The stickleback (*Gasterosteus aculeatus* L.) from Nova Scotia, Newfoundland and the French island of St. Pierre

by T. Penczak

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(With 1 figure and 1 table in the text)

Ciernik (Gasterosteus aculeatus L.) z Nowej Szkocji, Nowej Fundlandii i wyspy francuskiej Saint-Pierre
THE STICKLEBACK (*Gasterosteus aculeatus* L.) FROM NOVA SCOTIA, NEWFOUNDLAND AND THE FRENCH ISLAND OF SAINT PIERRE

by

Tadeusz Penczak

(including 1 figure and 1 table in the text)

The sticklebacks studied, caught in 1938 by professors S. Feliksiak and T. Jaczewski during their travels to Nova Scotia, Newfoundland and the French islands of St-Pierre and Miquelon come from Nova Scotia and Newfoundland and St-Pierre; at present they are kept in the collections of the Zoological Institute of the Polish Academy of Sciences in Warsaw.

Materials made available to me represent two species of the *Gasterosteidae* family: *Gasterosteus aculeatus* L. and *Apeltes quadracus* Mitch., the 8 specimens of the latter having been found in a freshwater mountain pond on the island of St-Pierre, location 85° 17 IX. 1938. Axelrod and Schultz /1955/ and Innes /1944/ confine this species to salt and brackish waters of the Atlantic Ocean around the shores of North America.

In this work I will concern myself only with the stickleback

*Translator's note: numbers in the right-hand margin refer to page numbers in the original.*
Gasterosteus aculeatus L.; Gasterosteus wheatlandi Putnam /1866/, a species peculiar to North America, does not appear in the collections, although it had previously been found in these regions together with the G. aculeatus L. /Hubbs 1929/.

The sticklebacks (G. aculeatus L.) made available for this study do not represent a uniform type of body structure. Sticklebacks from Nova Scotia and the island of St-Pierre resemble representatives of this species found in Europe /Berg 1949, Heuts 1947, 1947a, Penczak 1960, 1962/, but those found in one location in Newfoundland (Deer Lake) differ from one another in the structure of some bone elements.

Sauvage /1874/ records two species of stickleback in Newfoundland: Gasterosteus loricatus Reinh. and Gasterosteus biaculeatus Mitch. Some of the sticklebacks collected from Deer Lake (Nfld.) may, in spite of certain differences, be identified on the basis of data given by Sauvage as G. biaculeatus Mitch. Other sticklebacks from that island resemble sticklebacks from Nova Scotia and the island of St-Pierre.

Morphological and meristic characters are given for all sticklebacks jointly, except for those characters which differentiate the material investigated.

As before, I take "form" /Penczak 1960/ as the taxonomic unit, relating to the individual differences in body armour and the number of spines.

I wish to express my sincere thanks to Dr. Stanislaw Feliksiak for his help in correctly locating the various places where the sticklebacks were caught.
MATERIALS and METHODS

The material investigated numbered 46 specimens, collected between 19.VIII and 15.IX.1938 (Nova Scotia - 2 specimens, Newfoundland - 33 specimens and St-Pierre - 11 specimens). The material is from 8 locations numbered according to the unpublished itinerary of the voyage:


2. Newfoundland, St.George's river flowing into the bay, 200 m from the mouth, location 43, 25.VIII - 3 specimens.


5. Newfoundland, Terra Nova, Pitts Brook River, right tributary of the Terra Nova River, location 61, 6.IX - 1 specimen.

6. Newfoundland, Terra Nova, Terra Nova River, shallow overflow, location 62, 5.IX - 3 specimens.

7. St-Pierre, oozing water on a wet meadow, location 78, 15.IX - 8 specimens.

8. St-Pierre, swamp by a stream, location 79, 15.IX - 3 specimens.

I found material different from the rest in the third batch of the above-mentioned specimens (Deer Lake). Of the 10 sticklebacks collected in this location, seven are different from all the other material investigated, two specimens are of intermediate structure, and one resembles fish from the other locations. Based on the structure of
the spines, the pelvic girdle and the number of lateral plates, the sticklebacks studied may be divided into two groups:

I. The sticklebacks which are morphologically similar to European sticklebacks have 23 - 26 lateral plates and a well-developed caudal keel (longitudo carinae caudalis - M = 12.55). There are three dorsal spines, more rarely four, and the edges are serrated, almost to the top (Fig. 1A). The first dorsal spine is shorter than in the "atypical" sticklebacks from Deer Lake (longitudo DI - M = 9.55). The anterior edge of the pelvic girdle is straight and di- or trichotomous "wings" are clearly seen to extend over the lateral armour (longitudo alae pelvis - M = 15.55). Long ventral spines (longitudo VI - M = 16.05) have serrated edges and are connected by a fin fold with one soft ray, generally equal to half the length of the spine.

II. The group of sticklebacks from Deer Lake (Nfld.) differs in some characters from the rest of the material investigated. This group is represented in this collection, as already mentioned, by 7 sticklebacks / = G. biaculeatus Mitch (?) = type B'1 - Heuts = f. semiarmata C. et V. - Penczak 1960/; two specimens are of intermediate body structure and one specimen resembles the rest of the material investigated.

The lateral armour in the isolated group of sticklebacks is composed of 7 to 9 (12-13) plates and a weakly formed caudal keel (longitudo carinae caudalis M = 7.55); one specimen has no caudal keel at all (= f. hologymna Regan, Penczak 1960). Dorsal spines number three. They are long (longitudo DI - M = 10.91) and lightly serrated, and at the base they resemble the spines drawn by Sauvage for G. biaculeatus Mitch.
Key:  Fig. 1. - First dorsal spine (D I) of the stickleback (Gasterosteus aculeatus L.):
B - from Deer Lake, Newfoundland.

(fig. 1 B). The anterior edge of the pelvic girdle is slightly curved or straight and the lateral wings, single or dichotomous, extend a short distance over the armour of lateral plates (longitudo alae pelvis - M = 14.77). Ventral spines are long and cylindrical (longitudo V I - M = 16.33), slightly curved, longer than the medial plate, and their edges are serrated only at the base.

Sauvage (1874) also establishes other characters for the Newfoundland stickleback G. biaculeatus Mitch., such as a constant number of rays in fins D and A (D III 10, A I 8) and a constant number of lateral plates (8 plates), and it is evident from the sketch included in his report that the stickleback does not have a caudal keel. After examining the "atypical" sticklebacks from Deer Lake I have concluded that the number of rays in the fins is variable (D III 9-10, A I 7-10), the number of plates varies from 7 to 9, and the caudal keel is present. Taking into
account the number of lateral plates and the absence of the caudal keel (on the basis of Sauvage's sketch, 1874), the Deer Lake sticklebacks discussed here tend to resemble sticklebacks from Alaska, sketched and described by Greenbank and Nelson /1959/.

The material collected was preserved in 70% alcohol. Lateral plates and dorsal shields are clearly visible in a significant number of specimens, and where they were difficult to identify in some specimens I stained them with an alcohol solution of alizarin. Morphometric statistical investigations were carried out according to a scheme given in an earlier publication /Penczak 1962/, using the conversion formulae given by Pravdin /1931/.

**MORPHOMETRIC CHARACTERISTICS OF THE MATERIAL**

Detailed analysis of the morphological characters was carried out on 11 specimens. The structure of the organs being compared and some meristic characters were analyzed for a greater number of specimens. This quantitative choice of material was justified by the imperfect condition of the specimens: in some samples sticklebacks had damaged fins or bodies deformed by parasites.

With the exception of the characters previously mentioned, on the basis of which it was possible to divide the material being investigated, the remaining numerical data are given for all the sticklebacks taken jointly, since differences noted are within the limits of calculated error (m) for the mean (M).

Differences apply only to the numbers of soft rays in fins D and A, in the remaining fins the number of rays is constant (D III - (IV),
Soft rays of the dorsal fin are segmented and, in most specimens, unbranched (if branched rays are present, they range in number from 2 to 5). The caudal fin is composed of segmented and branched rays, except for two to four outer rays. In rare specimens branched rays are present also in the anal fin, numbering from 2 to 5. Soft rays of the anal fin are segmented. The fan-shaped pectoral fin is composed of segmented and unbranched rays.

The number of lateral plates is variable and in Deer Lake specimens ranges from 7 to 9; two specimens of intermediate structure from that location have 12 and 13 plates, the remaining sticklebacks studied have from 23 to 26 plates.

Dorsal shields vary only slightly and statistically this character can be expressed as follows:

\[
\begin{array}{cccccc}
\text{Number of lateral plates} & 6 & 7 & n \\
\text{f} & 8 & 3 & 11 \\
M \pm \sigma &=& 6.27 \pm 0.16, & \sigma &=& 0.54, & 3\sigma &=& \pm 1.68.
\end{array}
\]
Longitudo totalis for the sticklebacks measured ranges from 41 to 68 cm ($M \pm m = 52.05 \pm 2.30$, $\sigma = 7.50$, $3\sigma = \pm 22.50$), longitudo corporis from 37 to 61 mm ($M \pm m = 45.75 \pm 2.19$, $\sigma = 7.25$, $3\sigma = \pm 21.75$).

Table I. Morphological characters of the Gasterosteus aculeatus L. from Nova Scotia, Newfoundland and St-Pierre (% longitudo corporis).

<table>
<thead>
<tr>
<th>Ėecha</th>
<th>Praktyczny zakres zmienności</th>
<th>$M \pm m$</th>
<th>$\sigma$</th>
<th>$\pm 3\sigma$</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>altitudo corporis maxima</td>
<td>21,0 - 34,5</td>
<td>22,51 ± 0,46</td>
<td>1,54</td>
<td>4,62</td>
<td>11</td>
</tr>
<tr>
<td>altitudo capitii maxima</td>
<td>17,5 - 20,0</td>
<td>19,06 ± 0,23</td>
<td>0,77</td>
<td>2,31</td>
<td>11</td>
</tr>
<tr>
<td>latitudo capitii maxima</td>
<td>11,1 - 13,6</td>
<td>12,41 ± 0,32</td>
<td>1,09</td>
<td>3,27</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal capitii lateralis</td>
<td>27,1 - 21,3</td>
<td>29,32 ± 0,39</td>
<td>1,50</td>
<td>3,90</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal capitii dorsalis</td>
<td>34,7 - 21,0</td>
<td>27,50 ± 0,41</td>
<td>1,37</td>
<td>4,11</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal capitii-ventralis</td>
<td>18,9 - 24,4</td>
<td>20,00 ± 0,52</td>
<td>1,20</td>
<td>5,28</td>
<td>11</td>
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<tr>
<td>diametr oculi</td>
<td>7,5 - 10,2</td>
<td>8,05 ± 0,13</td>
<td>0,84</td>
<td>2,42</td>
<td>11</td>
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<tr>
<td>spatium antecocular</td>
<td>6,5 - 10,8</td>
<td>8,05 ± 0,30</td>
<td>1,00</td>
<td>3,00</td>
<td>11</td>
</tr>
<tr>
<td>spatium postocular</td>
<td>10,0 - 13,0</td>
<td>11,87 ± 0,30</td>
<td>0,90</td>
<td>2,70</td>
<td>11</td>
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<tr>
<td>spatium interocular</td>
<td>0,3 - 7,5</td>
<td>5,96 ± 0,10</td>
<td>0,54</td>
<td>1,62</td>
<td>11</td>
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<tr>
<td>spatium inter fim maxillae et margo infra-oculi</td>
<td>4,0 - 5,9</td>
<td>4,90 ± 0,21</td>
<td>0,70</td>
<td>2,10</td>
<td>11</td>
</tr>
<tr>
<td>spatium inter foramina nasalia</td>
<td>3,7 - 5,1</td>
<td>4,50 ± 0,21</td>
<td>0,70</td>
<td>2,10</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal maxillae</td>
<td>6,6 - 8,0</td>
<td>7,69 ± 0,23</td>
<td>0,77</td>
<td>2,31</td>
<td>11</td>
</tr>
<tr>
<td>spatium inter angulos oris</td>
<td>5,3 - 6,8</td>
<td>6,14 ± 0,21</td>
<td>0,70</td>
<td>2,10</td>
<td>11</td>
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<tr>
<td>spatium prædorsale</td>
<td>69,8 - 66,2</td>
<td>63,90 ± 0,43</td>
<td>1,44</td>
<td>4,32</td>
<td>11</td>
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<tr>
<td>spatium postdorsale</td>
<td>13,0 - 16,5</td>
<td>15,23 ± 0,43</td>
<td>1,48</td>
<td>4,44</td>
<td>11</td>
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<tr>
<td>spatium præventrale</td>
<td>42,6 - 47,7</td>
<td>45,41 ± 0,52</td>
<td>1,78</td>
<td>5,34</td>
<td>11</td>
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<tr>
<td>spatium postventrale</td>
<td>52,0 - 56,6</td>
<td>54,87 ± 0,33</td>
<td>1,09</td>
<td>3,27</td>
<td>11</td>
</tr>
<tr>
<td>spatium postanale</td>
<td>13,6 - 15,7</td>
<td>14,45 ± 0,30</td>
<td>0,93</td>
<td>2,70</td>
<td>11</td>
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<tr>
<td>spatium præanale</td>
<td>33,7 - 38,0</td>
<td>35,25 ± 0,50</td>
<td>1,56</td>
<td>4,68</td>
<td>10</td>
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<tr>
<td>distantia pectoralis-ventralis</td>
<td>3,9 - 8,1</td>
<td>6,23 ± 0,35</td>
<td>1,18</td>
<td>3,54</td>
<td>11</td>
</tr>
<tr>
<td>altitudo D</td>
<td>10,2 - 13,9</td>
<td>11,78 ± 0,34</td>
<td>1,14</td>
<td>3,42</td>
<td>11</td>
</tr>
<tr>
<td>altitudo A</td>
<td>10,0 - 12,1</td>
<td>10,90 ± 0,28</td>
<td>0,94</td>
<td>2,82</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal basis D</td>
<td>22,2 - 26,0</td>
<td>23,87 ± 0,40</td>
<td>1,34</td>
<td>4,02</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal basis A</td>
<td>13,7 - 21,0</td>
<td>16,42 ± 0,68</td>
<td>2,25</td>
<td>6,75</td>
<td>11</td>
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<tr>
<td>longitudinal P</td>
<td>14,6 - 18,1</td>
<td>17,14 ± 0,28</td>
<td>0,94</td>
<td>2,32</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal C</td>
<td>15,5 - 19,7</td>
<td>14,35 ± 0,32</td>
<td>1,00</td>
<td>3,00</td>
<td>10</td>
</tr>
<tr>
<td>latitudo pelvis</td>
<td>9,5 - 12,4</td>
<td>11,05 ± 0,23</td>
<td>0,97</td>
<td>2,91</td>
<td>11</td>
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<tr>
<td>longitudinal pelvis</td>
<td>19,1 - 27,1</td>
<td>23,50 ± 0,60</td>
<td>2,30</td>
<td>6,90</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal laminae medialis</td>
<td>14,0 - 18,0</td>
<td>17,00 ± 0,47</td>
<td>1,18</td>
<td>3,44</td>
<td>11</td>
</tr>
<tr>
<td>latitudo laminae medialis</td>
<td>4,0 - 7,0</td>
<td>5,77 ± 0,35</td>
<td>1,18</td>
<td>3,44</td>
<td>11</td>
</tr>
<tr>
<td>longitudinal ccelopatracoidem</td>
<td>17,3 - 21,7</td>
<td>20,05 ± 0,52</td>
<td>1,73</td>
<td>5,19</td>
<td>11</td>
</tr>
</tbody>
</table>
The morphological characters are given in the table (Table I), which includes only those measurements that do not differentiate the material under investigation.

The above work is of an analytical character and is a contribution to syntheses of the taxonomy of the stickleback (Gasterosteus aculeatus L.).

SUMMARY

The investigated material of 46 specimens of Gasterosteus aculeatus L. was collected in Nova Scotia, Newfoundland and St.-Pierre.

The sticklebacks caught in the Deer Lake, Nfld differ from the remainder of the investigated material in the structure of their dorsal [fig. 1 B] and pelvic spines, in the number of the bony plates as well as in the structure of certain elements of the pelvic girdle. The species of stickleback, as described for Newfoundland by Mitchell (after Sauvage 1874) — Gasterosteus biauruleatus Mitchell — could, with the exception of several differences, be compared to some of the specimens from the Deer Lake. But the presence in the Deer Lake of sticklebacks of intermediate structure and of a specimen completely similar to the remaining material could at best allow for preserving, for the form described by Mitchell, the taxonomical unit corresponding in rank to the ecological race.

The plastic characters pertaining to the individual variation are listed jointly for all specimens [table I].
LITERATURE


PIŚMIENNICTWO


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