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Three-spined stickleback *from Iceland* *Gasterosteus aculeatus islandicus* SAUVAGE

Ciernik z Islandii *Gasterosteus aculeatus islandicus* SAUVAGE

Трехиглая колюшка Исландии *Gasterosteus aculeatus islandicus* SAUVAGE

[With 3 Tables and 3 Figures in text]

INTRODUCTION

The three-spined stickleback of Iceland was first investigated and described as a new species — *Gasterosteus islandicus*, by SAUVAGE in 1874. In consequence of revision of the genus *Gasterosteus* L. by BERTIN, 1925; TAGLIANI, 1926; BERG, 1932 and other authors, the Palaearctic three-spined stickleback is considered to belong to only one species — *Gasterosteus aculeatus* LINNAEUS. According to that conception the name *Gasterosteus islandicus* was placed in the synonymy.

Many recent authors dealt with the variability of the stickleback, which is known as being of both genotypical and phenotypical character. HEUTS, 1947 interprets this variability as a result of ecological adaptivity. He recognizes two „adaptive types": one, the freshwater form, with a small number of bony plates and the sea form, with full number of bony plates on each side of the body. GREENBANK and NELSON, 1959 as well as BIGELOW and SCHROEDER, 1953 follow the division of HEUTS. MÜNZING, 1959 firmly declares that in Palaearctic exists only one species — *Gasterosteus aculeatus* LINNAEUS. He has divided the stickleback collected in many places in the mouth of the Elba River into two groups — "Wanderform" and "Stationäre". These two forms are, according to him, quite isolated from each other.

Although the unity of species *Gasterosteus aculeatus* LINNAEUS, according to the actual knowlege, is unquestionable, the variability of this species is so evident that it is possible to recognize some forms as subspecies.

The author had the opportunity of examining a certain number of sticklebacks specimens from Iceland. Exact examination of this material has convinced him that *Gasterosteus islandicus* SAUVAGE ought to be classified as a subspecies, according to the following data:

1. The sticklebacks from Iceland are all similar to each other and at the same time quite different from the sticklebacks of European continent.
2. The material was collected in eight places.
3. The pelvic girdle of these specimens is fundamentally different from that of the known species and subspecies of the genus *Gasterosteus* L.
4. The "Coefficient of difference" (=CD, MAYER, LINSLEY, USINGER, 1956) of some features is higher than the fixed value — 1,28.

MATERIAL AND METHOD

The material of the investigated stickleback is the property of the Department of Taxonomic Zoology of Charls University in Prague, Czechoslovakia, and was collected (38 specimens altogether) by dr V. LANDA in eight places of Iceland[1].

1. Djupavatn, Iceland, VII 1948, 10 specimens.
2. Skidastadir, North Iceland, 9. VIII. 1948, 14 specimens.
3. Reydarvatn Lake, Iceland, south part of the Lake, 27. VIII. 1948, 2 specimens.
4. Reydarvatn Lake, Leirartjarnir, Iceland, pools near the Leira River. 1948, 6 specimens.
5. Reydarvatn, Iceland, ditch with *Carex* near the Lake, 19. VII. 1948, 1 specimen.
6. Uxavatn Lake, Iceland, 11. VII. 1948, 1 specimen.
7. Kaldidalur, SW, Iceland, 2. VI. 1948, 3 specimens.
8. Sandflutavatn, Iceland, 5. VII. 1948, 1 specimen.

The plastic features of young and adult specimens deformed by parasites were not taken under consideration, whereas the meristic features could be used on almost all specimens. That is why the number of specimens submitted to detailed examination is not the same in all cases.

The measurments were made according to the method outlined in the author's earlier paper (PENCZAK, 1962). The length of the pelvis has been measured, not along its median suture of the bottom of the pelvis, on account of the deep curve of its margin, but along the longest side of the pelvis. The statistical analysis of the meristic and plastic features hase been made according to PRAVDIN, 1931.

The total length of the measured specimens was 35–62 mm, the body length 31–35 mm, the weight 0,5–2,3 g. The shape of the body is illustrated by the figures 1, 2, 3.

[1] The names of localities are copied from the labels.

In general there are only 5 lateral bony plates, and they lie separated from one another. Four of them are the largest and they lie below the first and second dorsal spine. In some specimens may be one, two or three small plates in front or behind the large plates. The keel on the tail is lacking in all examined specimens.

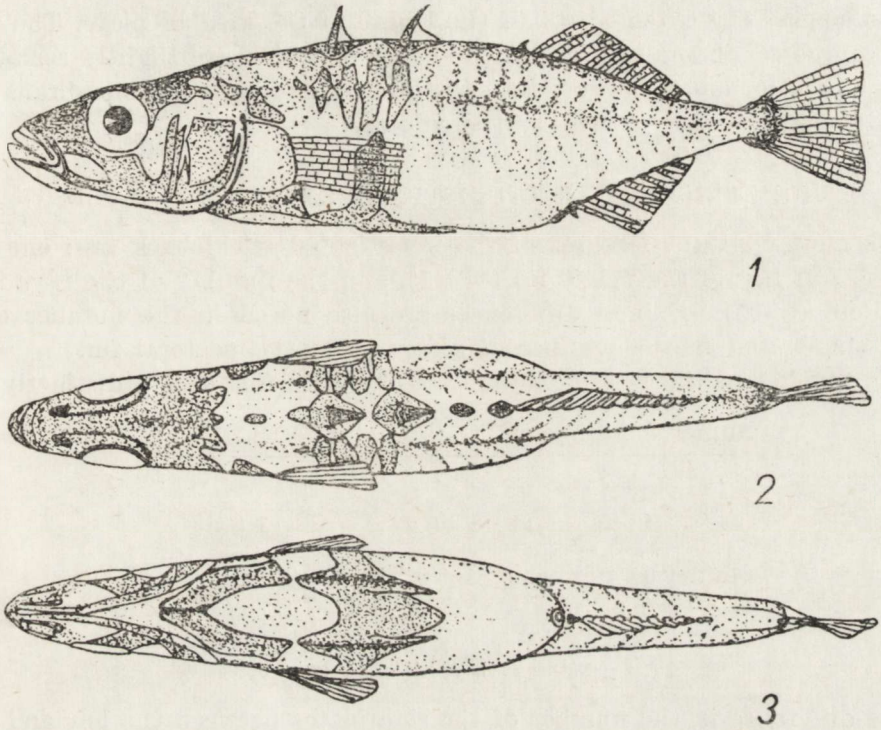

Fig. 1–3. *Gasterosteus aculeatus islandicus* SAUVAGE. 1 — side view, 2 — dorsal view 3 — ventral view.

The number of dorsal plates varies from four to seven, there are six in most cases. They are small and do not touch each other by the margin, except the second and the third. There are three or four dorsal spines.

The pelvic girdle is comparatively small, some of its elements are poorly developed and its ventral suture is scarcely visible. The oral margin of the pelvis is deeply excised. This important detail was also shown by SAUVAGE on the picture of his stickleback of Iceland.

Spines and rays in the fins are as follow: D III–IV[1] 9–13, A I 6–10, V I 1, P 9–10[2]. The dorsal spines have smooth or slightly serrate edges at the base. The first dorsal spine is situated behind the base of the pectoral fin, the second just above or behind the pelvic wing, the third at a certain distance behind

[1] In one specimen.
[2] In one specimen on both sides.

the end of the median plate. The rays of the dorsal and anal fins are articulated and very often unbranched. The base of the dorsal fin originates in most cases just opposite the middle, between the end of the median plate and the anal opening. The anal fin originates just below the fifth or sixth ray of the dorsal fin. The pectoral fin is composed of articulated and unbranched rays and its longest ray extends to half the length of the median plate. The pelvic fin is composed of one thin spine, the edges of which are slightly serrated at the base, and of one soft ray joined to the first one with the membrana. This spine is roughly twice, as long as the soft ray.

BIOMETRICAL CHARACTERISTIC OF EXAMINED SAMPLES

The most constant features of the investigated stickleback are: one spine and one soft ray in the pelvic fin (V I 1), and the number of the rays in the caudal fin (C 12). Minimal differences are also noted in the number of the dorsal spines and in the number of soft rays in the pectoral fin.

The number of the rays in the dorsal and anal fins differs distinctly:

numerus radiorum D	9	10	11	12	13	n
f	1	5	7	4	2	19

$M \pm m = 11.05 \pm 0.24$ $\quad \sigma = 1.07$

numerus radiorum A	6	7	8	9	10	n
f	1	6	9	3	1	20

$M \pm m = 7.85 \pm 0.21$ $\quad \sigma = 0.94$

The difference in the number of the side plates between the left and right side is not essential. In most cases the fishes have the same number of plates on both sides of the body, especially when all of these plates are large:

numerus laminarum lateralium	3	4	5	6	7	8	n
f	1	12	6	2	1	1	23

$M \pm m = 4.74 \pm 0.25$ $\quad \sigma = 1.21$

The dorsal plates differ in their shape, number and position on the back:

numerus scutarum dorsalium	4	5	6	7	n
f	1	2	13	1	17

$M \pm m = 5.85 \pm 0.15$ $\quad \sigma = 0.65$

Meristic features with their reference to the longitudo corporis in % are shown on the Table I. It displays a certain proportion among several of the measured elements: the first dorsal spine is shorter than the diameter of the

TABLE I. Characteristics of the plastic features of *Gasterosteus aculeatus islandicus* SAUVAGE from Iceland in percent of longitudo corporis.

Feature	Range of variability	$M \pm m$	σ	$\pm 3\sigma$	n
maxima altitudo corporis	21.2–26.4	23.84±0.47	1.77	5.21	14
minima altitudo corporis	3.6– 5.0	4.25±0.11	0.45	1.35	15
maxima altitudo capitis	17.1–20.2	18.79±0.22	0.88	2.64	15
maxima latitudo capitis	12.0–14.1	12.79±0.21	0.84	2.52	15
longitudo capitis lateralis	27.7–31.7	29.45±0.35	1.38	4.14	15
longitudo capitis dorsalis	25.0–28.9	27.05±0.35	1.36	4.08	15
longitudo capitis ventralis	20.4–24.7	22.45±0.38	1.48	4.44	15
diameter oculi	7,5– 9.1	8.31±0.16	0.64	1.92	15
spatium anteoculare	8.0–10.0	9.19±0.35	1.38	4.14	15
spatium postoculare	11.1–14.0	12.25±0.26	1.03	3.09	15
spatium interoculare	6.2– 8.1	7.18±0.16	0.64	1.92	15
longitudo maxillae	6.4– 8.9	7.65±0.23	0.92	2.76	15
spatium antedorsale	60.6–69.0	64.65±0.59	2.29	6.87	15
spatium postdorsale	12.1–17.1	14.72±0.36	1.43	4.29	15
spatium praeventrale	42.7–48.8	45.48±0.72	1.70	5.10	14
spatium postventrale	51.1–58.1	54.63±0.60	2.25	6.75	14
spatium praeanale	66.6–75.2	71.76±0.65	2.41	7.23	14
spatium postanale	11.7–15.6	14.20±0.21	1.10	3.30	14
distantia anus-pelvis	6.2–18.6	13.05±1.04	3.87	11.61	14
spatium praepectorale	32.7–38.6	36.11±0.42	1.66	4.98	15
distantia pectoralis-ventralis	5.7–11.2	7.77±0.42	1.56	4.68	14
altitudo spinae dorsalis (DI)	4.5– 8.6	6.18±0.32	1.26	3.78	15
altitudo spinae ventralis	6.8–12.7	9.52±0.51	2.00	6.00	15
altitudo D	7.8–12.6	10.20±0.35	1.32	3.96	14
altitudo A	8.3–11.3	9.85±0.33	1.30	3.90	15
longitudo basis D	21.1–28.2	24.71±0.58	2.26	6.78	15
longitudo basis A	11.8–17.5	15.05±0.29	1.41	4.23	13
longitudo P	13.0–17.5	15.71±0.36	1.41	4.23	15
longitudo C	11.2–15.2	13.11±0.28	1.10	3.30	15
longitudo armati corporis	10.3–17.0	12.91±0.58	2.18	6.54	14
altitudo alae pelvis	10.0–15.0	13.11±0.39	1.53	4.59	15
latitudo pelvis	10.1–13.2	11.55±0.24	0.91	2.73	14
longitudo pelvis	15.5–23.4	18.85±0.52	2.05	6.15	15
longitudo laminae medialis	8.8–16.1	11.52±0.49	1.92	5.76	15
latitudo laminae medialis	3.3– 6.4	5.38±0.22	0.88	2.64	15
longitudo ectocoracoideum	14.2–19.7	17.18±0.37	1.64	4.92	15

eye and than the length of the snout; the pectoral fin is longer than the pelvic spine and is never equal to it in length; the ectocoracoideum is longer than the wing of the pelvis; the longitudo postoculare and the length of the anal fin are in most cases equal. The length of the caudal fin is equal to the height of the pelvis wing.

DISCUSSION

The examined meristic characters of *Gasterosteus aculeatus islandicus* SAUVAGE are included within the range of variability of the nominal species *Gasterosteus aculeatus aculeatus* LINNAEUS. As there exist only a few papers dealing with the plastic features statisticaly examined, the stickleback from Iceland can be compared only with the specimens from the Amur-River, NIKOLSKIJ, 1956; Neman-River, ŽUKOV, 1958 and Ner-River, PENCZAK, 1962 [Table II]. Coefficient of difference might be cited only on the basis of the data obtained from the population of the stickleback of Ner-River, (Poland), because NIKOLSKIJ and ŽUKOV did not calculate the value of the σ (standard deviation) with reference to the features cited in Table III.

It is interesting to compare the pelvic girdle of Iceland specimens on account of its great deviation from the normal form, with the pelvic girdle of the species of other genera of the family *Gasterosteidae*: *Pungitius pungitius* (L.), *Apeltes quadracus* MITCHILL, *Spinachia spinachia* (L.) and *Eucalia inconstans*

TABLE II. Comparison of the plastic features which distinguish the subspecies *Gasterosteus aculeatus islandicus* SAUVAGE from *G. aculeatus aculeatus* LINNAEUS from the Amur-River, Neman-River and Ner-River in percent of longitudo corporis.

Feature	*G. aculeatus islandicus* SAUVAGE	*G. aculeatus aculeatus* L.		
	Iceland	Amur	Neman	Ner
longitudo basis D	24.71	27.2	26.0	23.17
longitudo basis A	15.05	20.5	18.0	17.92
longitudo P	15.71	20.1	16.8	15.28
altitudo spinae ventralis	9.52	15.5	17.0	17.92
altitudo spinae dorsalis (DI)	6.18	12.0	11.3	9.85

TABLE III. Coefficient of difference of *Gasterosteus aculeatus islandicus* SAUVAGE (Iceland) and *G. aculeatus aculeatus* LINNAEUS, Ner-River (Poland)

Feature	$M \pm m$ Iceland	$M \pm m$ Ner	$CD = \frac{M_1 - M_2}{\sigma_2 + \sigma_1}$
distantia anus-pelvis	13.05 ± 1.04	5.43 ± 0.17	1.35
altitudo spinae dorsalis (DI)	6.18 ± 0.32	9.85 ± 0.10	1.63
altitudo spinae ventralis	9.52 ± 0.51	14.76 ± 0.10	1.71
altitudo alae pelvis	13.11 ± 0.39	18.53 ± 0.10	2.15
longitudo pelvis	18.85 ± 0.52	24.62 ± 0.10	1.87
longitudo laminae medialis	11.52 ± 0,49	16.90 ± 0.10	1.86

(KIRT.). It must be emphasised that the shape of the pelvic girdle has been regarded as an essential feature used to recognise the genera of the family *Gasterosteidae* (BERTIN, 1925; LEINER, 1934). The oral margin of the pelvis, on its ventral side, is deeply excised in *Gasterosteus aculeatus islandicus* SAUVAGE, and even more so in *Spinachia spinachia* (L.). A slight excision, of not strictly regular depth, and of different shape than in the two above mentioned species, can only be seen in *Pungitius pungitius* (L.).

The median plate of *Gasterosteus aculeatus islandicus* SAUVAGE is more similar in its shape to that of *Pungitius pungitius* (L.) than to that of *Gasterosteus aculeatus* L.

The wings of the pelvis, which are lacking in *Spinachia spinachia* (L.) and *Apeltes quadracus* MITCHILL, are very well developed in *Gasterosteus aculeatus* L. and least developed in *Pungitius pungitius* (L.) and *Gasterosteus aculeatus islandicus* SAUVAGE.

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STRESZCZENIE

Na podstawie materiałów ciernika z Islandii, zebranych przez V. Landę w 1948 r., autor proponuje ciernika opisanego przez Sauvage (1874) jako *Gasterosteus islandicus* Sauvage, wyłączyć z synonimów *G. aculeatus* L. i uznać go za podgatunek — *G. aculeatus islandicus* Sauvage.

Powyższą decyzję autor powziął w oparciu o następujące dane:

1. Zebrane przez V. Landę cierniki charakteryzują się jednorodną budową ciała i odmienną od ciernika z kontynentu europejskiego. Szczególnie istotne różnice zaobserwowano w budowie pasa miednicowego. Pas miednicowy u ciernika z Islandii ma głębokie wycięcie w przedniej krawędzi miednicy, sięgające niekiedy nasady kolców brzusznych [rys. 3].

2. Materiały, na podstawie których autor oparł swoje badania, pochodzą z ośmiu stanowisk.

3. Coefficient of difference dla kilku cech przekracza przyjętą wartość 1,28 [Tabela III].

РЕЗЮМЕ

На основании материалов трехиглой колюшки, собранных В. Ландом (V. Landa) в 1948 году в Исландии, автор предлагает исключить колюшки, описанные Соважем (Sauvage, 1874) как *Gasterosteus islandicus* Sauvage из синонимов *G. aculeatus* L. и рассматривать их как подвид линнеевского вида, а именно *G. aculeatus islandicus* Sauvage.

К этому решению автор пришел на основании следующих данных:

I. Колюшки собранные В. Ландом характеризуются одинаковым строением тела, отличным от строения колюшек европейского материка, особенно существенное отличие наблюдается в строении тазового пояса. Тазовый пояс у колюшек из Исландии имеет глубокую вырезку в переднем крае, которая достигает иногда основания брюшных колючек (рис. 3).

2. Материалы, которые обследовал автор были собраны в восьми пунктах.

3. Coefficient of difference (см. Майр и др., 1956) по нескольким признакам превышает установленную величину 1,28 (Таблица III).

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