

RESEARCH ON THE FLUCTUATING ASYMMETRY OF SOME MORPHOLOGICAL CHARACTERS OF THE FINS OF *PERCA FLUVIATILIS SP.*

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Abstract

On our planet, most of the living organisms are characterized by a bilateral symmetry of their body. Besides the bilateral symmetrical organisms, well manifested, there are many creatures in which the symmetry is disrupted. These asymmetries may occur as some differences between the right and left side of their bodies and have most of the time a negative impact over the individuals. This paper reviews some aspects of the fluctuating asymmetry manifested at the length and width of the pectoral and ventral flippers of perch. This kind of data are almost absent in the speciality literature, therefore this study reviews a part of this problem. Four lots were organized according with the age and the weight of the fish. Their weight has been determined by weighing with a digital balance and the measurements have been making using vernier callipers. The age of the fish has been determined by counting the growth rings on the scales. The mean difference found at the pair flippers had values between 0,75 and 1,88 mm for the length of pectoral flippers; between 0,57 and 1,63 mm for the length of the ventral flippers; between 0,43 and 0,84 mm for the pectoral flippers base width; between 0,38 și 0,69 mm for the ventral flippers base width. The differences that were found between the right and the left side of the studied parameters are no statistically significant, although they show the phenomenon of fluctuating asymmetry.

Key words: fluctuating, asymmetry, *Perca*, age, flippers

INTRODUCTION

Before being a plant and animal grower, man used to be a collector and a hunter, exposing himself to many and great dangers in order to provide daily food. Among the animals that were hunted the fish was counted too, because it offered man a great trophic-biological valued meat, rich in proteins, lipids, calcium and especially phosphorus.

The fish has a dietetic, easily digestible meat which gives the body a energy, mental force and a remarkable longevity. Studies made so far show that one kilogram of fish meat equals with 1,7 kilograms of pork; with 32 hen eggs; with 6 liters of cow milk or with 9,5 kilograms of potatoes. [8]. Reported in the above, we could say that man is obliged to know in detail the biology of all the species of fish that inhabits the water of this planet, no matter how big or insignificant their economic importance is.

MATERIAL AND METHOD

The species of fish taken in our study, the perch, *Perca fluviatilis*, has the following systematic classification: Kingdom Animalia; Subkingdom Gnathostomata; Supraclasa Pisces; Clasa Osteopterygii, Supraorder Teleostei; Order Perciformes; Underorder Percoidei; Family Percidae; Gender *Perca* [2],[8], [9],[10].

The *Perca fluviatilis* species (the perch) is one of the approximately 6000 species of the Perciformes Order. It is a freshwater fish, although it can gradually adapt to the brackish waters. The body of this fish is elongate and laterally compressed, with an oval or suboval shape, with a pronounced spinal camber line. [1],[2],[3]. The relationship between the body length and the height of its maximum line is of 3/1-3,5/1 [3],[4]. The scales from the body's surface are small, with jagged edges and well stuck in the skin. When this fish reaches the age of maturity it can measure 30 centimeters in

length and may weigh 500-700 grams. The perch's head is subconic, with a short and blunt snout, the mouth is terminal and protrusile, with small but strong teeth, seated both on the maxilla and the mandible [1],[5]. The eyes are deprived of the lacrimal glands and eyelids. On their body there are 8 fins of which 4 are odd and 2 are in pairs. The two pairs of fins on which we have been studied the fluctuating asymmetry at these fish species are: the pectoral fins and the ventral fins [8],[9]. The *Perca fluviatilis* fins formula: $D_1/13-16$; $D_2/1/3$; $P/13$; $V/5$; $A8-9$; $C/17$ and the formula of the lateral line of these species is: $L. lat = 57(7-10)/(12-16)77$ [2],[5]. On the lateral side of the body the perch has 5-9 dark olive bands, one of them (the central one) has the appearance of letter "Y". These bands have the role of protection (mimics underwater vegetation) and intended to intimidate prey [8],[9]. From an ecological and ethological point of view, the perch is a cold, slack water species which prefers both clear and high turbidity water. The perch is a well adapted species to water with an oxygen content of 4% to 6%. The perch, especially the females, live in flocks of up to 5-7 individuals approaching the age and the body size, (especially during the winter [8]), and the food of these fish differ with age. So until the age of two this fish is peaceful, feeding himself with plankton, worms, crustaceans, etc., but after this age it becomes a predator and hunts a wide range of aquatic beings (juvenile fish, molluscs, frogs, snails, shells). The duration of the feed digestion may vary between 30 and 48 hours. It reproduces after the age of 3 years, at a water temperature of 7-8°C when females are spawning in the dawn of the day. Juveniles occur after 2 weeks, depending on water temperature and it is active even at hatching [8],[9].

In our research we used 31 copies of perch with different age and size (table 1), which have been harvested from the ponds of S.C. Pescaris S.A. Iași, Țigănași fish farm. The 31 fish were grouped in 4 batches, the number of copies in each batch being different (table 1), depending on age, size and weight. The age of the fish was determined using the method of highlighting, examination and counting of growth rings on scales which are from area placed above and below the lateral line opposite the two dorsal fins.

Other materials that we used in our research were: "Toya-150" type callipers, a "Momet" type digital balance, scissors,

microknives, tweezers, needles for dissection, glass blades, Berzelius glasses, pipettes, graduated cylinder, distilled water, ethyl alcohol, 5% ammonia solution, filter paper, gelatin, binocular microscope Novex type, computer Aurora-TB609A, Karce-K.C.-181, PC-512MB type with Lexmark-X1190 and Digimax-Samsung fotodigital device. The determination of the weight of the fish was done by weighing with an accuracy of ± 1 gram and the size of the pair fins were determined by measuring with callipers. Data obtained from the weighings and measurements were processed statistically, by calculating some usual statistical indices (the average and standard error of the mean; standard deviation, the variation and the coefficient of variability) and for testing the significance of the differences between the left and the right side of the body at the indicators studied the ANOVA monofactorial test was applied.

RESULTS AND DISCUSSIONS

In terms of age, weight and body size, the fish we studied (the perch) were characterized by a pronounced heterogeneity. Therefore, at the first lot of fish, the age of the 7 individuals ranged between 1 and 2,5 years, the average of this lot is $1,64 \pm 0,21$ years ($v=33,92\%$)(table 1).

The body weight of these fish ranged between 45 and 89 grams, the mean of the 7 individuals was $69,71 \pm 5,83$ grams ($v=22,14\%$). The second batch of fish was more homogeneous of age, the 16 individuals had ages between 3 and 4 years with an age mean of $3,44 \pm 0,09$ years ($v=10,45\%$)(table 1). The body weight of the fish from the second batch varied between a lower limit of 102 grams and an upper limit of 176 grams, with a mean of $145,38 \pm 6,18$ grams ($v=17\%$)(table 1). The fish from the third batch had the same age (4,5 years), but their body weight varied between 206 and 268 grams, the 4 individuals had an average body weight of $250,5 \pm 14,91$ grams ($v=11,91\%$)(table 1). The fourth batch of perch has an average age of $5,5 \pm 0,2$ years ($v=7,42\%$) and an average weight of $442,75 \pm 59,1$ grams ($v=26,64\%$)(table 1). The dimensions of length and width of the pair fins and not only have been increasing with age and the body weight. Thus, naturally, there is an increase of the length and width of the pectoral

and ventral fins of the fish, depending on age. grows from 21-22,5 mm, for one year old fish
 For example, the length of the pectoral fin up to 48-50 mm, for the fish of 5,5-6 years old.

Table 1.
 The age and the weight of the biological material used (31 *Perca fluviatilis* individuals)

Specification	n	Statistical indicators used			Variation limits		
		$\bar{X} \pm s$	s	V%	minimum	maximum	
Age of fish (years)	Lot I	7	1,64±0,21	0,556	33,92	1,0	2,5
	Lot II	16	3,44±0,09	0,359	10,45	3,0	4,0
	Lot III	4	4,50±0,0	0	0	4,5	4,5
	Lot IV	4	5,50±0,20	0,408	7,42	5,0	6,0
Weigh of fish (gr.)	Lot I	7	69,71±5,83	15,43	22,14	45,0	89,0
	Lot II	16	145,38±6,18	24,72	17,00	102,0	176,0
	Lot III	4	250,50±14,91	29,82	11,91	206,0	268,0
	Lot IV	4	442,75±59,10	118,20	26,64	347,0	616,0

Table 2.
 The main statistical indicators used regarding the defferences found for pair fins of *Perca fluviatilis*, between the left and the right side

Fish batch	Measured characters	n	Statistical indicators			Variation limits		
			$\bar{X} \pm s$	s	V%	minimum	maximum	
Lot I 1,64 years 69,71 grams	Pectoral fin length(mm)	stg.	7	27,29±1,23	3,26	11,96	25,5	30,5
		dr.	7	27,64±0,75	1,97	7,14	25,0	30,5
	Ventral fin length(mm)	stg.	7	29,36±2,04	2,70	18,42	25,0	33,5
		dr.	7	29,50±0,90	2,38	8,07	25,5	33,0
	Width at base of pectoral fin(mm)	stg.	7	7,36±0,26	0,70	9,51	6,5	9,0
		dr.	7	6,93±0,23	0,61	8,80	6,0	7,5
	Width at base of ventral fin(mm)	stg.	7	7,14±0,28	0,75	10,50	6,0	8,0
		dr.	7	7,00±0,29	0,76	10,86	6,0	8,0
Lot II 3,44 years 145,38 grams	Pectoral fin length(mm)	stg.	16	33,88±0,48	1,92	5,67	31,5	38,0
		dr.	16	33,69±0,47	1,88	5,58	30,5	36,5
	Ventral fin length(mm)	stg.	16	35,25±0,45	1,80	5,33	33,0	39,0
		dr.	16	35,78±0,42	1,68	4,70	33,0	39,5
	Width at base of pectoral fin(mm)	stg.	16	8,84±0,31	1,24	14,03	7,5	13,0
		dr.	16	8,50±0,12	0,48	5,65	8,0	9,5
	Width at base of ventral fin(mm)	stg.	16	8,00±0,20	0,80	10,00	7,0	10,0
		dr.	16	7,94±0,20	0,80	10,08	6,0	10,0
Lot III 4,50 years 250,50 grams	Pectoral fin length(mm)	stg.	4	40,00±1,70	3,40	8,50	35,0	42,5
		dr.	4	40,27±1,30	2,60	6,46	36,0	42,0
	Ventral fin length(mm)	stg.	4	41,13±1,98	3,96	9,63	36,5	46,0
		dr.	4	40,50±1,51	3,02	7,46	37,5	44,5
	Width at base of pectoral fin(mm)	stg.	4	10,38±0,55	1,10	10,60	9,0	11,5
		dr.	4	10,25±0,25	0,50	4,88	9,5	10,5
	Width at base of ventral fin(mm)	stg.	4	9,25±0,25	0,50	5,41	9,0	10,0
		dr.	4	9,50±0,35	0,70	7,37	8,5	10,0
Lot IV 5,50 years 442,75 grams	Pectoral fin length(mm)	stg.	4	46,88±1,33	2,66	5,67	44,0	50,0
		dr.	4	46,50±1,94	3,88	8,34	43,0	52,0
	Ventral fin length(mm)	stg.	4	48,25±1,97	3,94	8,17	45,0	54,0
		dr.	4	48,00±2,21	4,42	9,21	43,5	54,0
	Width at base of pectoral fin(mm)	stg.	4	11,75±0,52	1,04	8,85	10,5	13,0
		dr.	4	11,25±0,63	1,26	11,20	10,0	13,0
	Width at base of ventral fin(mm)	stg.	4	12,88±1,57	3,14	24,38	10,5	17,5
		dr.	4	12,50±1,19	2,38	19,04	11,0	16,0

The length of the ventral fin grows from 25-27,5 mm up to 48-54 mm, also, depending on age (1-5,5-6 years). For the width of the pair fins (pectoral and ventral), the evolution occurs from 6-7,5 mm, for one year old, to 12-17 mm, for 5,5-6 years old. By age group, these dimensions had mean values as follows. (table 2) (fig. 3,4). For the first batch of fish (1,64 years old and 69,71 grams), the pectoral fins have a average length of 27,29 mm, on the left side and 27,64 mm, on the right side, the average difference is of 0,35 mm (table 3)(fig. 1). Therefore, asymmetry is manifested, at this stage of age, for the right side of the body. For the second batch of age (3,44 years and 145,38 grams), the length of the pectoral fin has a average of 33,88±0,48 mm, on the left side and of 33,69±0,47mm, on the right side (table 2). The difference is, in this

case of 0,19 mm and the asymmetry is manifested on the left side of the body (fig. 1). For the batch of 4,5 years old (the third batch)(250,5 grams)the pectoral fin is longer on the right side than on the left side of the body with 0,27 mm, which means that the asymmetry is manifesting again on the right side of the body (fig. 1). For the fourth group of age (5,5 years and 442,75 grams), the difference in length between the left and the right side of the pectoral fin is of 0,38 mm, the asymmetry is manifested on the left side of the body. Consequently, at this character there is a fluctuating asymmetry which appears alternatively on the left and the right side of the body, along with aging. For the other characters studied by us there is an increase in size of the length and width, depending on the age of fish (table 2) (fig.1).

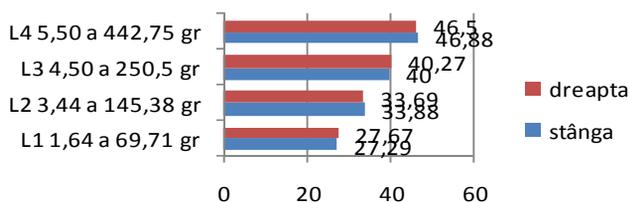


Fig. 1. Pectoral fin length of *Perca fluviatilis*, depending on age

For the length of the ventral fin, the asymmetry between the left and the right side of the body, has been manifested fluctuating also, in correlation with the age of fish, on the right for the first two batches and on the

left for the next two batches (ages). (tables 2,3) (fig. 2). For the width at base of the pectoral fin, the asymmetry was manifested only on the left side of the body, for all groups of age. (fig. 3).

Table 3.
 The differences found between the left and the right side of the body, for pair fins of *Perca fluviatilis* species

Specifications	Studied batch of fish										
	L1 1,64 years 69,71 gr.		L2 3,44 years 145,38 gr.			L3 4,5 years 250,5 gr.			L4 5,5 years 442,75 gr.		
	Val. abs.	Val. rel.	Val. abs.	Val. rel.	± %	Val. abs.	Val. rel.	± %	Val. abs.	Val. rel.	± %
Pectoral fin length (mm)	0,35	100	0,19	54,29	- 45,71	0,27	77,14	-22,86	0,38	108,57	+ 8,57
Ventral fin length (mm)	0,14	100	0,53	378,57	+ 278,57	0,37	264,28	+ 164,28	0,25	178,57	+ 78,57
Width at base of pectoral fin (mm)	0,43	100	0,34	79,07	- 20,93	0,13	30,23	-69,77	0,50	116,28	+ 16,28
Width at base of ventral fin (mm)	0,14	100	0,06	42,86	- 57,14	0,25	178,57	+ 78,57	0,38	271,43	+ 171,43

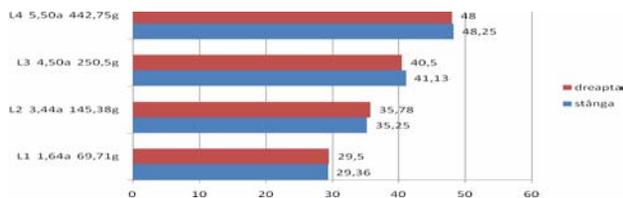


Fig. 2. Ventral fin length of *Perca fluviatilis*, depending on age

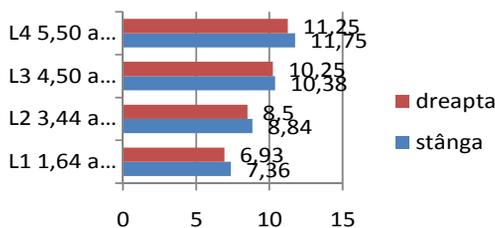


Fig. 3. Width at base of pectoral fin of *Perca fluviatilis*, depending on age

For the width at base of the ventral fin, the asymmetry was manifested on the left side, for the first two batches of age and then on

the right side for the third batch and again on the right side for the last batch of age, meaning the age of 5,5 years (L4) (fig. 4).

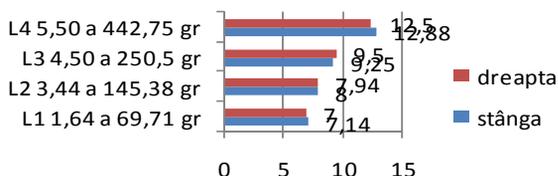


Fig. 4. Width at base of ventral fin of *Perca fluviatilis*, depending on age

Within age groups, the asymmetry phenomenon for the followed characters had manifested differently. So, for the length of the pectoral fin, from all 31 studied individuals, only two of them had no difference between the two sides of the body, and for the rest 29 (93,55%) of the fish, these differences varied between 0,5 mm și 4,0 mm, on the right or on the left side. Regarding the second character (the length of the ventral fin) the asymmetry manifested for 26 (83,87%) individuals, with values from 0,5 mm up to 30 mm, also on the right and left side of the body. For the width at base of

the pectoral fin, the asymmetry appeared at 26 (83,87% from the total number) and for the length of the ventral fin, the asymmetry occurred for 23, which represents 74,19 % from total number of perch (31=100%). The differences that were found between the left and the right side of the body, for the last two characters have varied between 0,5mm and 5,0 mm.

From a statistical viewpoint, all the differences that have been found between the left and the right side of the body, for the studied fish, have proven to be insignificant (table 4).

Table 4.
 Statistical significance of the differences between the left and the right side for the pair fins of *Perca fluviatilis* species, depending on age and body

Fish batch		Studied characters of <i>Perca fluviatilis</i>			
		Pectoral fin length (mm)	Ventral fin length (mm)	Width at base of pectoral fin (mm)	Width at base of ventral fin (mm)
		Left x Right	Left x Right	Left x Right	Left x Right
L1	1,64 years 69,71gr.	ns.	ns.	ns.	ns.
L2	3,44 years 145,38gr.	ns.	ns.	ns.	ns.
L3	4,5 years 250,50gr.	ns.	ns.	ns.	ns.
L4	5,5 years 442,75gr.	ns.	ns.	ns.	ns.

Regarding the causes that can explain these fluctuating asymmetry for *Perca fluviatilis*, they were not investigated in this study, but they could be genetical or external (environmental pollution, the stress etc.) [6], [4].

CONCLUSIONS

1. All the body parameters determined for the studied individuals of perch are growing in correlation with the age of the fish.

2. At the pair characters there was revealed the fluctuating asymmetry phenomenon, both for the individuals and the groups of age.

3. The differences of asymmetry between the pair characters studied by us are not statistical significant.

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