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Sexual Dimorphism in the Dorsal Fins of Ollentodon and Skiffia, Mexican Goodeid Teleosts

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Sexual Dimorphism in the Dorsal Fins of *Ollentodon* and *Skiffia*, Mexican Goodeid Teleosts[1]

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Abstract. The dorsal fins of males of *Ollentodon multipunctatus, Skiffia lernae and Skiffia variegata* differ from the dorsal fins of the females. The first 4-5 rays of the male dorsal fins have a spine-like appearance and are separated from each other by a deep notching at the periphery of the fin membrane. The female fin is undifferentiated. The male dorsal is generally higher and longer at the base than the female fin. Similarly, the rays in the male fin are thicker than those in the female. Whereas most rays in the fin are bifurcated twice to form three or four terminal branches, the first five rays in both sexes are primarily single (non-split) or bifurcated once. There is no structural difference in the first five rays of the two sexes. The fins of the two genera are alike in structure although the dorsal fin of the male *Ollentodon* is higher or larger, proportionately, than that of *Skiffia.*

INTRODUCTION

The sexually dimorphic anal fin of the Goodeidae, fresh-water viviparous cyprinodonts from Mexico, has been known since Meek's studies of the family (1902, 1904). He recognized the modified anal fin of the males as a unique characteristic of the group of fishes now classified as the family Goodeidae. The male anal fin has, in addition to a first degenerate ray, a group of six foreshortened rays (numbers 2-7). In most species, the six rays are shorter than the others and are usually separated from the rest of the anal fin by a conspicuous notch. The modification of the fin is constant within each species (Hubbs and Turner, 1939; Turner, Mendoza, Reiter, 1962). The anal fin is not as highly evolved as that of the poeciliids but no doubt it aids in insemination.

No pronounced sexual dimorphism of the dorsal fin has been described for any goodeid although some differences in size have been noted. Meek (1904) recorded that in *Skiffia lermae, Skiffia variegata* and *Skiffia multipunctata* (= *Ollentodon multipunctatus*) the dorsal fin of the male was higher than in the female but also that the "anterior portion" of the dorsal fin was shortened in the male. Similarly, Hubbs and Turner (1939) recognized that the dorsal fin of the male in *Ollentodon* and

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Skiffia was more "expansive (longer basally and with higher rays)". Other minor differences in the dorsal fin will be discussed later.

In this paper, the writer describes what is considered a marked difference in sexual dimorphism of the dorsal fin in closely related genera, *Skiffia* and *Ollentodon*.

Materials

This study is based on three species but with emphasis on the first: *Ollentodon multipunctatus* (Pellegrin), *Skiffia lermae* (Meek) and *Skiffia variegata* (Meek).

Despite different generic classification, *Ollentodon* and *Skiffia* are very similar and no doubt are very closely related. It should be noted that whereas Hubbs and Turner (1939) provisionally considered *Skiffia lermae* and *Skiffia variegata* as two separate species, both de Buen (1942- 43) and Alvarez (1950) classified them as subspecies of *Skiffia lermae*. This slight taxonomic disagreement has no effect on this study.

Specimens used in this study were collected in the field in Mexico during several summers from 1954 to 1964. Specimens of *S. variegata* were collected in Lago Zirahuén, Michoacán. Collections of *S. lermae* were made in Lago de Pátzcuaro, Hacienda de Chapultepec on the outskirts of Pátzcuaro, and Minzita, near the Presa de Coíntzio, all in the state of Michoacán. *O. multipunctatus* was collected extensively from the Laguna de Camécuaro, near Zamora, Michoacán, and from the outskirts of Guadalajara, Jalisco, near the airport, in ditches along the highway.

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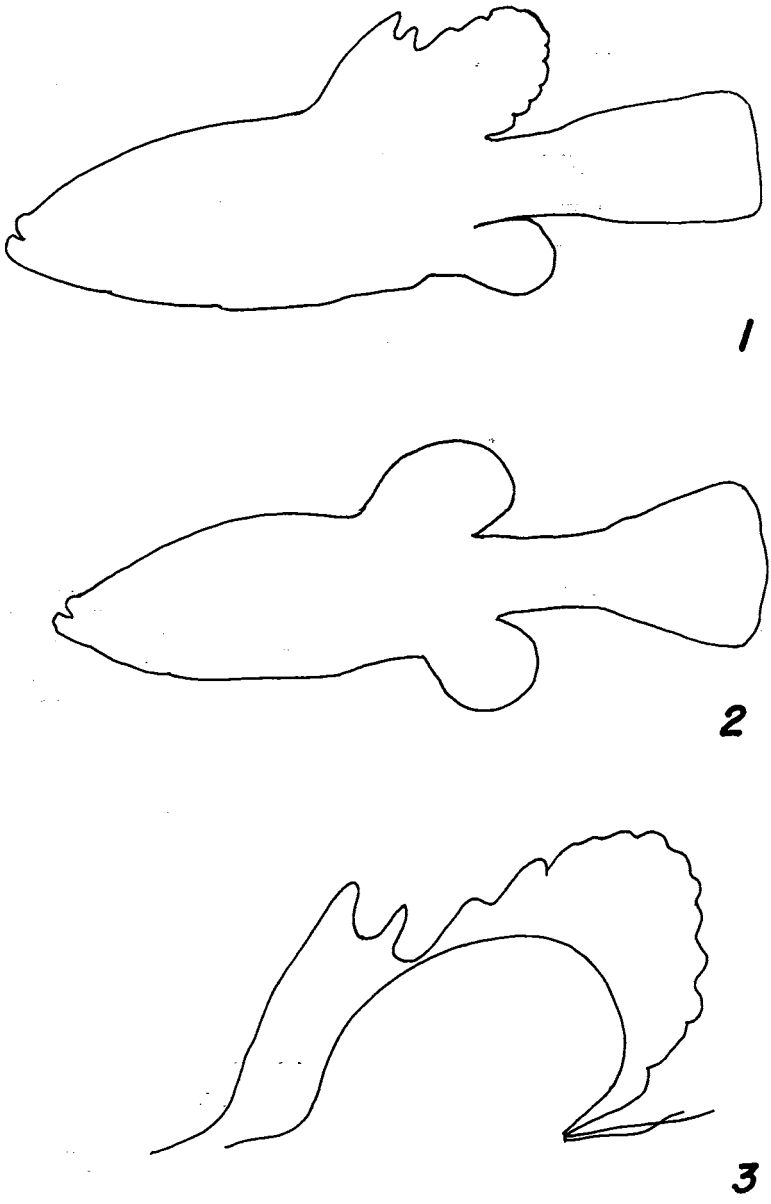
This study is based on more than 350 preserved specimens of the three species. In addition, a very large but undetermined number of living specimens of *Ollentodon* have been examined in the laboratory, where living specimens are available for study. A limited number of specimens of *S. lermae* and *O. multipunctatus* were stained with alizarin and cleared in potassium hydroxide and glycerine for detailed analysis of the fins.

Dorsal Fins

Shape. Figures 1 and 2 show the pronounced differences in size and contour of the dorsal fins of two typical specimens of *Ollentodon*. The difference is further emphasized in Figure 3 where the dorsal fins of the two sexes are superimposed. The fin of the female is a simple, undifferentiated fin, rounded in general shape with the anterior and posterior rays gradually reduced in length. The male, on the other hand, has a series of anterior spine-like rays clearly separated from adjacent rays by a deeply notched or scalloped fin membrane (Figures 1, 3, 6, 7,). In preserved specimens, the fin differences are largely unnoticed although the anterior rays of the male fin do appear shorter (Figures 4, 5). It is only in the living specimens, when the fins are erected, that the differences becomes conspicous. These characteristics of the dorsal fins are typical of more than 350 specimens examined of the three species from all collection sites.

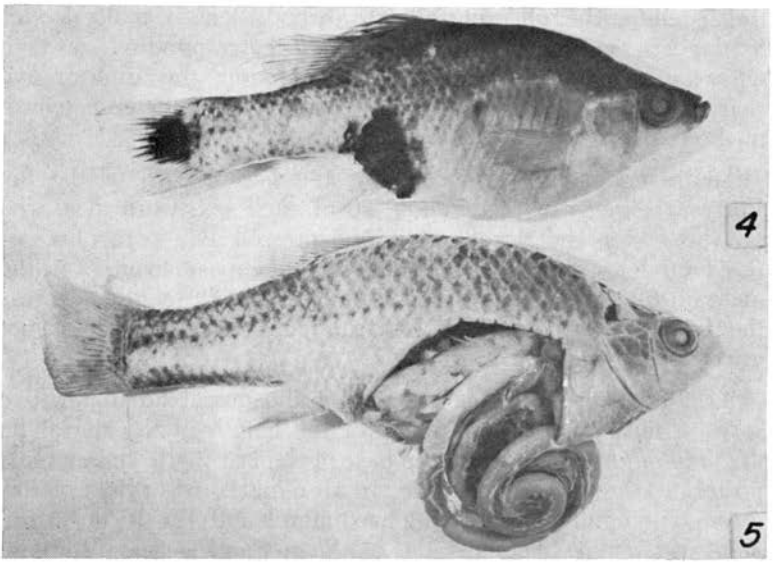
The nature of the notched or scalloped fin membrane in the male does vary somewhat in different specimens. Notches between adjacent anterior rays may vary from one to as many as four. In a representative count from 25 *Ollentodon* males, 18 specimens exhibited three notches between the first four anterior rays, three specimens had two, three had four and one had none. Furthermore, one specimen was found in which two fin rays were isolated by deep indentations on either side but with no indentation between the two. Of males examined in the three species, only two or three failed to show typical differentiation. As a result of the notching of the fin membrane, anterior rays give the appearance of spines protruding from the membrane. In other areas of the fin the rays do not necessarily protrude beyond the fin membrane. Thus, despite variations in the pattern of the fin membrane, the male dorsal fin is readily identifiable because of its shape.

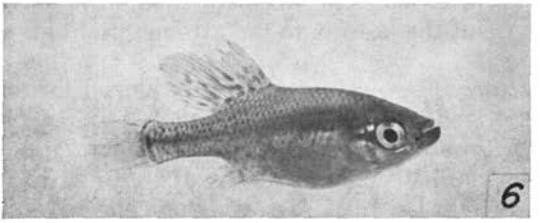
Size. The male fin appears to be larger than that of the female, not only on length of rays but also in length of the base of the fin (Figure 3). In a random sampling made of six *Ollentodon* males and six *Ollentodon* females, each ray was measured and its length was expressed as a percentage of the total length of the specimen. These calculations, limited as they are, show that the male rays in *Ollentodon* are unquestionably longer, sometimes 80-90% longer than corresponding rays in the female. Furthermore, although the anterior 4-5 rays in the male are markedly shorter than the rest, they still exceed in length the corresponding rays in the female by 20-30%. In *S. lermae,* most rays of the male fin also are longer than corresponding rays in



Figures 1, 2. Outline drawings of a young *Ollentodon multipunctatus* made (25 mm) and a female (23.6 mm) to show the relative size and shape of the dorsal fins .

Figure 3. The dorsal fins of the above specimens superimposed to emphasize the differences in the sexually differentiated fins. Figures 1 to 3 were traced from photographs.





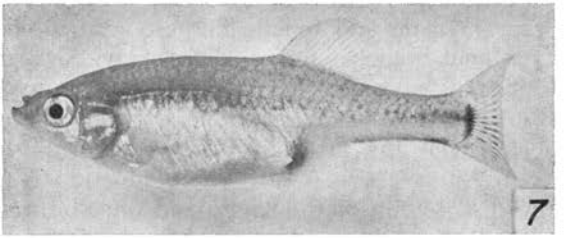


Figure 4. Mature field specimen of an *Ollentodon multipunctatus* male (73 mm), photographed after preservation. Note the collapsed dorsal fin.

Figure 5. Mature field specimen of an *Ollentodon multipunctatus* female (85 mm) photographed after preservation. Note the very short dorsal fin.

Figure 6. *Ollentodon multipunctatus* male (32 mm) photographed alive in the laboratory. Note the fully erected dorsal fin showing the unique structure of the anterior portion of the fin.

Figure 7. *Ollentodon multipunctatus* female (46 mm) photographed alive in the laboratory. The caudal fin is foreshortened due to movement of the fin at time of exposure. The laboratory-born-and-reared specimens do not attain the massiveness of the field specimens.

the female, although proportionate to body length, male rays of *Skiffia* are considerably smaller than corresponding rays in *Ollentodon* males. In contrast to *Ollentodon*, the anterior five rays of the fin in S. *lermae* are essentially equivalent in length in the two sexes.

Another aspect of size concerns the base length of the fin. Forty specimens of *Ollentodon*, 20 of each sex, were measured for this factor and the length was expressed as a percentage of the total length of the specimen. Average base length for the male fin for 20 specimens was 21.0% of the body length, whereas the female fin averaged 17.7%. Although the difference is not great, it is constant in the sexes.

As a final indication of the size of the dorsal fin in the two sexes, a measurement was made of the length of the dorsal fin in *Ollentodon* females from the base of the last ray to the extreme posterior edge of the dorsal fin. In all females, regardless of size (from 65-85 mm in length) the maximum length for this measurement was 7 mm. In some males of *Ollentodon* the dorsal fin is so long that it actually overlaps part of the caudal fin. In one such male specimen 65 mm long, the fin actually measured 12.5 mm from the base of the last ray to the extreme posterior edge.

Fin structure. First, ray counts in the dorsal fins of the three species agree with previously published reports (Hubbs and Turner, 1939, and others). S. *variegata* from Zirahuén and S. *lermae* from the Pátzcuaro area have the typical 13-14 rays and *O. multipunctatus* has 16-17 rays, whether collected in Camécuaro or Guadalajara. There is no marked difference in the internal structure of the fin in the two sexes of *Ollentodon* or *Skiffia*. Most fin rays in male and female fins are bifurcated twice to give four terminal branches for each basic ray. Also, many rays split once, forming an anterior and a posterior branch, then the posterior branch only splits again giving a total of three terminal branches. However, the first five rays are typically single or bifurcate only once. There is no clear distinction between the sexes in the distribution of the single and once-bifurcated rays. Because of the spine-like appearance of the first few rays in the male, one might expect special structural characteristics; none is evident. Despite this fact there is very clear photographic evidence that during swimming movements the first rays are more or less rigid and do not flex laterally as does the rest of the fin. The anterior rays of the male fin are often slightly curved and come to a point whereas the anterior rays of the female are straight, closely bound to adjacent rays, but still appear quite pointed though not protruding beyond the fin membrane.

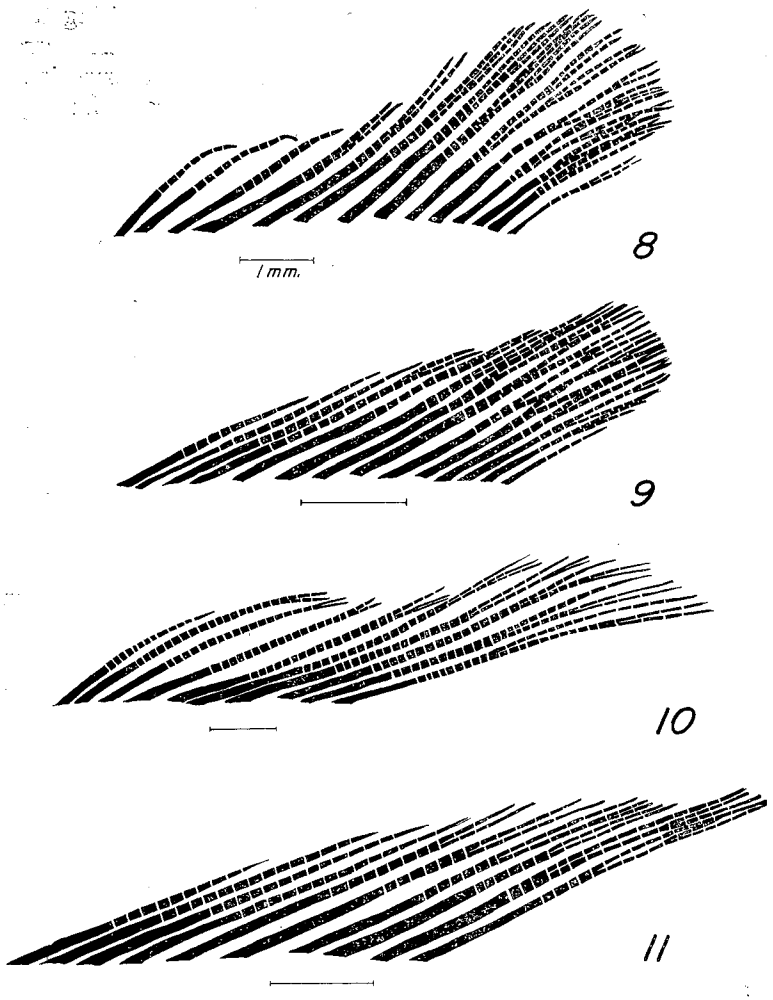


Figure 8. The rays in the complete dorsal fin of a *Skiwa lermae* male (63 mm). This and subsequent figures are tracings from projections of specimens stained with alizarin.

Figure 9. The rays in a complete dorsal fin of a *Skiwa lermae* female (63 mm)

Figure 10. The first ten rays of the dorsal fin of an *Ollentodon multipunctatus* male (63 mm).

Figure 11. The first ten rays of the dorsal fin of an *Ollentodon multipunctatus* female (69 mm).

Finally, using the *Ollentodon* and *Skiffia* specimens chosen randomly for the drawings in Figures 8-11, the thickness of the rays can be compared in the two sexes. Measurements of the actual rays with a micrometer ocular indicates that in both *Ollentodon* and *S. lermae,* rays in the male are clearly thicker

than corresponding rays in the female. It is not surprising that rays in the large *Ollentodon* females are thicker than corresponding rays in *S. lermae* females. However, it is surprising that, despite size differences, *S. lermae* males have fin rays essentially as thick as those of the larger species.

Discussion

The few sex differences in the dorsal fin, reported in the literature of the family Goodeidae, have been confined to minor differences. Hubbs and Turner (1939) single out slight sex differences in the placement of the dorsal fin in *Ollentodon, Skiffia, Girardinichthys, Balsadichthys* and others, more "expansive" fins in *Xenoophorus* males and color differences in *Ilyodon.* Meek (1904) further recognized that the anterior rays of the male dorsal fins of *Ollentodon* and *Skiffia* were shorter but he made no further mention of fin differences and his drawing of a male *S. lermae* (p.141) indicates that he did not fully understand the structure of the male dorsal fin.

The sexual dimorphism of the fin reported here for *Ollentodon* and both species of *Skiffia* is the most serious difference reported to date for the family. In a sense, this is a fitting complement to the highly specialized anal fin of the males in the family. Whereas the anal fin no doubt aids in insemination, the specialized dorsal fin probably is nonadaptive.

The fact that the characteristics of the male fin are found essentially in all males of *Ollentodon* and the two species of *Skiffia,* indicates that this is a genetic character in the two genera and not just a local regional variation of one species.

The presence of identical dorsal fins in *Ollentodon* and *Skiffia* accentuates further the similarity and close relationship of the two genera which are similar in other characteristics. It is futher logical to assume that *Skiffia* and *Ollentodon* had a common origin and that the genetic basis for the fin structure was established before *Ollentodon* and *Skiffia* evolved differences in size, ray counts and dentition.

It is interesting that embryological differentiation of the modified anal and dorsal fins of *Ollentodon* does not occur at the same time. In unpublished data obtained in our laboratory, it has been determined that the differentiation of the anal fin occurs clearly by the fourtieth day, or possibly earlier, while differentiation of the dorsal fin does not occur until about the sixtieth day.

Lastly, it is unlikely the unusal dorsal fin would have been noticed had living specimens not been available in the laboratory.

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The Antagonistic Effect of Strontium Ions for Anesthetization of *Paramecium caudatum* with Nickel Ions[1]

CLAIR G. RAUSCH

Abstract. The purpose of this investigation was (1) to compute the effects of strontium ion antagonism and the observed biological effect of the strontium ion for anestesia of *Paramecium caudatum* with the nickel ion, (2) to compare the prolonged effect of the strontium ion antagonism for nickel ions upon the vitality of *P. caudatum* for control groups using the fission rate as an index of vitality.

The experimental data showed a biological antagonism of the strontium ions for the nickel ions in anesthetization of *P. caudatum*. Further, the vitality study showed that the presence of strontium ions reduced the inhibitory effect of nickel ions for fission of *P. caudatum*.

The effects of salts of metals upon protozoans have been an object of investigation for many years. Studies made recently in the area of ion antagonism have been concerned with the disparity between the observed experimental results and the theoretically predicted results. Experimental evidence to show ion antagonism between the strontium and nickel ions has not been presented.

Review of the Literature

The action of various salts and salt antagonisms upon the ciliary action of *Paramecium caudatum* (Ehrenberg) has been

[1]Part of a thesis submitted in partial fulfillment for the Degree Master of Arts, Biology Department, Drake University, Des Moines, Iowa.