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SIZE-AT-AGE AND SEX VARIABILITY OF PLASTIC VALUES IN OCELLATED WRASSE, *SYMPHODUS OCELLATUS* (LINNAEUS, 1758) (LABRIDAE, PERCIFORMES), IN NORTHERN PART OF THE BLACK SEA

The paper presents the results of a study of the size-at-age and sex variability of plastic characters in the late ontogenesis of Ocellated wrasse, *Symphodus ocellatus* (Linnaeus, 1758) from the northern part of the Black Sea. It is established, that males and females can be differentiated into small and large individuals based on absolute values of 26 plastic characters. Differences between these groups are highly reliable in all characters. According to the relative values, the differences are significant for 14 characters in males , and 6 characters in females. The expression of sex differences in *S. ocellatus* increases with age both in absolute and relative values of plastic characters. Among large and small individuals of the Ocellated wrasse, males are significantly larger than females. The structure of the expression and the directionality of sex differences in the Ocellated wrasse also are changed.

K e y w o r d s: plastic characters, size-at-age and sexual variability, *Symphodus ocellatus*, Black Sea.

Introduction

Body size in fish is determined by their age, growth rate and puberty. It is known that fish have a strong positive correlation between age and body size (Cherepanov, 1986), so researchers often study the size or size -at-age variation of plastic characters instead of age (Fauna…, 1982; Schevchenko, 1971, etc.). Sex differences in the linear dimensions and proportions of the body are characteristic for many fish species. Unlike sexual dimorphism, when males and females differ in qualitative discrete characters, which allow to consider them as two independent morphs, sex differences in quantitative characters with continuous variability are characterized by such indicators as expression, directionality and structure.

The *expression* or magnitude and significance of differences between males and females are usually assessed by average values of characters (for example, using Student's t-test), by integral indicators (main components, factors, canonical variables, etc.), by difference metrics (Euclidean distance, Mahalanobis metric) or by the value of specially calculated indicators (Lovich, Gibbons, 1992; Peskov et al., 2017).

The *directionality* of sex differences is determined by the sign with a corresponding difference indicator. For example, if males are larger than females ($L_{♂} > L_{♀}$), when comparing them along the body length "$L_{♂} — L_{♀}$", the value of the difference indicator will have a "+" sign, if vice versa ($L_{♂} < L_{♀}$) the sign "–". In the majority of clupeid and carp fishes, females are larger than males. Salmon males, as many other species protecting the eggs, are larger than females (Svetovidov, 1964).

The *structure* of sex differences is determined by the fact that the magnitude and expression of differences between males and females differ in various characters, therefore, all compared characters can be structured (grouped, ranked) according to these criteria.

Thus, the aim of this paper is to estimate the size-at-age and sex variability of plastic characters of Ocellated wrasse, *Symphodus ocellatus* (Linnaeus, 1758), in late ontogenesis.

Material and methods

We used materials sampled in the coastal waters of Ukraine in the Black Sea. The material is housed in the ichthyological collection of the National Museum of Natural History, National Academy of Sciences of Ukraine (Movchan et al., 2003) (Table 1).

Table 1. Brief characteristics of the processed material

No.	Sampling site	Sampling date	Sex, number of specimens
1139	Crimea, Chernomorskyi Distr., Rybachie vill.	25.05.1958	1 ♂
1161	Kherson Reg., Golopristanskyi Distr., cordon "Yagorlytsky Kut" of the Black Sea Biosphere Reserve, Yagorlytskyi Bay	6–10.07.1980	2 ♂, 3 ♀
1171	Crimea, Sudakskyi Distr., Karadag Reserve	1–23.06.1980	1 ♂, 1 ♀
1182	Nikolaev Reg., Ochakovskyi Distr., Pokrovka vill., Yagorlytskyi Bay	1–5.07.1980	6 ♂, 2 ♀
1188	Odessa Reg., Tatarbunarskyi Distr., Sasyk Lake	18.08–7.09.1967	4 ♂, 5 ♀
3516	Crimea, Sudakskyi Distr., Karadag Reserve	14–31.05.1979	2 ♂, 1 ♀
5564	Crimea, Sudakskyi Distr., Karadag Reserve	24.06–8.07.1980	8 ♂, 1 ♀
5570	Kherson Reg., Golopristanskyi Distr., Tendra	20.07.1988	1 ♂, 16 ♀
5635, 5636	Crimea, near Sevastopol, Kazachia Bay	5–27.06.1974	5 ♂, 6 ♀
5851	Crimea, Sudakskyi Distr., Karadag Reserve	31.05.1979	1 ♂, 1 ♀
7649	Crimea, Sudakskyi Distr., Karadag Reserve	5.08.2002	5 ♂
7920	Crimea, near Yalta, "Cape Martian" Reserve	9.09.2010	1 ♂
8595	Crimea, Chernomorskyi Distr., near Olenevka vill., Bolshoi Kostel Bay	23–27.06.2007	3 ♂, 2 ♀
9546	Crimea, Leninskyi Distr., Kerch Peninsula, Opuk cape	29–31.05.2013	2 ♂

Fish were caught by gill nets at depth of 10–15 m, and fixed in 4 % formaldehyde solution for subsequent processing in laboratory.

Measurements of plastic characters are made with an electronic caliper, with 0.1 mm precision: TL — total body length; SL — standard body length (from the beginning of the upper lip to the beginning of base of caudal fin rays); H — maximum body height before ventral fins; h — height of the caudal peduncle; aD_1 — the distance from the beginning of the upper lip to the first spiny ray of the dorsal fin; aD_2 — the distance from the beginning of the upper lip to the first soft ray of the dorsal fin; aP — antepectoral length (from the upper lip to beginning of the pectoral fin base); aV — anteventral length (from the upper lip to beginning of the ventral fin base), aA — anteanal length (from the upper lip to beginning of the anal fin); pD — postdorsal length (from the end of dorsal fin base to the beginning of the base of the middle rays of caudal fin); l_{caud} — the length of caudal peduncle (from the end of anal fin base before the base of the middle rays of caudal fin); lD — length of the dorsal fin base; lD_1 — length of the base of the spiny part of the dorsal fin; lD_2 — length of the base of the soft part of the dorsal fin; hD_1 — height of the last spiny ray of the dorsal fin; hD_2 — maximum height of the soft part of the dorsal fin; lA — length of the anal fin base; hA — height of the third spiny ray of the anal fin; lP — pectoral fin length; lV — ventral fin length; h_{ll} — distance from the base of the 2nd spiny ray in dorsal fin to the lateral line; C — head length; hC — head height at the vertical of the middle of the eye; r — snout length (from the beginning of the upper lip to the anterior edge of the eye); o — horizontal diameter of the eye; po — postorbital length; io — interorbital length. The following meristic characters were also counted: D_1 — the number of spiny rays in dorsal fin; d_2 — the number of soft rays in dorsal fin; A — the number of spiny rays in anal fin; a — the number of soft rays in anal fin; P — the number of soft rays in pectoral fin; l.l. — the number of scales along the lateral side of the body; sp. br. — the number of gill rakers on the first gill arch.

The sex of the fish was determined by the shape and color of the urogenital papilla (in females it is large and black).

Differentiation of individuals according to the absolute values of morphometric characters was studied using hierarchical cluster analysis. The Euclidean distance — DE — was calculated as a measure of the generalized differences between individuals on absolute values of 26 plastic characters. Based on the fact that the size and age of fish strongly correlate with each other (Cherepanov, 1986), the groups that emerged were considered as size-age classes. For each sample, the standard statistical parameters of the variational series were calculated: minimum (min), maximum (max), arithmetic average (M) values of the character, arithmetic average error (m), and standard deviation (SD). The significance of differences between the compared samples was estimated by the average values of characters using Student's t-test. The similarity in the structure of sex and size-age differences was estimated using the Spearman rank correlation coefficient (Rs), comparing the consistency in the variation of the values of Student's t-test for 26 plastic characters (Lakin, 1990). Differences at a 5 % level of significance were considered as statistically significant. Differences between the size-at-age and sex groups of Ocellated wrasse were analyzed over the entire set of characters using discriminant analysis. As a measure of generalized differences in the complex of absolute and relative plastic characters, we calculated the Squared Mahalanobis Distance SqMD. The studied material was processed statistically using the STATISTICA 6.0 and Microsoft Office Excel software packages.

Results and discussion

Brief biological characteristics. The species distribution covers the waters of the East Atlantic (Bay of Biscay), the Mediterranean, Adriatic, Aegean, Marmara,

Black Sea, and the western part of the Azov Sea to the Berdyansk Spit (Svetovidov, 1964; Diripasco et al., 2011; Vasil'eva, Luzhnyak, 2013; Bilecenoglu et al., 2002; Golani et al., 2006). In the waters of Ukraine this species is found from the Zmeinyi Island (Snigirev, 2008) and further eastward from the Danube coast to the Kerch Strait in the waters of Ukraine (Vinogradov, 1960; Pinchuk, Tkachenko, 1996; Boltachev, Karpova, 2012). It was often observed in the Odesa Bay until 2003, however, it was not registered here later (Chernikova, Zamorov, 2011). The isolated population is known from the Tiligul estuary (Kovtun, Tarasenko, 2005). Target species inhabits coastal biotopes with rocky and (less often) sandy soils among the thickets of underwater vegetation to a depth of 30 m, but is most numerous in shallow waters (up to 5–10 m). The food spectrum includes invertebrates: small crustaceans, mollusks, sea worms, as well as bryozoans, hydroid polyps and plants (Vasil'eva, 2007; Quignard, Pras, 1986), and diet changes throughout the year are a specific adaptive response to transformations in the environment (Ouannes-Ghorbel et al., 2003). Males grow faster than females (Quignard, Pras, 1986). In the Black Sea, it reaches sexual maturity at the age of one year at a length of about 3.5 cm (Salekhova, 1971). Spawning is multiportional. Reproduction in the Black Sea continues from April to August under water temperature from 12 to 26 °C, spawning peaks from the end of May to the end of June (Salekhova, 1971). Species biology has been well studied in the Mediterranean Sea (Taborsky et al., 1987; Alonso, Wagner, 1999, 2000; Kabasakal, 2001; Alonso, 2008; Lipej et al., 2009; Alonso, Heckman, 2010). Standard body length reaches 14 cm, usually 7–8 cm (Vasil'eva, 2007). In the Black Sea, the age limit for females is 3+, and 5+ years for males (Salekhova, 1971).

Brief diagnosis. D XIII–XV+8–11; A III+8–11; P 12; V I 5; l.l. 30 (Golani et al., 2006, Mediterranean Sea). D (XIII) XV+(9) 10; A III+(9) 10; P I+11–12; l.l. 32–34 (Svetovidov, 1964). D XIII–XV+8–11; A III+8–11; l.l. 30–34; sp.br. 14–18 (Vasil'eva, 2007, Black Sea). D XIV+9–10; A III+9–10; P I+11–12; V I 5; l.l. (31) 32–34 (Movchan, 2011, Black Sea). D XIII–XV (M=13.89±0.040)+9–11 (M=9.95±0.050); A III+9–11 (M=9.91±0.051); P 11–13 (M=12.01±0.022); l.l. 30–34 (M=31.86±0.094); sp.br. 14–16 (M=14.78±0.080) (original data, northern part of the Black Sea).

The distance from the base of the second spiny ray in dorsal fin to the lateral line is less than half as long as the soft part of the dorsal fin (37.29–50.00 %, mean 47.13 % in males and 44.19 % in females). Body height is equal or slightly greater than the head length. The dorsal fin is long, consists of spiny and soft parts. The length of its base averages 53.73 % of the standard body length (SL) in males and 52.82 % in females. The pectoral fins are longer than ventral, with an average of 21.63 % SL in males and 20.52 % in females. Ocellated wrasse reaches sexual maturity at the age of one year at a length of about 3.5 cm in the Black Sea. Therefore, all investigated specimens are mature.

Size and age variability. According to the results of hierarchical cluster analysis (Fig. 1), both males and females of the Ocellated wrasse are differentiated into small ($SL_{♂}$ = 43–70 mm and $SL_{♀}$ = 42–56 mm) and large ($SL_{♂}$ = 71–93 mm and $SL_{♀}$ = 59–72 mm) individuals.

Differences between large and small individuals are highly significant in the mean absolute values of 26 characters in both males (Table 2) and females (Table 3). At the same time, in females these differences are noticeably larger in most characters than those in males, with the exception of three signs (aP, hD_2, hA), the size-age differences for which are greater in males. The generalized differences between small and large individuals in males (SqMD = 21.99) are slightly larger than in females (SqMD = 16.48).

In large males, the relative values of 10 characters are on average significantly greater than those of small males, while the relative value of the anteventral length (aV), the height of the 3rd spiny ray of the anal fin (hA), the length of the snout (r) and the horizontal diameter of the eye (o), on the contrary, are significantly bigger in small males (Table 4).

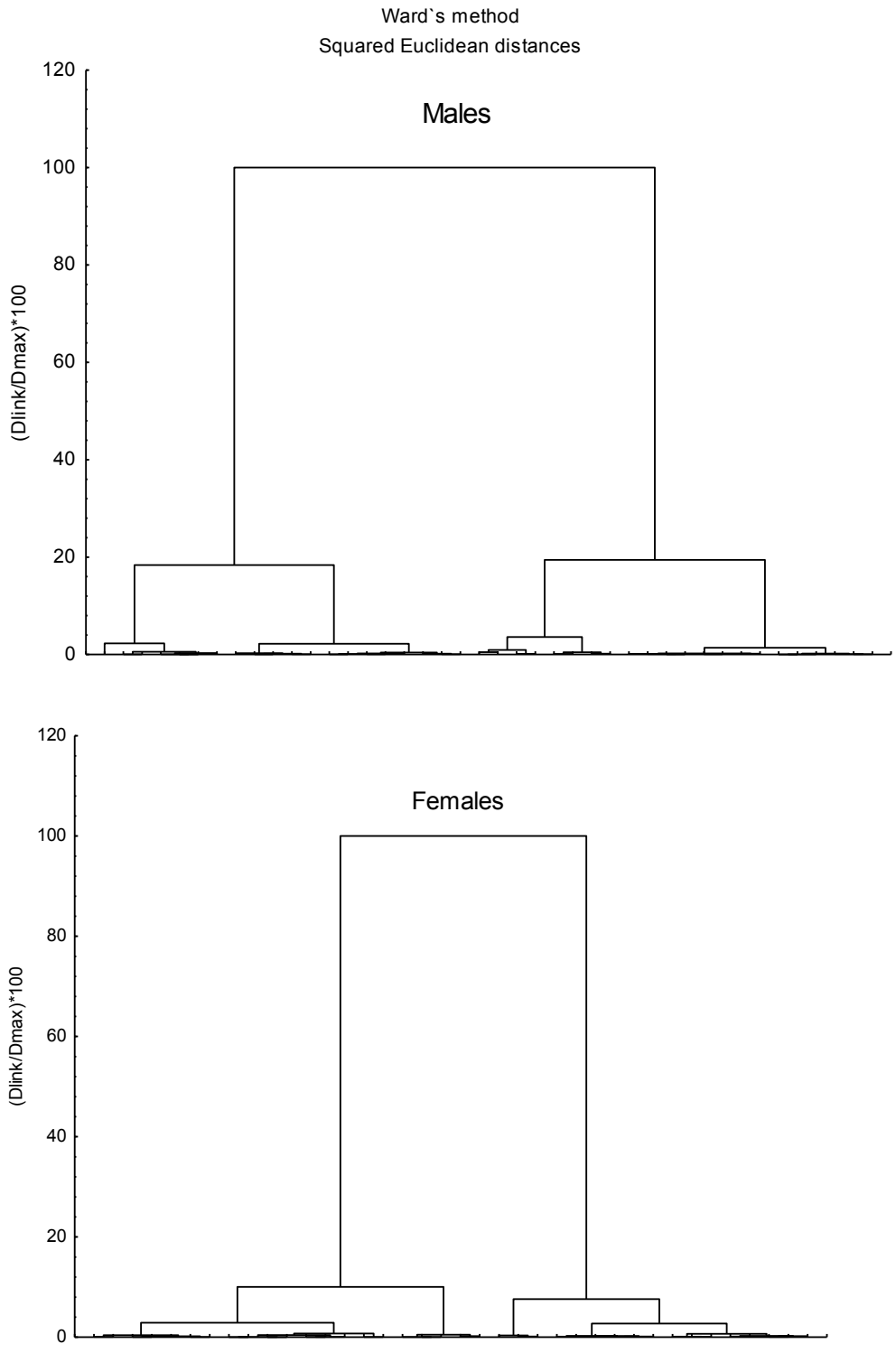

Fig. 1. Differentiation of males and females of *Symphodus ocellatus* in absolute values of 26 plastic characters.

Table 2. The results of the comparison of absolute values (mm) of plastic characters in two size-age groups of *Symphodus ocellatus* (males)

Character	Small individuals (n = 20)				Large individuals (n = 22)				t_{st}
	min	max	M	SD	min	max	M	SD	
SL	43.0	70.0	59.65	7.11	71.0	93.0	78.68	6.61	8.96***
H	13.1	25.9	20.81	3.59	22.9	35.1	28.94	2.76	8.16***
h	5.7	10.3	8.40	1.39	10.2	13.3	11.54	0.93	8.54***
aD_1	14.4	23.5	20.29	2.40	23.6	32.8	26.74	2.49	8.55***
aD_2	28.9	47.3	41.09	4.70	47.5	66.2	54.46	4.83	9.09***
aP	16.3	24.2	20.53	1.92	22.7	33.5	26.50	2.88	7.97***
aV	18.7	31.3	25.53	2.82	28.6	41.8	32.54	3.73	6.91***
aA	26.5	43.2	37.14	4.22	43.3	60.4	48.46	4.95	8.00***
pD	6.6	11.5	8.88	1.33	9.2	13.7	11.25	1.11	6.24***
l_{caud}	7.1	10.9	8.83	1.16	10.0	12.7	11.33	0.86	7.86***
lD	21.4	36.8	31.35	4.49	38.0	54.6	43.21	4.06	8.95***
lD_1	15.4	26.8	21.27	2.95	24.5	36.3	29.14	2.57	9.17***
lD_2	6.0	13.1	10.08	1.85	11.2	18.3	14.08	1.81	7.08***
hD_1	6.6	9.7	7.88	0.87	8.2	12.4	9.85	1.09	6.54***
hD_2	6.0	11.7	9.05	1.50	9.3	16.7	13.46	1.99	8.16***
lA	10.6	17.7	14.75	2.18	17.8	26.1	20.54	2.20	8.56***
hA	5.4	8.0	6.73	0.81	6.3	9.5	8.13	0.89	5.36***
lP	9.1	14.9	12.75	1.58	13.7	21.6	17.21	1.73	8.72***
lV	7.3	12.6	10.36	1.50	11.3	19.8	14.29	1.96	7.32***
h_{ll}	2.8	6.1	4.72	0.85	5.5	8.9	6.65	0.87	7.28***
C	15.6	23.8	20.85	2.35	24.6	33.7	27.66	2.70	8.75***
hC	8.0	14.1	11.43	1.73	12.7	19.4	15.73	1.74	8.03***
r	5.2	8.1	6.76	0.72	7.3	11.8	8.60	1.20	6.08***
o	3.2	4.9	4.23	0.39	4.5	5.8	5.20	0.30	9.11***
po	6.9	11.7	9.61	1.54	11.2	16.2	13.36	1.28	8.53***
io	2.9	5.5	4.33	0.87	4.7	7.2	5.94	0.63	6.84***

Note. min-max — minimum and maximum values of the character; M — mean value of the character; SD — standard deviation; t_{st} — Student's criterion, *** $P < 0.001$.

Table 3. The results of the comparison of absolute values (mm) of plastic characters in two size-age groups of *Symphodus ocellatus* (females)

Char-acter	Small individuals (n = 21)				Large individuals (n = 17)				t_{st}
	min	max	M	SD	min	max	M	SD	
SL	42.0	56.0	48.00	3.94	59.0	72.0	64.24	3.65	13.16***
H	14.0	20.5	16.73	1.82	19.9	26.1	22.84	1.89	10.07***
h	4.9	7.3	6.18	0.65	7.7	9.5	8.46	0.61	11.16***
aD_1	13.3	20.2	16.45	1.74	19.0	25.5	22.16	1.87	9.65***
aD_2	28.6	39.2	33.33	2.79	39.8	50.7	44.00	3.27	10.68***
aP	13.8	20.6	16.44	1.87	18.1	25.9	21.55	2.11	7.81***
aV	16.6	26.4	19.99	2.47	24.0	33.7	27.34	2.53	8.99***
aA	26.3	38.4	30.86	3.28	37.2	50.8	42.78	3.65	10.47***
pD	5.7	8.4	6.79	0.69	8.2	10.2	9.32	0.70	11.16***
l_{caud}	5.8	7.7	6.58	0.58	7.9	10.5	8.75	0.65	10.79***
lD	21.5	29.6	25.44	2.08	30.8	38.1	33.78	2.35	11.44***
lD_1	15.4	20.2	17.46	1.28	20.1	26.3	22.84	1.67	10.92***
lD_2	6.1	10.8	7.98	1.09	9.1	13.7	10.94	1.33	7.38***
hD_1	4.5	7.0	6.29	0.61	6.8	9.0	7.72	0.64	6.98***
hD_2	5.2	8.2	6.77	0.89	7.9	10.5	8.96	0.86	7.72***
lA	9.0	11.8	10.59	0.80	12.6	16.4	14.66	1.21	11.97***
hA	4.2	6.6	5.54	0.60	5.6	7.4	6.49	0.56	5.06***
lP	8.1	11.7	9.80	1.10	12.0	15.1	13.28	0.85	10.97***
lV	6.5	9.8	8.17	0.93	9.2	12.2	10.68	0.79	8.97***
h_{ll}	2.8	4.6	3.51	0.46	4.1	6.0	4.82	0.50	8.38***
C	14.3	20.7	16.82	1.90	19.8	26.0	22.29	1.90	8.83***
hC	6.0	10.6	8.62	1.10	10.7	14.2	12.05	1.13	9.42***
r	3.8	6.9	4.92	0.79	5.4	8.1	6.72	0.82	6.84***
o	3.4	4.3	3.84	0.24	4.1	5.0	4.68	0.25	10.45***
po	6.4	9.3	7.54	0.98	8.9	12.3	10.46	1.09	8.60***
io	2.7	3.8	3.33	0.29	3.9	5.1	4.57	0.35	11.68***

Note. min-max — minimum and maximum values of the character; M — mean value of the character; SD — standard deviation; t_{st} — Student's criterion, *** $P < 0.001$.

Table 4. Comparison results of relative values (%) of plastic characters in two size-age groups of *Symphodus ocellatus* (males)

Charac-ter	Small individuals (n = 20)				Large individuals (n = 22)				t_{st}
	min	max	M	SD	min	max	M	SD	
SL	53.0	85.0	74.40	8.93	89.0	120.0	87.10	14.99	8.96***
H	43.0	70.0	59.65	7.11	71.0	93.0	69.62	11.76	2.89***
h	30.5	39.2	34.69	2.59	30.1	40.8	35.80	2.54	2.64**
aD_1	12.6	16.1	14.01	0.93	13.6	16.2	14.36	0.88	0.17
aD_2	32.4	36.0	34.02	1.05	32.6	35.8	33.99	1.00	0.42
aP	65.1	74.5	68.95	2.25	64.2	72.5	69.09	2.00	1.72
aV	32.0	37.9	34.55	1.50	29.7	38.1	34.08	1.73	2.50**
aA	39.8	47.0	42.90	2.01	38.7	46.3	42.06	2.20	1.50
pD	59.2	67.2	62.33	1.88	59.3	65.7	61.91	1.77	1.76
l_{caud}	13.2	16.9	14.87	1.15	11.7	15.5	14.58	1.04	1.49
lD	13.4	17.0	14.82	0.95	12.8	15.8	14.61	0.87	3.82***
lD_1	48.9	55.8	52.42	2.28	50.3	58.7	53.73	2.42	2.39**
lD_2	32.0	40.6	35.63	2.01	32.8	39.9	36.38	2.05	2.39**
hD_1	14.0	19.8	16.80	1.65	15.6	20.5	17.35	1.48	1.88
hD_2	10.6	15.5	13.32	1.68	11.1	14.2	12.91	1.38	3.96***
lA	11.7	17.7	15.14	1.41	12.7	19.6	16.15	1.86	3.56***
hA	21.6	27.3	24.67	1.36	23.6	28.3	25.40	1.44	2.45**
lP	8.8	14.0	11.39	1.63	8.5	12.5	10.85	1.43	1.67
lV	20.2	22.7	21.36	0.68	18.8	23.4	21.63	1.03	2.01
h_{ll}	15.7	19.8	17.33	1.07	15.5	21.3	17.74	1.33	0.48
C	38.4	50.0	46.90	3.09	40.7	50.0	47.13	2.87	0.43
hC	33.5	36.3	34.98	0.84	32.2	37.5	35.07	1.22	2.09*
r	49.5	60.3	54.65	3.22	49.9	66.9	55.84	3.68	2.49**
o	28.8	34.9	32.49	1.89	27.5	35.0	31.71	2.06	3.87***
po	18.5	22.9	20.35	1.23	16.5	21.4	19.59	1.40	2.73***
io	40.7	51.6	45.89	3.33	43.5	51.5	47.18	3.10	1.65

Note. min-max — minimum and maximum values of the character; M — mean value of the character; SD — standard deviation; t_{st} — Student's criterion, * — at $P < 0/05$; ** — at $P < 0/01$; *** — $P < 0/001$.

Large females have significantly higher relative values of aA, hC and po than small females. The relative values of hD_1, hA, and o are significantly higher in small females (Table 5). The generalized differences in the relative values of plastic characters are much bigger in females (SqMD = 8.03) in contrast to males (SqMD = 5.44).

Table 5. Comparison results of relative values (%) of plastic characters in two size-age groups of *Symphodus ocellatus* (females)

Character	Small individuals (n = 21)				Large individuals (n = 17)				t_{st}
	min	max	M	Sx	min	max	M	SD	
SL	53.0	70.0	60.67	5.10	73.0	89.0	80.06	4.64	13.16***
H	42.0	56.0	48.00	3.94	59.0	72.0	64.24	3.65	1.22
h	31.4	37.9	34.82	1.90	32.1	38.4	35.54	1.70	1.87
aD_1	11.7	13.6	12.85	0.52	12.2	14.2	13.17	0.51	0.42
aD_2	30.0	36.7	34.24	1.66	31.7	37.7	34.47	1.68	1.61
aP	66.9	71.6	69.45	1.20	65.6	72.8	68.46	2.27	1.07
aV	31.1	38.0	34.19	1.76	30.2	36.8	33.52	2.07	1.29
aA	38.3	48.0	41.54	2.33	39.7	47.3	42.51	2.31	2.77***
pD	60.2	69.8	64.21	2.52	62.0	71.1	66.52	2.58	1.15
l_{caud}	12.8	15.9	14.14	0.98	12.1	16.3	14.53	1.04	0.28
lD	12.2	15.7	13.73	0.81	12.4	15.7	13.65	0.98	0.83
lD_1	48.5	55.7	53.02	1.81	49.7	55.9	52.57	1.60	1.64
lD_2	33.6	38.9	36.43	1.69	32.4	38.7	35.55	1.62	0.82
hD_1	13.8	19.3	16.60	1.40	14.0	20.5	17.01	1.65	2.87***
hD_2	9.0	15.2	13.15	1.44	10.4	14.4	12.03	0.96	0.37
lA	11.3	16.0	14.09	1.35	12.7	15.6	13.95	0.95	1.73
hA	20.0	24.9	22.10	1.22	21.2	25.5	22.83	1.32	3.97***
lP	8.4	13.6	11.58	1.31	8.6	11.8	10.12	0.96	0.88
lV	18.5	22.3	20.39	1.14	19.4	22.3	20.68	0.87	1.18
h_{ll}	14.1	18.8	17.01	1.13	14.8	17.5	16.63	0.82	0.19
C	37.8	49.2	44.11	3.13	37.3	49.5	44.29	3.01	0.59
hC	31.1	37.6	34.99	1.75	32.4	37.7	34.67	1.63	3.81***
r	41.1	55.1	51.20	2.78	51.0	58.3	54.07	1.85	1.18
o	26.1	34.2	29.17	2.49	25.9	34.0	30.12	2.45	3.81***
po	20.3	27.2	23.00	1.86	18.8	22.7	21.08	1.24	3.47***
io	42.4	47.7	44.74	1.37	43.5	50.5	46.92	2.28	1.57

Note. min-max — minimum and maximum values of the character; M — mean value of the character; SD — standard deviation; t_{st} — Student's criterion, *** $P < 0.001$.

Sex differences. In both size-age groups, males are significantly larger than females (Tables 3, 4, 6). At the same time, the differences between large males and females on most characters are significantly bigger than those between small ones. Sex differences only on 4 characters (aP, aV, aA and r) are bigger in group of small Ocellated wrasse.

Sex differences by the relative size of plastic characters are expressed in both size-age groups of males and females of Ocellated wrasse. The mean values of 7 relative characters (h, l_{caud}, hD_2, lA, lP, h_{ll} and hC) are significantly higher in males of both size-age groups and only 2 characters (aA and o) are greater in females in contrast to males. In addition, sex differences are significant in two characters (pD and r) in the group of small individuals only and in four characters (lD, lD_1, lV and io) in the group of large individuals (in both cases, males have average values of relative characters). The generalized differences between males and females in the group of small individuals are somewhat larger in the body proportions (SqMD = 23.21) than in its linear dimensions (SqMD = 19.53). On the contrary, the generalized sex differences in the body linear dimensions (SqMD = 45.50) are noticeably bigger than those in its proportions (SqMD = 32.60) in group of large individuals.

Data given above showed that sex differences in Ocellated wrasse increase with age both in absolute and relative values of plastic characters; it is accompanied by increased morphological differentiation between males and females in overall size and body proportions.

The expression and directionality of sex differences in Ocellated wrasse are manifested in the fact that the mean values of all 26 plastic characters in males are significantly higher compared with females (Tables 3, 4). At the same time, in group of large mature fishes, the expression of sex differences on 22 characters is greater than in small ones, and only in 4 is the opposite (Table 6).

Table 6. The magnitude of sex differences (t_{st}) in absolute and relative values of plastic characters in two size-age groups of *Symphodus ocellatus*

Character	Absolute values		Relative values	
	Large	Small	Large	Small
SL	8.68***	6.45***	8.68***	6.45***
H	8.17***	4.55***	2.09*	0.18
H	12.47***	6.50***	7.76***	4.90***
aD_1	6.56***	5.83***	1.10	0.51
aD_2	8.06***	6.39***	1.13	0.88
aP	6.19***	6.92***	0.23	0.70
aV	5.18***	6.68***	1.68	2.00
aA	4.13***	5.30***	7.01***	2.71*
pD	6.65***	6.24***	0.68	2.17*
l_{caud}	10.65***	7.80***	2.71*	3.96***
lD	9.10***	5.37***	4.19***	0.93
lD_1	9.24***	5.32***	2.71*	1.38
lD_2	6.26***	4.41***	1.80	0.42
HD_1	7.66***	6.71***	1.62	0.35
hD_2	9.52***	5.89***	7.09***	2.44*
lA	10.63***	8.03***	7.96***	6.34***
hA	7.05***	5.33***	0.71	0.42
lP	9.30***	6.88***	3.54**	3.34**
lV	7.83***	5.55***	4.03***	0.94
h_{ll}	8.24***	5.61***	3.27**	2.88**

Character	Absolute values		Relative values	
	Large	Small	Large	Small
C	7.29***	6.02***	0.93	0.02
hC	7.97***	6.19***	3.07**	3.67***
R	5.80***	7.77***	1.21	4.82***
o	5.95***	3.76***	5.56***	5.42***
po	7.62***	5.09***	1.91	1.44
io	8.62***	4.87***	2.29*	1.20

Note. * — at P < 0/05; ** — at P < 0/01; *** — P < 0/001.

An increase of the body length in large individuals in contrast to small ones, as well as in males in contrast to females, are accompanied by an increase in the size of all other 25 characters. It is important to find out if the structure of the variability of all 26 plastic characters is the same in all four cases. By comparing the difference vectors (Student's t -values) using the Spearman rank correlation coefficient (Rs), an average level of similarity was established (Rs = 0.54; p < 0.01) in the structure of differences between small and large individuals in males and females. The average level of similarity (Rs = 0.52; p < 0.01) was also noted between the structure of sex differences in group of large individuals and size-age differences in females. In all other cases, the level of similarity of the vectors of differences was below the average level (0.09–0.39).

The results of the study confirm the data of Shevchenko (1971) that males have larger relative sizes of the anal fin base, while females have larger eye diameter than males. At the same time, our data contradict the conclusion of Shevchenko (1971) that males are more tall and have larger relative sizes of the head and dorsal fin. According to our data, the males are characterized by significantly higher relative values of the height and length of the caudal peduncle, the height of the soft part of the dorsal fin, pectoral fin length, head height and the snout length, as well as the females have larger anteanal distance (Tables 4, 5). In all cases, the value of the Student's t-test for the aforementioned features significantly exceeds the critical table values.

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РОЗМІРНО-ВІКОВА І СТАТЕВА МІНЛИВІСТЬ ПЛАСТИЧНИХ ОЗНАК ЗЕЛЕНУШКИ ПЛЯМИСТОЇ, *SYMPHODUS OCELLATUS* (LINNAEUS, 1758) (LABRIDAE, PERCIFORMES), У ПІВНІЧНІЙ ЧАСТИНІ ЧОРНОГО МОРЯ

Наведено результати вивчення розмірно-вікової і статевої мінливості пластичних ознак у пізньому онтогенезі зеленушки плямистої, *Symphodus ocellatus* (Linnaeus, 1758) в північній частині Чорного моря. Встановлено, що самці і самки за абсолютними значеннями 26 пластичних ознак диференціюються на дрібних і великих особин, відмінності між якими високо достовірні за всіма ознаками. За відносними значеннями ознак відмінності достовірні у самців за 14 ознаками, у самок — за 6. Показано, що з віком у *S. ocellatus* збільшується вираженість статевих відмінностей як за абсолютними, так і за відносними значеннями пластичних ознак. Серед великих і дрібних особин зеленушки самці достовірно більші за самок. З віком у зеленушки плямистої змінюються структура вираженості і спрямованості статевих відмінностей.

К л ю ч о в і с л о в а: пластичні ознаки, розмірно-вікова і статева мінливість, *Symphodus ocellatus*, Чорне море.

В. Н. Песков, Л. Г. Манило

РАЗМЕРНО-ВОЗРАСТНАЯ И ПОЛОВАЯ ИЗМЕНЧИВОСТЬ ПЛАСТИЧЕСКИХ ПРИЗНАКОВ ЗЕЛЕНУШКИ ГЛАЗЧАТОЙ, *SYMPHODUS OCELLATUS* (LINNAEUS, 1758) (LABRIDAE, PERCIFORMES) В СЕВЕРНОЙ ЧАСТИ ЧЕРНОГО МОРЯ

Приведены результаты изучения размерно-возрастной и половой изменчивости пластических признаков в позднем онтогенезе зеленушки глазчатой, *Symphodus ocellatus* (Linnaeus 1758) в северной части Черного моря. Установлено, что самцы и самки по абсолютным значениям 26 пластических признаков дифференцируются на мелких и крупных особей, различия между которыми высоко достоверны по всем признакам. По относительным значениям признаков различия достоверны у самцов по 14 признакам, у самок — по 6. Показано, что с возрастом у *S. ocellatus* увеличивается выраженность половых различий как по абсолютным, так и по относительным значениям пластических признаков. Среди крупных и мелких особей зеленушки самцы достоверно крупнее самок. С возрастом у зеленушки глазчатой изменяются структура выраженности и направленности половых различий.

К л ю ч е в ы е с л о в а: пластические признаки, размерно-возрастная и половая изменчивость, *Symphodus ocellatus,* Черное море.