A CASE OF EXTREME CURVATURE OF REGENERATING FIN RAYS*

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Since the year 1890, there have been published in this country and abroad, in the neighborhood of twenty papers which have dealt with the subject of regeneration in the fins of fishes. Anyone wishing to look up these works may consult Birnie (1934) and Nabrit (1929, 1938) for references.

In studies by the writer, not yet published, on rate and completeness of regeneration of fins of sunfishes, one-half to three-fifths of the caudal fin was removed from between 75 and 100 specimens, and the regenerated tails were subsequently examined. While in two or three cases the regenerated tails differed slightly in shape from normal tails, the regenerated tail in one fish was decidedly different from all the rest.

The kinds of sunfishes used in these particular experiments included the bluegill *(Helioperca macrochira)*, the green sunfish *(Apomotis cyanellus)*, and some hybrids of which these two species were the parental types. The operation of shortening the tail was conducted by the following method. The specimen was etherized, then placed on a block of hard paraffin, and, with the tail spread naturally, a razor blade was used to make the cut. While tail fins from which about half the tissue was removed were eventually restored to almost their original proportions, there were certain details of pigmentation of the fin and structure of the rays which were found to be characteristic of regenerated fins.

These structural peculiarities may be enumerated as follows:

1. In species in which the tail fin contains much dark pigment, as in the bluegill and green sunfish, the regenerated portion of the fin allows more light to pass through it than the original basal portion, (Figs. 1 and 2), although, by reflected light, this difference in pigmentation is not so apparent.

2. Both in blue gills and in green sunfish, cutting off part of the fin causes the dark pigment to disappear from the cut ends of the rays in the tail stump. In the case of a fish that has just been operated on, this disappearance of pigment causes the cut edge to be light in color. Since the pigment may not be replaced for at least a year, the cut ends of the rays may show up conspicuously as a row of light dots just forward from the line of cut. These dots may be seen in Figures 1 and 2.

3. The regenerated rays may, in fact often do, bend slightly up or down from the point at which they join the old part of the fin, and may re-bend again, to produce a weak S-shaped fin ray.

4. Immediately posterior to the line of cut, the regenerated rays are sometimes noticeably thicker or thinner than the rays that were cut off.

5. The point of cut on the ray which later becomes the point of union between old and new ray material is usually not obliterated. There is, however, much more likelihood that this line will be obliterated in young than in old specimens. It may be noted that in the guppy, the point at which the rays were cut was difficult to find in certain individuals less than a month after the operations.

Figure 1 is typical of the appearance of a regenerated caudal fin from which about 50 per cent has been removed by a straight cut across the rays. The portion of the tail which photographed light is the regenerated tissue. It should be pointed out that the light source was behind the fin in making the photographs.

The case in which the regenerated tail was decidedly different from normally regenerated tails is shown in Figure 2. The two individuals represented in these figures were of the same experimental group. Both photographs were made

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from the live animals, thirteen months after the operations.

The animal represented in Figure 1 had a standard length of 111 mm., while the one in Figure 2 had a length of 130 mm.

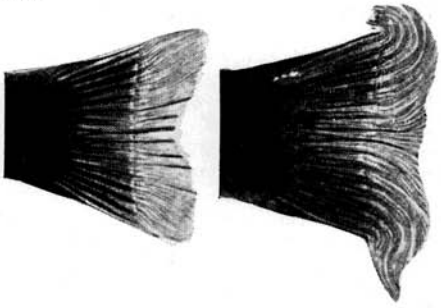

Fig. 1. Normal tail fin regeneration in a bluegill. Animal 126g. Standard length, 111 mm.; original tail length, 28 mm.; length of piece removed, 13 mm. Regenerated part distinctly lighter than stump. Photographed by transmitted light on the live animal 13 months after the operation. Dark streaks in the region of the notch were probably caused by folds in the webbing of the fin, and not by a difference in pigmentation. Date of operation—March 10, 1937.

Fig. 2. Abnormal fin regeneration in a bluegill. Animal 126j. Standard length, 130 mm.; original length of tail, 32 mm.; length of piece removed, 17 mm. Photographed by transmitted light on the live animal 13 months after the operation. Date of operation—March 10, 1937.

The development of the tail in Figure 2 may best be discussed from the standpoint of the growth of the rays. It will be noticed that all of the rays except one, at the upper margin, and another ray in the middle of the tail, show marked bending, upward or downward, in the regenerated portion. In the upper lobe of the fin, three rays make almost full 180 degree turns, and in the lower lobe, several rays are strongly S-shaped. The 180 degree bend in the upper lobe was not found in any other case among all the animals worked on. However, the strong S-shape bends in the rays of the lower lobe of Figure 2 were observed in one or two other experimental animals. Rather weak S-shape bends in the regenerated rays have been mentioned as of common occurrence. The sharp downward bend of the outer unbranched ray in the lower lobe has been observed in one fish caught recently from natural waters. This was a yellow perch which was taken at Chautauqua Lake, Havana, Illinois, in April, 1940.

Aside from the pronounced bending of the rays in the fin shown in figure 2, this individual showed the typical structural characteristics of regenerated fins listed above. No clue as to the cause of the bending of the rays has so far been found.

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BIBLIOGRAPHY

Birnie, James H. 1934. Regeneration of the tail fins of Fundulus embryos. Biol. Bull. 66: 316-325.

Hansen, Donald F. 1938. Studies on regeneration in the fins of fishes. Ph. D. thesis, University of Illinois.

Nabrit, S. Milton. 1929. The role of the fin rays in the regeneration of the tail-fins of fishes. Biol. Bull. 56: 235-266.

———— 1938. Regeneration in the tail fins of embryo fishes. Jour. Exp. Zool. 79: 299-308.