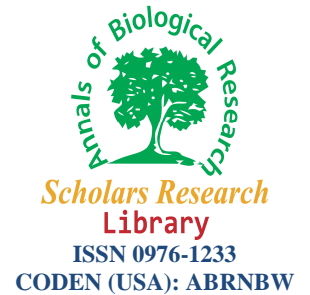




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## Morpho-biological features of Shirvan roach (*Rutilus Atropatenus* Derjavin, 1937) from the Azerbaijan waters

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### ABSTRACT

The article concerns morphometric and biological characteristics of endemic fish Shirvan roach (*Rutilus atropatenus*) in Azerbaijan. Materials for studies were collected in 2008-2013 yy. in swampy reservoirs located in Gabala region (Nic and Chuxur Qabala villages). The results of the study were compared with the results of the studies conducted by A.N.Derjavin and Yu.A.Abdurrəhmanov.

**Key words:** Shirvan roach, morphometric, endemic, Chuxur Qabala, Nic, Gabala, Azerbaijan.

### INTRODUCTION

Shirvan roach (*Rutilus atropatenus*) is one of the endemic fishes in Azerbaijan, dwells in on the territory of Nic and Chuxur Qabala villages of Qabala region in the swamp areas of water basins.

For the first time A.N.Derdzavin indentified this fish species in 1934 y. in the villages Nic (in the spring Dasbatan and in the river Zeyindara) and Chuxur Qabala (in the spring Haji Mammad and Qazbulag).

For the first time Derjavin gave description of plastic signs of 30 specimens of fish [4]. Yu.A.Abdorrahmanov investigated 50 specimens of this fish of Nic village in the Qarasu river in the September 1935 [2]. Owing to lack of studies of Shirvan roach, we consider realization of the studies of Shirvan roach in the Azerbaijan ponds to be reasonable.

### MATERIALS AND METHODS

In the 2008-2013 yy., 4 specimens of fish of Shirvan roach from the spring in the territory of Nic village at the Gabala district (N 40°55'51``; E 47°39'30``) and 79 specimens of fish from the water basin of Chuxur Qabala village (N 40°53'34``; E 47°41'07``) were caught and examined with application of general ichthyological methods [3, 5, 7, 8, 9] (Fig.).



Figure. Shirvan roach - *Rutilus atropatenus* Derjavin, 1937

In analysis the following signs have been used: *TL* – total length; *SL*- standard length; *W*- total weight; *W<sub>1</sub>*- useful weight; *F*- Fulton index; *K*- Klark index; *Squ.*- scales number of the length fish; *l.l.*- number of lateral line scales; *nss*- scales number of the above side lateral line; *nsi*- scalls number of the under side lateral line; *D, A* - number of branched rays in dorsal and anal fins; *c* - head length; *H, h* – maximum and minimum body depths; *AD, aV, aA* and *PD* – antedorsal, anteventral, anteanal and postdorsal distances; *l<sub>caud</sub>* - length of the tail body; *ID* and *IA* – length base of dorsal and anal fins; *hD* and *hA* – height of dorsal and anal fins; *IP* and *IV* – length of pectoral and ventral fins; *P-V* and *V-A* - pectroventral and ventroanal distances; *IC<sub>1</sub>* and *IC<sub>2</sub>* – length of the top and lower parts of the caudal fin; *ao* – lengts of rostrum; *po* – postorbital distance; *o* –diameter of eye; *hc* – height of head; *io* –width buy. Total measurments were analysed in statistical normatives among males and females separately [6]; Averages (M), Standardize (S) and Error of means (m). This analysis showed significant differences between male and female, and these results are compared with results of A.N.Derjavin and Yu.A.Abdorrahmanov.

**RESULTS AND DISCUSSION**

While analysing morphometric peculiarities of Shirvan roach, it was found that its body standard length (*SL*) varying within the range of 42.5-75.8 mm is equal to 57.9±1.17 mm. Particularly, length of male fish varies within the range of 42.5-70.0 mm and is equal to 55.5±1.50 mm, while length of female fish varies within the range of 45.8-75.8 mm and is equal to 60.3±1.69 mm. The difference between length of male and female fish in average constituted 4.8 mm. Table 1 presents detailed information concerning morphometric peculiarities of the studied fish.

**Table 1.Morphometric indexes of Shirvan roach**

Indexes	Males (n=25)	Females (n=25)	Both sexes (n=50)	P (♂-♀)
	lim M±m	lim M±m	lim M±m	
<i>SL, mm</i>	42.5-70.0 55.5±1.50	45.8-75.8 60.3±1.69	42.5-75.8 57.9±1.17	<0.05
<i>Squ.</i>	36-40 38.2±0.26	37-40 37.9±0.16	36-40 38.1±0.15	>0.05
<i>l.l.</i>	18-36 25.5±1.07	17-37 25.2±1.11	17-37 25.3±0.76	>0.05
<i>nss</i>	6-7 6.1±0.07	6-7 6.1±0.06	6-7 6.1±0.04	>0.05
<i>nsi</i>	3-4 3.2±0.07	3-4 3.2±0.09	3-4 3.2±0.06	>0.05
<i>D</i>	7-8 7.5±0.10	7-8 7.56±0.10	7-8 7.52±0.07	>0.05
<i>A</i>	6-7 6.9±0.07	6-7 6.8±0.09	6-7 6.8±0.06	>0.05
Relation to standard length of body ( <i>SL</i> ) in percent				
<i>c</i>	26.9-30.6 28.6±0.19	26.0-29.9 27.9±0.23	26.0-30.6 28.2±0.15	<0.05
<i>H</i>	26.9-33.3 29.2±0.25	27.4-30.8 29.0±0.19	26.9-33.3 29.1±0.16	>0.05
<i>h</i>	11.3-13.3 12.5±0.10	11.2-13.5 11.9±0.12	11.2-13.5 12.2±0.09	<0.001
<i>AD</i>	51.0-56.2 53.7±0.25	50.6-55.9 53.8±0.24	50.6-56.2 53.7±0.17	>0.05
<i>aV</i>	48.6-53.5 51.9±0.22	50.7-55.7 52.6±0.26	48.6-55.7 52.2±0.17	<0.05
<i>aA</i>	66.3-72.5 70.0±0.29	69.2-74.3 71.8±0.26	66.3-74.3 70.9±0.23	<0.001
<i>PD</i>	32.7-38.5 36.4±0.26	34.5-38.7 36.7±0.22	32.7-38.7 36.6±0.17	>0.05
<i>l<sub>caud</sub></i>	19.3-24.1 21.9±0.24	19.2-23.0 21.6±0.17	19.2-24.1 21.8±0.15	>0.05
<i>ID</i>	11.6-14.2 12.8±0.12	10.7-14.0 12.3±0.15	10.7-14.2 12.5±0.10	<0.05
<i>hD</i>	15.7-21.4 19.0±0.37	13.8-21.0 17.5±0.37	13.8-21.4 18.3±0.28	<0.001
<i>IA</i>	9.2-12.3 10.6±0.15	8.3-10.8 9.6±0.12	8.3-12.3 10.1±0.12	<0.001
<i>hA</i>	12.2-17.2 14.9±0.29	10.4-16.7 13.4±0.30	10.4-17.2 14.2±0.23	<0.001
<i>IP</i>	17.7-27.5 22.1±0.41	17.3-20.8 18.81±0.23	17.3-27.5 20.4±0.33	<0.001
<i>IV</i>	14.6-19.3 16.4±0.22	13.4-16.3 14.7±0.16	13.4-19.3 15.6±0.18	<0.001
<i>P-V</i>	24.6-28.9 26.9±0.23	25.0-28.8 27.3±0.21	24.6-28.9 27.1±0.16	>0.05
<i>V-A</i>	16.8-20.7 18.9±0.20	17.1-23.1 20.4±0.25	16.8-23.1 19.6±0.19	<0.001
<i>IC<sub>1</sub></i>	17.6-21.6 19.4±0.24	16.8-21.8 18.8±0.29	16.8-21.8 19.1±0.19	>0.05
<i>IC<sub>2</sub></i>	17.3-22.2	16.0-21.5	16.0-22.2	>0.05

	19.5±0.28	18.8±0.29	19.1±0.21	
Relation to the head length in percent				
<i>ao</i>	25.5-31.5 29.0±0.40	25.7-32.3 29.5±0.37	25.5-32.3 29.2±0.27	>0.05
<i>o</i>	22.8-28.8 25.3±0.27	22.2-28.7 25.8±0.30	22.2-28.8 25.5±0.20	>0.05
<i>po</i>	44.2-53.2 50.0±0.50	44.3-52.1 49.4±0.40	44.2-53.2 49.7±0.32	>0.05
<i>hc</i>	55.6-83.8 75.6±1.03	68.0-83.4 77.3±0.72	55.6-83.8 76.4±0.63	>0.05
<i>io</i>	37.3-44.4 40.7±0.38	37.1-46.1 40.9±0.53	37.1-46.1 40.8±0.32	>0.05

Table 2. Comparison of morphometric signs of Shirvan roach studied in different times

Indexes	07. 1934, [4], (n=10)	09. 1935, [2], (n=50)	05. 2008 (n=50)	P		
	<u>lim</u> M±m	<u>lim</u> M±m	<u>lim</u> M±m	1-2	1-3	2-3
	1	2	3			
<i>SL, mm</i>	45.0-81.0 63.9±4.22	52.7-87.9 67.8±0.23	42.5-75.8 57.9±1.17	>0.05	>0.05	<0.001
<i>Squ.</i>	37-39 37.9±0.14	37-39 37.8±0.11	36-40 38.1±0.15	>0.05	>0.05	>0.05
<i>l.l.</i>	17-38 27.1±2.22	17-38	17-37 25.3±0.76	-	>0.05	-
<i>nss</i>	7	6-7	6-7 6.1±0.04	-	-	-
<i>nsi</i>	4	3-4	3-4 3.2±0.06	-	-	-
<i>D</i>	7-8 7.5±0.17	7-8	7-8 7.52±0.07	-	>0.05	-
<i>A</i>	7-8 7.1±0.10	-	6-7 6.8±0.06	-	>0.05	-
Relation to standard length of body (SL) in percent						
<i>c</i>	26.2-28.8 27.3±0.22	24.5-29.1 26.5±0.17	26.0-30.6 28.2±0.15	<0.01	<0.01	<0.001
<i>H</i>	27.8-31.0 29.3±0.39	24.4-32.5 28.6±0.21	26.9-33.3 29.1±0.16	>0.05	>0.05	>0.05
<i>h</i>	12-13.1 12.5±0.11	9.1-14.1 11.5±0.13	11.2-13.5 12.2±0.09	<0.001	<0.05	<0.001
<i>AD</i>	53.1-56.1 54.6±0.25	48.5-57.0 53.6±0.28	50.6-56.2 53.7±0.17	<0.01	<0.001	>0.05
<i>PD</i>	34.9-37.8 36.4±0.32	33.3-41.0 36.5±0.25	32.7-38.7 36.6±0.17	>0.05	>0.05	>0.05
<i>l<sub>caud</sub></i>	20.8-23.5 22.4±0.27	19.2-23.0 21.7±0.28	19.2-24.1 21.8±0.15	>0.05	>0.05	>0.05
<i>ID</i>	12.1-13.5 12.7±0.16	10.0-14.5 11.7±0.16	10.7-14.2 12.5±0.10	<0.001	>0.05	<0.001
<i>hD</i>	14.7-17.5 15.8±0.28	15.0-21.8 17.8±0.22	13.8-21.4 18.3±0.28	<0.001	<0.001	>0.05
<i>lA</i>	9.3-11.0 10.2±0.17	7.5-10.8 9.2±0.21	8.3-12.3 10.1±0.12	<0.001	>0.05	<0.001
<i>hA</i>	11.7-14.4 12.9±0.29	10.1-18.8 13.6±0.17	10.4-17.2 14.2±0.23	<0.05	<0.001	<0.001
<i>lP</i>	19.1-22.6 20.3±0.33	17.9-23.3 20.1±0.23	17.3-27.5 20.4±0.33	>0.05	>0.05	>0.05
<i>lV</i>	14.8-17.2 16.3±0.23	14.2-18.5 16.1±0.18	13.4-19.3 15.6±0.18	>0.05	<0.05	<0.05
<i>P-V</i>	26.4-29.0 27.6±0.26	20.3-28.0 23.5±0.27	24.6-28.9 27.1±0.16	<0.001	>0.05	<0.001
<i>V-A</i>	-	17.3-23.5 20.2±0.24	16.8-23.1 19.6±0.19	-	-	>0.05
<i>lC<sub>2</sub></i>	17.8-21.3 19.0±0.33	16.7-21.6 19.0±0.19	16.0-22.2 19.1±0.21	>0.05	>0.05	>0.05
Relation to the head length in percent						
<i>ao</i>	26.6-29.0 28.3±0.24	24.3-29.6 26.4±0.27	25.5-32.3 29.2±0.27	<0.001	<0.01	<0.001
<i>o</i>	23.9-27.7 25.6±0.43	18.6-28.5 24.6±0.20	22.2-28.8 25.5±0.20	<0.05	>0.05	<0.001
<i>po</i>	45.7-55.3 52.8±0.97	42.8-54.3 48.5±0.21	44.2-53.2 49.7±0.32	<0.001	<0.001	<0.001
<i>hc</i>	-	72.0-88.0 82.4±0.12	55.6-83.8 76.4±0.63	-	-	<0.001
<i>io</i>	41.1-46.3 44.1±0.49	34.3-43.0 38.8±0.34	37.1-46.1 40.8±0.32	<0.001	<0.001	<0.001

As it is seen from Table 1, while comparing male and female specimens of Shirvan roach no one of 6 meristic signs showed actual differences ( $p>0.05$ ). While comparing 18 plastic signs in relation to body standard length, in 8 signs (*h*, *aA*, *hD*, *lA*, *hA*, *lP*, *lV*, *V-A*) differences were significant ( $p<0.001$ ), in 3 ones (*c*, *aV*, *ID*) – slightly significant ( $p<0.05$ ), whereas in 7 ones (*H*, *AD*, *PD*, *l<sub>caud</sub>*, *P-V*, *lC<sub>1</sub>*, *lC<sub>2</sub>*) they were non-significant ( $p>0.05$ ). Comparison of 5

plastic signs (*ao*, *o*, *po*, *hc*, *io*) in relation to length of head did not reveal any significant changes ( $p>0.05$ ). Although, while comparing morphometric signs of male and female specimens of Shirvan roach, a number of signs revealed significant differences, sexual dimorphism developed slightly in this fish.

Table 2 presents comparison of morphometric signs of Shirvan roach studied in different times. As it is seen from the table, no one of compared meristic signs showed significant changes.

A.I.Derzhavin's and Yu.A.Abdurrahmanov's comparative analysis of the results of the studies was as follows: among 14 plastic signs relatively to standard length of the body, 7 signs (*c*, *h*, *AD*, *ID*, *hD*, *IA*, *P-V*) showed significant differences ( $p<0.001$ ;  $p<0.01$ ), one sign (*hA*) had slight difference ( $p<0.05$ ), while 6 signs did not have significant differences ( $p>0.05$ ). While comparing 4 signs (*ao*, *o*, *po*, *io*) relatively to head length, 3 signs had significant differences, but one had just slight difference ( $p<0.05$ ).

While comparing A.I.Derzhavin's results of the studies with ours among 14 plastic signs 4 ones (*c*, *AD*, *hD*, *hA*) demonstrated significant differences ( $p<0.001$ ;  $p<0.01$ ), 2 signs (*h*, *IV*) had slight differences ( $p<0.05$ ), and 8 ones were non-significant ( $p>0.05$ ). While comparing 4 signs relatively to head length, 3 signs (*ao*, *po*, *io*) had significant differences ( $p<0.001$ ;  $p<0.01$ ), whereas one sign was non-significant ( $p>0.5$ ).

While comparing Yu.A.Abdurrahmanov's results of the studies with ours among 15 plastic signs 6 ones (*c*, *h*, *ID*, *IA*, *hA*, *P-V*) showed significant differences ( $p<0.001$ ), one had slight difference ( $p<0.05$ ), but 8 signs (*H*, *AD*, *PD*, *l<sub>caud</sub>*, *hD*, *IP*, *V-A*, *IC<sub>2</sub>*) were non-significant ( $p>0.05$ ). Comparison of all signs relatively to head length revealed significant differences ( $p<0.001$ ).

The revealed differences in morphometric signs of Shirvan roach are probably related to fish catches not in the same season and their measuring by different researchers.

It is fresh water fish. It dwells in the forests, in string waters resembling swamp, in the ponds with silty bottom and mighty development of water plants. Owing to being an endemic species and dwelling in restricted areals, it was included into the second edition of the "Red Book" of Azerbaijan [1].

In 2008-2013 yy. body indexes of Shirvan roach engaged in reproduction process were as follows: total length (*TL*) of the body varying in the range of 50.5-87.2 mm, in average was equal to  $67.6\pm 1.27$  mm; standard length (*SL*) of the body varying in the range of 42.5-75.9 mm, in average was equal to  $57.9\pm 1.17$  mm; total mass of the body (*W*) varying in the range of 2.0-13.1 g, in average was equal to  $5.5\pm 0.34$  g; mass of the body without entrails (*W<sub>i</sub>*) varying in the range of 1.5-10.0 g, in average was equal to  $4.2\pm 0.27$  g; Fulton's coefficient of stoutness (*F*) varying in the range of 2.31-3.59, in average was equal to  $2.67\pm 0.03$ ; Klark's coefficient of stoutness (*K*) varying in the range of 1.68-2.63, in average was equal to  $2.0\pm 0.03$ . Much more detailed information is presented in the Table 3.

**Table 3. Biological indexes of Shirvan roach engaged in reproduction**

Indexes	Males (n=39)	Females (n=34)	Both sexes (n=73)
	<u>lim</u> M±m	<u>lim</u> M±m	<u>lim</u> M±m
<i>TL, mm</i>	50.5-80.8 65.2±1.64	53.5-87.2 70.0±1.83	50.5-87.2 67.6±1.27
<i>SL, mm</i>	42.5-70.0 55.5±1.50	45.8-75.8 60.3±1.69	42.5-75.8 57.9±1.17
<i>W, (g)</i>	2.0-9.0 4.8±0.40	2.7-13.1 6.16±0.53	2.0-13.1 5.5±0.34
<i>W<sub>i</sub>, (g)</i>	1.5-7.1 3.7±0.33	2.2-10.0 4.6±0.41	1.5-10.0 4.2±0.27
<i>F</i>	2.40-3.59 2.67±0.05	2.31-3.0 2.70±0.04	2.31-3.59 2.67±0.03
<i>K</i>	1.74-2.63 2.04±0.04	1.68-2.40 1.97±0.04	1.68-2.63 2.00±0.03

The age of studied fishes was between 0+ - 2+, most of them are two years old. Age-dependent changes of biological indexes of Shirvan roach show in Table 4.

Table 4. Age-dependent changes of biological indexes of Shirvan roach

Indexes	1-year-old (n=25)	2-year-old (n=42)	3-year-old (n=16)
	<u>lim</u> M±m	<u>lim</u> M±m	<u>lim</u> M±m
TL, mm	<u>27.5-61.0</u> 45.0±0.21	<u>60.5-78.1</u> 68.0±0.91	<u>71.5-87.2</u> 78.9±1.66
SL, mm	<u>19.3-52.1</u> 36.4±0.21	<u>51.0-68.5</u> 58.4±0.90	<u>61.0-75.8</u> 68.0±1.57
W, q	<u>0.2-4.2</u> 1.6±0.23	<u>3.3-8.3</u> 5.3±0.24	<u>5.7-13.1</u> 8.8±0.73
W <sub>1</sub> , q	<u>0.2-2.9</u> 1.3±0.17	<u>2.6-6.2</u> 4.0±0.18	<u>4.4-10.0</u> 6.8±0.56
F	<u>2.35-3.15</u> 2.72±0.04	<u>2.31-2.63</u> 1.96±0.04	<u>2.52-3.0</u> 2.74±0.05
K	<u>1.74-2.64</u> 2.21±0.05	<u>1.68-2.63</u> 1.96±0.03	<u>1.9-2.35</u> 2.12±0.05

Shirvan roach reaches sexual maturity after one year. It releases roe partially three times in May and June. The diameters of the fully rippen roe varies within 1.28-1.54 mm. Productivity of the studies fish varying in the range of 1675-5240 roes, in average constituted 3684 roes.

In October, 2012 y. In the ovaries of the studied fish the diameters of big-sized roes varied in the range of 0.69-0.94 mm, the diameters of middle-sized roes varied in the range of 0.47-0.61 mm, while the diameters of middle-sized roes varied in the range of 0.24-0.41 mm.

According to the literature [2], Shirvan roach feeds with larvae of water insects and detritus. In the stomach of our studied fish a lot of thread-like algae, syclops, needle-shaped larvae and other water insects and their larvae were met.

### CONCLUSION

1. Among 23 compared plastic signs of males and females of Shirvan roach 8 signs showed significant ( $p < 0.001$ ), 3 signs showed slight changes ( $p < 0.05$ ), while 12 ones were non-significant ( $p > 0.05$ ).
2. Shirvan roach begins to release its roe in May-June, the time of the most intensive release of the roe happens at the end of May. The diameters of rippen roes vary within 0.69-0.94 mm.
3. Shirvan roach feeds mostly with thread-like algae, syclops, needle-shaped larvae and other water insects and their larvae.

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