43
Anal fin length	14.7 – 19.7	10.1 – 18.0	2.3	10.1 – 19.7
	17.1 ± 0.81	15.1 ± 0.34		15.5 ± 0.33
Anal fin height	7.7 – 13.6	7.5 – 13.9	0.6	7.5 – 13.9
	10.3 ± 1.00	9.6 ± 0.31		9.7 ± 0.30

Table 1. Contiuned

Characters	*Pomatoschistus bathi*			
	♂ (n = 15)	♀ (n = 25)	M_{diff}	♂♀ (n = 40)
Pectoral fin length	20.9 – 24.6	19.8 – 24.8	0.8	19.8 – 24.8
	21.9 ± 0.69	22.5 ± 0.24		22.4 ± 0.23
Ventral fin length	24.2 – 26.4	22.9 – 29.9	1.6	23.0 – 30.0
	25.4 ± 0.44	26.3 ± 0.36		26.2 ± 0.32
Caudal fin length	20.5 – 27.5	16.5 – 23.9	1.8	16.5 – 27.5
	22.3 ± 1.32	19.8 ± 0.30		20.2 ± 0.36
Distance between ventral fin and anus	16.3 – 21.7	14.7 – 24.3	1.5	14.7 – 24.4
	18.7 ± 1.00	20.3 ± 0.41		20.1 ± 0.39
Head length	24.7 – 27.5	26.0 – 28.6	1.5	24.7 – 28.6
	26.2 ± 0.46	27.0 ± 0.15		26.8 ± 0.15
	in % of head length			
Height head	49.7 – 55.7	45.7 – 59.0	1.3	45.7 – 59.0
	52.2 ± 1.10	50.6 ± 0.65		50.8 ± 0.58
Height head through the middle of the eye	30.9 – 43.2	30.4 – 47.7	1.1	30.4 – 47.7
	38.5 ± 2.09	35.9 ± 0.88		36.4 ± 0.82
Maximum head depth	40.7 – 45.3	35.2 – 43.8	3.0	35.2 – 45.4
	42.5 ± 0.84	39.5 ± 0.50		40.0 ± 0.48
Snout length	18.0 – 26.0	17.0 – 28.2	0.1	17.0 – 28.2
	21.3 ± 1.60	21.2 ± 0.54		21.2 ± 0.51
Upper jaw length	22.0 – 32.7	18.8 – 33.4	0.9	18.8 – 33.4
	29.8 ± 2.05	27.9 ± 0.53		28.2 ± 0.56
Lower jaw length	24.0 – 38.5	25.2 – 35.9	0.2	24.0 – 38.5
	32.3 ± 2.38	31.9 ± 0.55		31.9 ± 0.58
Orbital diameter	20.8 - 27.8	23.1 – 29.4	0.4	20.8 – 29.4
	25.6 ± 1.24	26.1 ± 0.31		26.0 ± 0.32
Post-orbital distance	48.7 – 78.0	31.9 – 56.3	1.3	31.9 – 78.0
	58.9 ± 5.03	52.1 ± 0.96		53.2 ± 1.20
Distance between eye and mouth angle	10.5 – 16.7	7.6 – 15.2	1.1	7.6 – 16.7
	12.6 ± 1.11	11.3 ± 0.32		11.5 ± 0.33
Distance between angles of mouth	27.4 – 31.8	22.2 – 35.0	1.9	22.2 – 35.0
	30.0 ± 0.79	28.0 ± 0.62		28.4 ± 0.55
Interorbital distance	3.8 – 6.0	3.2 – 6.1	1.1	3.2 – 6.1
	4.7 ± 0.40	4.3 ± 0.14		4.3 ± 0.14
Cheek height	26.4 – 31.6	25.1 – 33.4	0.6	25.1 – 33.4
	29.4 ± 1.09	28.7 ± 0.49		28.8 ± 0.44
Width of the lip in the corner of the mouth	2.7 – 5.3	2.3 – 6.0	0.1	2.3 – 6.0
	4.2 ± 0.44	4.3 ± 0.20		4.3 ± 0.18
Istmus width	10.5 – 14.7	6.4 – 20.5	1.8	6.4 – 20.5
	12.8 ± 0.72	11.2 ± 0.55		11.4 ± 0.48

* Above the line is the variation range of a parameter and under the line is the mean value and its error.

present in the gonads of females.

Eggs of two sizes were observed in the female's gonads in the first half of May, indicating intermittent spawning. In females with *SL* 24.4 – 27.8 mm and *W* 0.19 – 0.27 g of IV maturity stage, the number of yolk oocytes varied from 430 to 680 pcs. (the average 494 pcs), while there was a low correlation between the body length and individual fecundity of a similar size individuals (Figure 4).

The life span of *Pomatoschistus bathi* slightly exceeds one year. In our samples (from June to mid-August), two age generations were observed, in which juveniles began to appear intensively while in the following months there were only 0+ (Figure 5).

In the *Pomatoschistus bathi* guts from the Karadag region, only representatives of Harpacticoida group were found (Harpacticoida identifed by Dr. Kolesnikova E.A.). Food items with the length 0.6 and 0.7 mm have contributed 68% to the total number of consumed organisms (Figure 6).

Consumption of harpacticoids is a common feature for juveniles of coastal fish species. According to our data, the contribution of Harpacticoida the total number of consumed organisms in the guts of juvenile species of the families of Atherinidae and Mugilidae (in samples collected in Sevastopol Bay) has varied from 40 to 80%. In guts of two individuals food items were over digested so counting of these items was not possible, although numerous fragments of crustaceans were observed.

The species composition of the consumed organisms in the *P. bathi* guts from the Kazachya Bay

(Sevastopol) was much wider and was contributed by six groups, namely: Harpacticoida, Calanoida, Cyclopoida, Cladocera, Cirripedia, and algae. Harpacticoids have dominated in the goby guts reaching 67% of the total number of the consumed organisms (Figure 7, 8). An average length of harpacticoids has varied from 0.3 to 1 mm. Food items with the length 0.4 and 0.6 mm were dominant.

The contribution of Cirripedia to the gut content was 8%, while Cladocera have contributed 2%. The role of eggs and algae was about 1%.

Determination of the species composition has allowed us to identify a specific feeding niche of goby. Four families namely: Thalestridae, Tisbidae, Ameiridae, and Harpacticidae have dominated the goby diet. Representatives of Tisbidae family inhabit algae (Vodyanitsky, 1969). The *Ameira parvula* species can be found on algae, as well as sandy and muddy bottoms. Representatives of Thalestridae family inhabit algae, shelly, sandy and muddy bottoms (Vodyanitsky, 1969). The most preferable food item in the diet of goby (with up to 50% of the consumed Harpacticoida) was *Harpacticus flexus.* This cosmopolite species can be found mainly on algae (Vodyanitsky, 1969). Larvae of Cirripedia (whose contribution to the gut content was 8%), dominates during the first (free-swimming) life stage.

Individuals of Cyclopoida group (represented by the invader *Oithona davisae* and contributing 9% to the total number of the consumed organisms) should be noted as well. According to our observations, juveniles and larvae of coastal fishes actively consume this species. Studying of the vertical distribution of *Oithona davisae* in the open waters of the south-west of Crimea showed that the maximum concentration of copepods was observed in the layer 0 - 10 m, while the abundance was decreasing with the depth (Temnykh *et al.*, 2012).

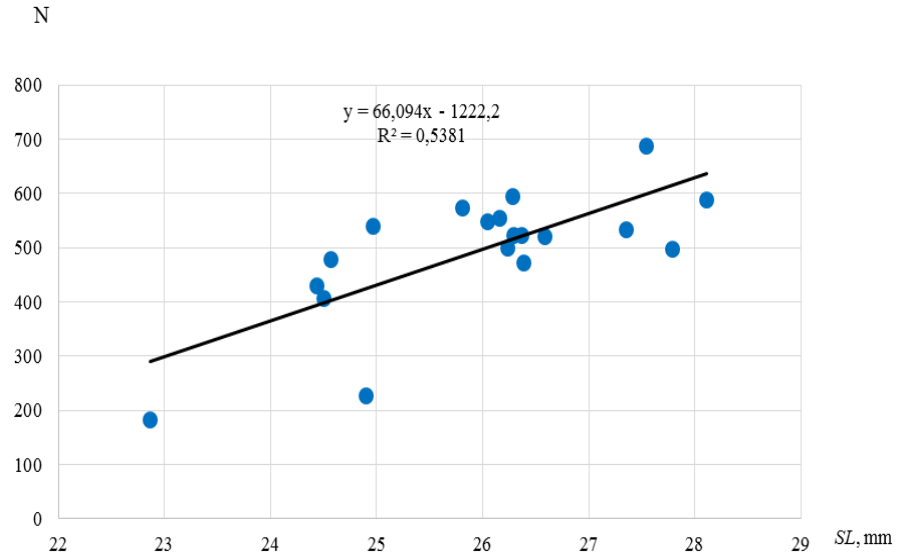

Figure 4. Dependence of absolute fecundity N of *Pomatoschistus bathi* on standard length.

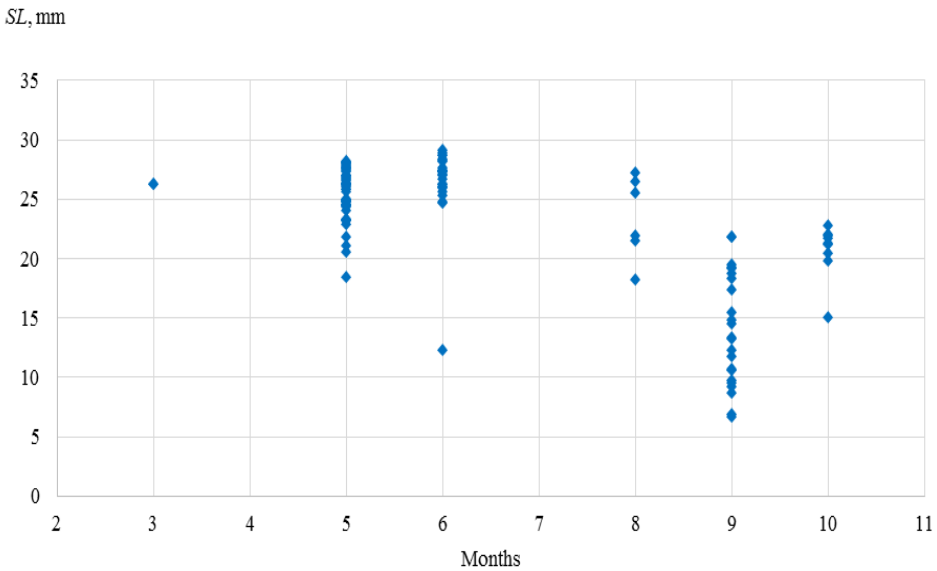

Figure 5. The standard lengths of *Pomatoschistus bathi* from March to October.

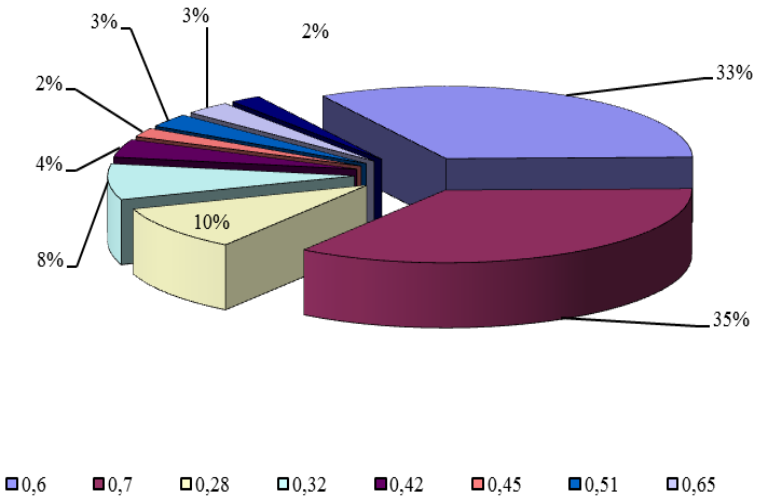

Figure 6. The percentage of food items (by the criterion of length) in the guts of *Pomatoschistus bathi* (% of total), in the area of Karadag biological station, June 2013.

Figure 7. Food items (Calanoida, Harpacticoida and Cirripedia) from gut of *Pomatoschistus bathi* (scale bar 0.5 mm).

According to the unpublished data (Gubanova *et al.,* 2013), *Oithona davisae* also inhabits the surface layer of coastal waters near Sevastopol.

Thus, the main food of *P. bathi* are representatives of Harpacticoida group, followed by Calanoida, Cyclopoida, Cladocera and Cirripedia. Taking into account that consumed preys inhabit different biotopes (such as coarse-grained soils, algae, and the surface layers), it can be concluded that *P. bathi* has a wide food niche favoring an intensive population growth in a coastal fish community.

For the first time karyotype of this species having 2n = 44 chromosomes with the number of chromosome shoulders NF = 50 (6 sm, 38 sta) has been identified (Figure 9).

Genus of *Pomatoschistus* has not been studied in details karyologically, but these species whose karyotype has been studied, were characterized by 46 (*P. pictus*, *P. minutus*, *P. microps*), 32 (*P. norvegicus*), and 37 chromosomes (*P. lozanoi*) (Vasil'ev and Grigoryan, 1993; Klinkhardt, 1992).

A characteristic feature of the karyotype of *P. bathi* is the presence of a pair of very large acrocentric chromosomes. This may be due to Robertsonian translocation of two small acrocentric chromosomes of ancestral karyotype and a corresponding decrease of the number of chromosome shoulders from 52 to 50.

Discussion

The areal of this species include the Mediterranean, Aegean and Marmara Sea. Individuals have been found near the coast of south-western France, Turkey, and the Aegean Sea (Miller, 1986), in the Gulf of Trieste (Orlando-Bonaca and Lipej, 2005), the Ligurian Sea (Tunesi *et al*. 2005), the islands of Lavezzi (Dufour *et al*. 2007), in the eastern Adriatic (Orlando-Bonaca and Lipej, 2005) and the Sea of Marmara (Kovačić *et al*. 2012). In the Black Sea, first official registration of *P. bathi* was dated back to 2003. They come from Abkhazia (Gagra and Pitsunda regions) and from the Cape Utrish, which is the Krasnodar region (Vasilyeva and Bogorodsky, 2004). Our long-term underwater observations have shown: 1) the absence of this species in the Crimea earlier, 2)

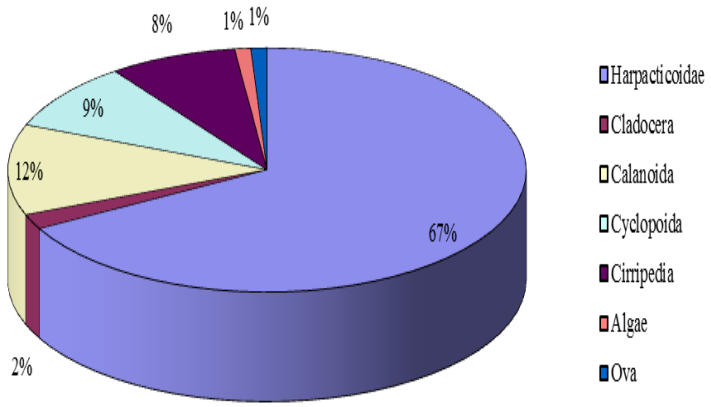

Figure 8. The species composition of the consumed food items in the guts of *Pomatoschistus bathi* in Kazachya bay, June 2014 (% of the total consumed organisms).

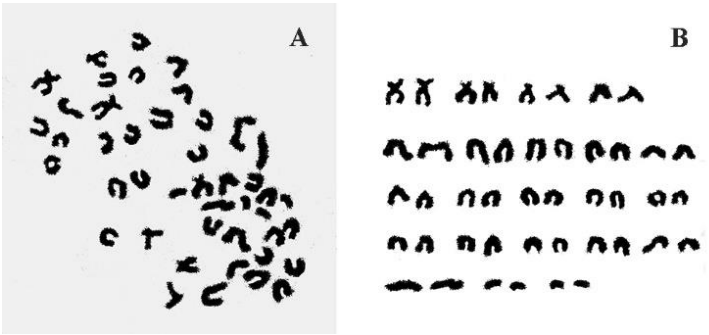

Figure 9. The metaphase plate (A) and karyotype (B) of *Pomatoschistus bathi*.

it's gradual, but rapid spread along the coast of the peninsula, 3) gradual increase of its abundance, which is often observed during the colonization of new habitat by alien species. It is unlikely that this is the sharp increase abundance of native species due to changes in environmental conditions, because other species of sand gobies with similar ecology do not show such tendencies. Therefore, in our opinion, *P. bathi* is a new and alien species for the Black Sea and it is a typical example of mediterraneanization of the Black Sea that is a gradual expansion of areal of this Mediterranean immigrant into the Black Sea, followed by a full and successful naturalization. Attributing *P. bathi* to the native species of this region (Herler *et al*., 2014) is not correct.

In the Black Sea, *P. bathi* is distributed along the coast of the Caucasus, Crimea, Bulgaria (Vassilev *et al*., 2012), but it has not been found near Turkey which is most likely to be due to the fact that catching this small species with traditional devices is low effective.

The biology and ecology of *P. bathi* is not well studied, despite the fact that in some areas in the Mediterranean this species is quite common (Patzner, 2005).

The main habitats of goby are sandy or pebble biotopes (Miller, 1986), including macrophytes in some cases (Orlando-Bonaca *et al*., 2008). However, according to our observations, behavior of goby is quite specific; the fish inhabits sandy areas (less shelly areas) and algae or rocks covered with macrophytes (mainly Cystoseira).

It should be noted that recently, in regions near Sevastopol and Sinop (Turkey), larvae of goby was referred to morphologically close species - *P. pictus* (Boltachev and Matishov, 2010), though adult individuals have never been observed in these waters. It can be assumed that these species belong to *P. bathi*, while *P. pictus* has not been found in the Black Sea. We found only one paper, which describes the food spectrum of *Pomatoschistus bathi* from the Mediterranean based data from 1984 (Zander and Hagemann, 1989). According to this paper, food spectrum of *P. bathi* with the length more than 30 mm was contributed by Harpacticoidae, Gammaridae, Mysidae, Fish, Ostracoidea. The diet of *P. bathi* with the length from 15 to 30 mm was contributed by Harpacticoidae, Gammaridae, Mysidae, Fish, Ostracoidea.

Observations of Zander and Hagemann (1989) only partially match our observations, because we have not found Gammaridae, Mysidae and fish in the

guts of goby. There are indirect indications of the predation coming from the analysis of goby guts caught in the Kazachya Bay and near Karadag. We found scales of fish there, but the question is, how did they get into goby guts remain unclear. We did not find other reports indicating that goby can feed on juvenile fish.

Overall, our data imply full naturalization of *P. bathi* in the Black Sea. This process can play a dual role in the functioning of the coastal communities. On one hand, food spectrum of *P. bathi* and juveniles of other coastal fish species are very similar, so a rapid growth of the abundance can affect negatively the competition for food. On the other hand, high abundance of *P. bathi* can provide food for many valuable predatory fish species.

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