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INTRASPECIFIC AGGRESSIVENESS OF THREE SPECIES OF GOBIIDAE FISH OF THE GENUS *PONTICOLA* ILJIN, 1927 IN LABORATORY CONDITIONS

The intensity of intraspecific aggressiveness of three species of gobiidae fish of the genus *Ponticola* was studied – Pinchuk's goby *Ponticola cephalargoides* (Pinchuk, 1976), mushroom goby *Ponticola eurycephalus* (Kessler, 1874) and ratan goby *Ponticola ratan* (Nordmann, 1840). A different level of intraspecific aggressiveness is shown in the investigated fish species. Pinchuk's goby showed the greatest aggressiveness – its single-sex and mixed groups behaved more aggressively than groups of mushroom goby and ratan goby. At the same time, indicators of the intensity of aggressiveness in the groups of mushroom goby and ratan goby did not show a statistically significant difference between these two fish species.

Key words: *Ponticola cephalargoides*, *Ponticola eurycephalus*, *Ponticola ratan,* intraspecific aggressiveness

Studies of the ichthyofauna of the Black Sea have remained relevant for a long time. Features of the formation of the Black Sea aquatic biotopes led to the emergence in our region of unique ichthyocenoses, in particular bottom ichthyofauna, an important component of which are fish of the (Actinopterygii; Gobiiformes; Gobiidae) [4]. The most common group among them are representatives of the genus Ponticola, which belong to the Ponto-Caspian relict species [3].

Our research focuses on three species of gobiidae fish of the genus *Ponticola*: Pinchuk's goby *Ponticola cephalargoides* (Pinchuk, 1976), mushroom goby *Ponticola eurycephalus* (Kessler, 1874) and ratan goby *Ponticola ratan* (Nordmann, 1840). These species are distributed along the northern coast of the Black Sea and are an important component of bottom biocenoses [1]. Their habitats overlap and they inhabit similar biotopes. However, the frequency of the occurrence of these species is different. While Pinchuk's goby is quite common and is considered as a potentially industrial species, mushroom goby and ratan goby are much less common [2].

In our work, such an aspect of the behaviour of these species as aggressiveness is considered. This form of interaction is characteristic of representatives of the gobiidae family and can manifest itself both in interspecific and intraspecific interrelation. For example, the intraspecific aggressiveness of the male goby *Trimma*

marinae Winterbottom, 2005 is associated with the protection of the female during the spawning period and is a consequence of the monogamy that is characteristic of this species [9]. Differentiated aggressive behaviour is demonstrated by the goby *Bathygobius soporator* (Valenciennes, 1837), which lives in shallow areas of the Gulf of Mexico. The form of manifestation of aggression is in the characteristic colour, position of swimmers and depends on the sex, size, and stage of maturation of the offender of the territory controlled by the male [15]. *Gobius cruentatus* Gmelin, 1789, during territorial interactions, emits acoustic signals, which consist of four types of sound emissions. It is the largest acoustic repertoire described so far in gobiidae fish and is thought to perform a threatening function [12].

The aggressiveness of fish is also a component of interspecific relationships of individual representatives of ichthyocenosis and therefore can be a factor that affects the distribution of species and the frequency of their occurrence in habitats. This aspect of behaviour was studied in representatives of the Gobiidae family from the Black Sea, specifically *Proterorhinus semilunaris* (Heckel, 1837), *Neogobius melanostomus* (Pallas, 1814), *Ponticola kessleri* (Günther, 1861), and *N. fluviatilis* [7, 11]. So, invasions of this fish, which continue in the Western European rivers Rhine and Meuse, lead to interaction with local bottom fish species. Since both groups live at the bottom and prefer shelters for at least part of their life cycle, the emergence of competition for shelter becomes a limiting factor. Experiments were conducted with habitat selection between two common native bottom fish species (*Cottus perifretum* Freyhof, Kottelat and Nolte, 2005 and *Barbatula barbatula* (Linnaeus, 1758) and four invasive non–native goby species (*Proterorhinus semilunaris* (Heckel, 1837), *Neogobius melanostomus* (Pallas, 1814), *Ponticola kessleri* (Günther, 1861) and *Neogobius. fluviatilis* (Pallas, 1814). Native *C. perifretum* demonstrated a significant shift in habitat selection with the co–distribution of territory by *P. kessleri* and *P. semilunaris*. It has been displaced and moved from available shelter sites to less desirable habitat types [11]. Thus, this type of behaviour favours when very aggressive invaders can outcompete local species for resources [8].

Experiments have also been conducted on how competitive behaviour in the interspecies relationship between two invasive gobies, *P. kessleri* and *N. melanostomus* may affect the development of populations of these fish in the Rhine River. Direct competitive interactions between species were observed. *N. melanostomus* was more active and won most interspecies conflicts, though it was smaller. Also in feeding experiments it was found that *N. melanostomus* prefers gammarids (Gammaridae) over fish during direct competition, while for *P. kessleri* the opposite occurs, it prefers fish over gammarids. The results of this study show that the two species exhibit different strategies and prove that *P. kessleri* and *N. melanostomus* can occupy different niches, which makes it possible for them to coexist [7].

The coexistence of native species of goby fish is also based on interspecific aggressive interactions. Thus, in experimental conditions, biotic interactions of three tidal gobies were considered – *Bathygobius fuscus* (Rüppell, 1830), *Chaenogobius*

annularis (Hilgendorf, 1879) and *Chaenogobius gulosus* (Sauvage, 1882). Studies have shown that species identity and body size are important elements of aggressive behaviour that affect the use of the habitat of these fish. Such methods of interaction can contribute to the coexistence and distribution of species in fish clusters [6].

Species of the genus *Ponticola* are territorial, and therefore they are characterized by this type of behaviour. However, the significance of such behaviour in the formation of benthic ichthyocenoses by representatives of the genus has not been studied in detail. However, the assessment of the aggressiveness of fish, in particular gobies, is complicated by the inability to observe them in natural conditions for a long time, which is necessary to obtain reliable data. This requires fixation and mathematical processing of the results of observations, which would allow comparing the indicators of aggressiveness of different species.

The purpose of our study was to study the aggressive behaviour and to determine the intensity of intraspecific aggressiveness of goby fish of the genus Ponticola which live in the Gulf of Odesa and are an important component of the bottom ichthyocenosis of the northwestern part of the Black Sea of Ukraine.

Materials and methods of research

Ichthyological material was collected in the coastal waters of Odesa Bay from Cape Northern Odesa to Cape Big Fountain during fishing with fishing rods from July 1 to September 15, 2023. Laboratory experiments were carried out in the aquarium room of the department of zoology, hydrobiology and general ecology of Odesa I. I. Mechnikov National University.

Two groups of fish of each species were selected for the research. From each species, one group consisted of 10 males with a total length of 13–14 cm, the second group – of 5 males (total length of fish 13–14 cm) and 5 females (total length of individuals – 12–13 cm).

When keeping fish, natural seawater was used. The water temperature in the aquarium was maintained at 14 °C, the fish were fed once a day. The diet of gobies consisted of frozen mussels, fish and blood worms. Fish that were involved in the experiment were at least two weeks in artificial aquarium conditions.

To determine the intensity of aggressiveness, the total motor activity of the fish was first measured, which was recorded at one-hour intervals. For the unit of aggressive behaviour, the average number of aggressive movements per hour was chosen, which led to a change in the position or escape of the fish in the direction in which they were committed. It was not taken into account whether there was a physical contact between the fish or not. The intensity of aggressiveness was estimated as a percentage ratio of aggressive activity to the total motor activity.

The following equipment was used for the aggressive behaviour level experiment:

– an aquarium of organic glass 110 cm long, 110 cm wide and 50 cm high;
– external filters for aquarium water “Jebo – 803” (China);

– digital network camera Hikvision DS-2CD2432F–I (China);
– laboratory thermometer;
– tests for measuring hydrochemical parameters “Tetra” (Germany);
– Titan 2000 refrigerator (Germany);
– heater for the aquarium “Hagen” (Canada).

Observations were conducted for each group hourly from 9:00 AM to 3:00 PM over 5 days. Each sample consisted of 30 observations. The total motor activity of the fish was recorded using a digital camera installed above the aquarium at a height of 125 cm so that the camera lens covered the entire area of the bottom of the aquarium. Then the resulting video was transferred to the computer memory and processed according to the original method of tracking laboratory animals, “Method of computer vision” [13]. For comparing the obtained results, a nonparametric statistical criterion, the Mann-Whitney test, was applied with a significance level of $p \leq 0.01$. We chose this criterion because it assesses differences between two independent samples for any quantitatively measured feature and allows detecting variations in parameter values between small samples, which was crucial in our experiments [5].

Study results and discussion

The motor activity of Pinchuk’s goby was studied from October 21 to October 25, 2023. During the studies, the total motor activity of the fish was first calculated. The number of movements was recorded in time intervals, after which the average value was calculated (Table 1).

Table 1

Motor activity of Pinchuk’s goby (number of movements per hour)

Observation Day		Time interval						
		9,00–10,00	10,00–11,00	11.00–12.00	12.00–13.00	13.00–14.00	14.00–15.00	Mean value
1st	♂♂	93	76	112	88	107	100	96.0±10.33
	♂♂+♀♀	109	105	111	93	124	97	106.5±8.17
2nd	♂♂	79	109	66	112	69	70	84.1±17.56
	♂♂+♀♀	98	101	105	123	107	108	107.0±5.67
3rd	♂♂	64	98	69	106	79	93	84.8±14.17
	♂♂+♀♀	118	108	98	124	95	106	108.2±8.56
4th	♂♂	95	85	70	101	104	102	92.8±10.22
	♂♂+♀♀	93	104	95	109	111	103	102.5±5.67
5th	♂♂	89	81	111	98	66	74	86.5±12.83
	♂♂+♀♀	119	101	103	92	94	96	100.8±6.83

A statistically significant difference ($p \leq 0.01$) in the locomotor activity of fish was observed between male-only groups and mixed-sex groups, regardless of the observation day. The significance level (p) used in the Mann-Whitney test, with values less than 0.01, indicates the reliability of these differences. Thus, overall locomotor activity was higher in the group composed of individuals of different sexes.

The activity of fish which can be interpreted as a manifestation of aggressive behavior, or aggressive activity was also calculated. This type of behavior was also observed in both groups (Table 2).

Table 2

Aggressive activity of Pinchuk's goby (number of movements per hour)

Observation day		Time interval						
		9,00–10,00	10,00–11,00	11.00–12.00	12.00–13.00	13.00–14.00	14.00–15.00	Mean value
1st	♂♂	36	48	46	28	22	47	37.8±9.17
	♂♂+♀♀	81	71	77	80	78	70	76.2±3.78
2nd	♂♂	49	32	48	26	36	34	37.5±7.33
	♂♂+♀♀	78	81	79	82	72	76	78.0±2.67
3rd	♂♂	44	50	49	23	22	26	35.6±12.00
	♂♂+♀♀	78	75	83	81	77	74	78.0±2.67
4th	♂♂	51	46	33	40	27	43	40±6.67
	♂♂+♀♀	71	85	73	72	82	77	76.7±4.67
5th	♂♂	41	49	30	23	42	45	38.3±7.89
	♂♂+♀♀	73	86	81	84	69	74	77.8±5.83

The differences between the results of counting aggressive movements in the male group and the mixed group were also statistically significant ($p \leq 0.01$). The number of aggressive movements in the group which consisted of males and females was higher.

The intensity of the aggressiveness of Pinchuk's goby the single–sex group of males was 42.6%, and in the mixed group it was higher and amounted to 73.6% (Table 3).

Thus, the total motor activity, aggressive activity and intensity of aggressiveness in the group, which consisted of 5 males and 5 females of Pinchuk’s goby was higher than in the group, which included only males.

Similar observations were also made with mushroom goby. Fixation of the general activity of fish was carried out from 26.10.2023 to 30.10.2023. The same two groups of fish were involved in the experiment (Table 4).

Table 3

Intensity of aggressiveness of Pinchuk's goby (number of movements per hour,%)

Activity type		Observation day					
		1st	2nd	3rd	4th	5th	For the entire period
Motor activity	♂♂	96.0±10.33	84.1±17.56	84.8±14.17	92.8±10.22	86.5±12.83	88.9±13.87
	♂♂+♀♀	106.5±8.17	107.0±5.67	108.2±8.56	102.5±5.67	100.8±6.83	105.0±7.47
Aggressive activity	♂♂	37.8±9.17	37.5±7.33	35.6±12.00	40±6.67	38.3±7.89	37.81±8.81
	♂♂+♀♀	76.2±3.78	78.0±2.67	78.0±2.67	76.7±4.67	77.8±5.83	77.3±3.88
Intensity of aggressiveness %	♂♂	39.4	44.6	42.0	43.1	44.3	42.6
	♂♂+♀♀	71.5	72.9	72.1	74.2	77.2	73.6

Table 4

Motor activity of mushroom goby (number of movements per hour)

Observation day		Time interval						
		9,00–10,00	10,00–11,00	11.00–12.00	12.00–13.00	13.00–14.00	14.00–15.00	Mean value
1st	♂♂	95	73	96	84	59	56	77.2±14.50
	♂♂+♀♀	83	72	77	93	95	66	81.0±9.33
2nd	♂♂	87	90	61	92	67	89	81.0±11.33
	♂♂+♀♀	80	79	98	89	91	82	86.5±6.17
3rd	♂♂	86	75	70	80	90	73	79.0±6.33
	♂♂+♀♀	98	87	78	70	83	67	80.5±8.83
4th	♂♂	88	48	71	95	66	74	73.7±12.00
	♂♂+♀♀	75	74	82	71	94	85	80.2±6.83
5th	♂♂	48	69	87	52	67	54	62.8±11.50
	♂♂+♀♀	89	82	69	85	75	88	82.8±6.22

The total number of movements in both groups of goby red differed and had a statistical difference ($p \leq 0.01$). In general, the fish in the mixed group showed greater activity than in the single–sex group.

The number of aggressive movements was also higher in the mixed group than in the group consisting only of males (Table 5). The difference in the indicators of aggressive activity of both groups was statistically significant ($p \leq 0.01$).

Table 5

Aggressive activity of mushroom goby (number of movements per hour)

Observation day		Time interval						
		9,00–10,00	10,00–11,00	11.00–12.00	12.00–13.00	13.00–14.00	14.00–15.00	Mean value
1st	♂♂	15	27	26	21	19	23	21.8±3.50
	♂♂+♀♀	47	39	21	35	32	49	37.2±7.83
2nd	♂♂	33	21	25	35	27	34	29.2±4.83
	♂♂+♀♀	21	26	24	44	39	43	32.8±9.17
3rd	♂♂	32	28	27	34	33	13	27.8±5.22
	♂♂+♀♀	51	54	33	53	56	23	45.0±11.33
4th	♂♂	18	29	30	32	17	26	25.3±5.22
	♂♂+♀♀	54	57	50	48	38	29	39.3±8.33
5th	♂♂	28	19	14	27	29	13	21.7±6.33
	♂♂+♀♀	58	50	43	34	59	42	47.7±8.00

Using indicators of general motor and aggressive activity, the intensity of aggressiveness in experimental groups of mushroom goby was calculated (Table 6).

Table 6

Indices of various forms of motor activity of mushroom goby (number of movements per hour,%)

Activity type		Observation day					
		1st	2nd	3rd	4th	5th	Mean value
Motor activity	♂♂	77.2±14.50	81.0±11.33	79.0±6.33	73.7±12.00	62.8±11.50	74.7±12.51
	♂♂+♀♀	81.0±9.33	86.5±6.17	80.5±8.83	80.2±6.83	82.8±6.22	81.9±7.45
Aggressive activity	♂♂	21.7±6.33	29.2±4.83	27.8±5.22	25.3±5.22	21.8±3.50	25.7±5.6
	♂♂+♀♀	37.2±7.83	47.7±8.00	45.0±11.33	39.3±8.33	32.8±9.17	41.7±9.90
Intensity of aggressiveness %	♂♂	29.9	36.0	35.2	34.3	34.6	34.0
	♂♂+♀♀	45.9	37.9	55.9	49.0	57.6	49.3

Observations of the activity of the mushroom goby showed that the activity, both general and aggressive, is more pronounced in the mixed group. Accordingly. the intensity of aggressiveness was higher in the group of males and females – 49.3% than in the group in which there were only males – 34.0%.

Another type of gobies, which was monitored – ratan goby. Two groups of this species of goby were observed since November 1, 2023 to November 5, 2023.

The results of observations of motor activity showed a difference in the behaviour of the two experimental groups (Table 7).

Table 7

Motor activity of the ratan goby (number of movements per hour)

Observation day		Time interval						
		9,00–10,00	10,00–11,00	11.00–12.00	12.00–13.00	13.00–14.00	14.00–15.00	Mean value
1st	♂♂	74	82	98	65	71	59	74.8±10.11
	♂♂+♀♀	42	46	48	25	30	26	36.2±9.17
2nd	♂♂	90	61	84	92	69	88	80.7±10.44
	♂♂+♀♀	34	40	36	27	30	25	32.0±4.67
3rd	♂♂	66	85	65	89	57	92	75.7±13.00
	♂♂+♀♀	27	35	29	41	46	26	34.0±6.67
4th	♂♂	86	75	82	62	78	83	77.7±6.11
	♂♂+♀♀	25	49	28	40	43	46	38.5±8.00
5th	♂♂	81	60	75	65	91	68	73.3±9.00
	♂♂+♀♀	29	25	35	46	38	34	34.5±5.17

Unlike Pinchuk's goby and mushroom goby, the motor activity in the mixed ratan goby group was lower than in the single–sex group, and these indicators had a statistically significant difference ($p \leq 0,01$).

The results of calculation of aggressive actions in two experimental groups are given in Table 8.

A greater number of aggressive movements among experimental fish goby ratan was also observed in single–sex groups. Fish in the mixed group showed almost half as many aggressive actions to each other. These differences between the obtained magnitudes of observations were statistically significant ($p \leq 0.01$).

To compare the intraspecific aggressiveness of the species considered in our work, we determined the intensity of this indicator for the ratan goby (Table 9).

According to the indicators, a greater intensity of aggressiveness is inherent in the mixed group (41.3%) than in the same–sex group of males (32.7%).

Table 8

Aggressive activity of the ratan goby (number of movements per hour)

Observation day		Time interval						
		9,00–10,00	**10,00–11,00**	**11.00–12.00**	**12.00–13.00**	**13.00–14.00**	**14.00–15.00**	**Mean value**
1st	♂♂	37	16	18	35	19	36	26.8±9.17
	♂♂+♀♀	10	12	8	19	13	20	13.7±3.89
2nd	♂♂	15	19	35	39	29	31	28.0±7.33
	♂♂+♀♀	11	10	13	14	19	9	12.7±2.67
3rd	♂♂	30	11	13	14	28	23	19.8±7.17
	♂♂+♀♀	19	18	20	12	15	17	16.8±2.22
4th	♂♂	29	38	36	12	23	17	25.8±8.50
	♂♂+♀♀	13	16	17	18	15	10	14.8±2.22
5th	♂♂	12	20	35	34	25	23	24.8±6.50
	♂♂+♀♀	10	11	13	20	17	14	14.2±2.89

Table 9

Indices of various forms of motor activity of ratan goby
(number of movements per hour,%)

Activity type		Observation day					
		1st	2nd	3rd	4th	5th	Mean value
Motor activity	♂♂	74.8±10.11	80.7±10.44	75.7±13.00	77.7±6.11	73.3±9.00	76.4±10.30
	♂♂+♀♀	36.2±9.17	32.0±4.67	34.0±6.67	38.5±8.00	34.5±5.17	35.0±7.04
Aggressive activity	♂♂	26.8±9.17	28.0±7.33	19.8±7.17	25.8±8.50	24.8±6.50	25.1±8.07
	♂♂+♀♀	13.7±3.89	14.2±2.89	16.8±2.22	14.8±2.22	12.7±2.67	14.4±3.20
Intensity of aggressiveness %	♂♂	35.8	34.7	26.2	33.2	33.8	32.7
	♂♂+♀♀	35.0	42.8	49.4	38.4	41.1	41.3

Thus, the obtained indicators allow us to assess the intensity of the aggressive behaviour of Pinchuk's goby, mushroom goby and ratan goby observed in single–sex and mixed groups (Table 10).

Table10

Indices of various forms of motor activity of Pinchuk's goby, mushroom goby and ratan goby

Species	Total mobility (movement/h)		Aggressive mobility (movement/h)		Intensity of aggressiveness,%	
	♂♂	♂♂+♀♀	♂♂	♂♂+♀♀	♂♂	♂♂+♀♀
Pinchuk's goby	88.9±13.87	105.0±7.47	37.81±8.81	77.3±3.88	42.6	73.6
Mushroom goby	74.7±12.51	81.9±7.45	25.7±5.6	41.7±9.90	34.0	49.3
Ratan goby	76.4±10.30	35.0±7.04	25.1±8.07	14.4±3.20	32.7	41,3

The highest value of intraspecific aggressiveness was recorded for Pinchuk's goby– in the group consisting only of males – 42.6%, and 73.6% in the group of males and females. The mushroom goby also had lower rates of aggressive behavior intensity in the same–sex group – 34.0% than in the mixed group – 49.3%. We got the lowest rates of aggressiveness for the single–sex group of ratan goby – 32.7%, while in the mixed group the aggressiveness of these fish was greater – 41.3%.

In a group comparison of the intensity of the aggressiveness of Pinchuk's goby, the mushroom goby and the ratan goby, the statistical difference was between the indices of the aggressive behavior of Pinchuk's goby and the mushroom goby, as well as for Pinchuk's goby and ratan goby. This was true for both single–sex and mixed groups. There is no statistical difference between the aggressive activity of the mushroom goby and ratan goby groups (Table 11).

Table 11

Comparison of intensity of aggressiveness of Pinchuk's goby, mushroom goby and ratan goby

Species	Observation day										Statistical difference
	1st		2nd		3rd		4th		5th		
	♂♂	♂♂+♀♀	♂♂	♂♂+♀♀	♂♂	♂♂+♀♀	♂♂	♂♂+♀♀	♂♂	♂♂+♀♀	
Pinchuk's goby Mushroom goby	39.4 29.9	71.5 45.9	44.6 36.0	72.9 37.9	42.0 35.2	72.1 55.9	43.1 34.3	74.2 49.0	44.3 34.6	77.2 57.6	p≤0.01.
Pinchuk's goby Ratan goby	39.4 35.8	71.5 35.0	44.6 34.7	72.9 42.8	42.0 26.2	72.1 49.4	43.1 33.2	74.2 38.4	44.3 33.8	77.2 41.1	p≤0.01
Mushroom goby Ratan goby	29.9 35.8	45.9 35.0	36.0 34.7	37.9 42.8	35.2 26.2	55.9 49.4	34.3 33.2	49.0 38.4	34.6 33.8	57.6 41,1	No statistically significant differences

Thus, Pinchuk's goby showed the greatest intraspecific aggressiveness – its single–sex and mixed groups behaved more aggressively than the mushroom goby and ratan goby groups. At the same time, the intensity of aggressiveness in the mushroom goby and ratan goby groups did not show a statistically significant difference. However, the motor and aggressive activity of the goby ratan in the single–sex group was higher than in the mixed group, while the Pinchuk goby and the mushroom goby, on the contrary, showed more activity in the mixed group.

The research by Sebastianutto on the significance of aggressive signals in the gobiidae (*Gobius cruentatus*) during territorial interactions [12], experiments conducted by Kessel et al. to study aggressive behaviour in *P. semilunaris*, *N. melanostomus*, *P. kessleri*, and *N. Fluviatilis* as native species during colonization [11], and observations by Borcherding, Hertel, and Breiden on competitive behaviour in *P. kessleri* and *N. melanostomus* [7] all indicate that aggression plays a crucial role in the life of the Black Sea representatives of the Gobiidae family. This leads us to consider that the aggression exhibited by the studied fish may have adaptive significance and influence fish distribution in benthic ichthyocenoses.

Conclusions

Our observations indicate varying levels of intraspecific aggression in the gobiidae fish: *Ponticola cephalargoides* (Pinchuk, 1976), *Ponticola eurycephalus* (Kessler, 1874), and *Ponticola ratan* (Nordmann, 1840).

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Referenses

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ВНУТРІШНЬОВИДОВА АГРЕСИВНІСТЬ ТРЬОХ ВИДІВ БИЧКОВИХ РИБ РОДУ *PONTICOLA* ILJIN, 1927 В ЛАБОРАТОРНИХ УМОВАХ

Резюме
Проблема. Агресивна поведінка може проявлятися як у міжвидових, так і у внутрішньовидових взаємовідносинах риб. Така форма взаємодії характерна для представників родини Gobiidae. Вона може впливати на розподіл та чисельність видів у іхтіоценозах. Особливості та вираження агресивності у чорноморських бичків є найменш дослідженим типом поведінки, зокрема у видів роду *Ponticola* Iljin, 1927
Мета. Метою роботи було вивчення внутрішньовидової агресивної поведінки трьох видів бичків роду *Ponticola* – бичка Пінчука *Ponticola cephalargoides* (Pinchuk, 1976), бичка рудого *Ponticola eurycephalus* (Kessler, 1874) та бичка кам'яного *Ponticola ratan* (Nordmann, 1840).
Методика. Іхтіологічний матеріал зібрано в прибережній акваторії Одеської затоки від мису Північний Одеський до мису Великий Фонтан при проведенні лову вудками з 1 липня по 15 вересня 2023 року. Лабораторні експерименти проводили в акваріальній кафедри зоології, гідробіології та загальної екології Одеського національного університету імені І. І. Мечникова.
Для досліджень були відібрані по дві групи риб кожного виду. Для визначення інтенсивності агресивності спочатку вимірювали загальну рухову активність риб, яку фіксували за інтервалами тривалістю в одну годину. За одиницю агресивної поведінки обрано середню кількість агресивних рухів за годину, які приводили до зміни положення чи втечі риби, в напрямку якої

вони були здійснені. Інтенсивність агресивності оцінювалась у відсотковому співвідношенні агресивної активності до загальної рухової активності.
Спостереження проводились за кожною групою протягом шести годин з 9.00 до 15.00 години продовж 5 днів. Загальну рухову активність риб фіксували за допомогою цифрової камери, встановленої над акваріумом. Отриманий відеозапис переносили в пам'ять комп'ютера та обробляли за оригінальною методикою для трекінгу лабораторних тварин «Метод комп'ютерного зору». Для порівняння отриманих результатів застосовували непараметричний статистичний критерій Манна-Уітні.
Основні результати. Найбільшу внутрішньовидову агресивність показав бичок Пінчука – його одностатеві та змішані групи поводили себе агресивніше, ніж групи бичка рудого та бичка ратана. Водночас показники інтенсивності агресивності в групах бичка рудого та бичка ратана не показали статистично значимої відмінності між двома даними видами риб. Однак, загально рухова та агресивна активність бичка ратана в одностатевій групі була вищою, ніж у змішаній групі, тоді як бичок Пінчука та бичок рудий навпаки, у змішаній групі виявляли більшу активність.
Висновки. Наші спостереження свідчать про різний рівень внутрішньовидової агресивності у бичка Пінчука *Ponticola cephalargoides* (Pinchuk, 1976), бичка рудого *Ponticola eurycephalus* (Kessler, 1874) та бичка кам'яного *Ponticola ratan* (Nordmann, 1840), що може мати адаптивне значення та впливати на розподіл риб в донних іхтіоценозах.

Ключові слова: *Ponticola cephalargoides*, *Ponticola eurycephalus*, *Ponticola ratan,* внутрішньовидова агресивність

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INTRASPECIFIC AGGRESSIVENESS OF THREE SPECIES OF GOBIIDAE FISH OF THE GENUS *PONTICOLA* ILJIN, 1927 IN LABORATORY CONDITIONS

Summary
Introduction. Aggressive behavior can be manifested both in interspecific and intraspecific relationships of fish. This form of interaction is typical for representatives of the Gobiidae family. It can affect the distribution and abundance of species in ichthyocenoses. Peculiarities and expression of aggressiveness in the Black Sea gobies is the least researched type of behavior, in particular in species of the genus *Ponticola* Iljin, 1927
Aim. The aim of the work was to study the intraspecific aggressive behavior of three species of bulls of the genus Ponticola – Pinchuk's goby *Ponticola cephalargoides* (Pinchuk, 1976), mushroom goby *Ponticola eurycephalus* (Kessler, 1874) and ratan goby *Ponticola ratan* (Nordmann, 1840).

Methods. Ichthyological material was collected in the coastal waters of Odesa Bay from Cape Northern Odesa to Cape Big Fountain during fishing with fishing rods from July 1 to September 15, 2023. Laboratory experiments were carried out in the aquarium room of department of zoology, hydrobiology and general ecology of Odesa I. I. Mechnikov National University.

To determine the intensity of aggressiveness, the total motor activity of the fish was first measured, recorded at one-hour intervals. For the unit of aggressive behaviour, the average number of aggressive movements per hour was chosen, which led to a change in the position or escape of the fish in the direction in which they were committed. The intensity of aggressiveness was estimated as a percentage ratio of aggressive activity to total motor activity.

Observations were carried out on each group for 6 hours from 9.00 to 15.00 for 5 days. The total motor activity of the fish was recorded using a digital camera installed above the aquarium. Then the resulting video was transferred to the computer memory and processed according to the original method of tracking laboratory animals, "Method of computer vision"

Results. Pinchuk's goby showed the greatest intraspecific aggressiveness – its single–sex and mixed groups behaved more aggressively than the mushroom goby and ratan goby groups. At the same time, the intensity of aggressiveness in the mushroom goby and ratan goby groups did not show a statistically significant difference. However, the motor and aggressive activity of the goby ratan in the single–sex group was higher than in the mixed group, while the Pinchuk goby and the mushroom goby, on the contrary, showed more activity in the mixed group.

Conclusion. Our observations also indicate a different level of intraspecific aggressiveness in different species of Gobiidae, which may have adaptive significance and affect the distribution of fish in ichthyocenoses

Key words: *Ponticola cephalargoides*, *Ponticola eurycephalus*, *Ponticola ratan,* intraspecific aggressiveness

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