

Regeneration of Gills in Zygoptera Naiads¹

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In the summer of 1957, Zygoptera naiads were collected from a pond 8.3 miles north of Willis, Oklahoma. Dr. George H. Bick of Southwestern Louisiana Institute identified them as belonging to two species of damselflies, *Lestes disjunctus australis* and *Enallagma civile*.

Each naiad was placed and reared in a separate dish and supplied with food in the form of immature mayflies and midges. When a naiad molted, its exuvium was preserved in 65% alcohol. When emergence seemed near, a cage was placed over the dish until the adult had appeared and dried, then both the adult insect and its last exuvium were preserved. Whenever a naiad died, the body was preserved in alcohol.

Naiads normally have three gills at the end of the abdomen. Numerous control individuals in possession of all their gills were maintained. Some naiads were found at collection to have one or more gills missing, and these were distributed among three experimental groups, supplemented with specimens whose gills were clipped short or completely removed in the laboratory. The first experimental group was made up of insects with no gills at all, or with a stump of one or more gills remaining. The second group consisted of naiads with two gills partially or completely removed. The third group of naiads had one gill missing or represented by a stump.

Measurements of gill lengths were made daily for twelve consecutive days and at intervals thereafter, using micrometer eyepieces in a binocular microscope. Slight difficulty was experienced in the measurement of gills because they were not always held at the same angle.

A first series of specimens was collected June 27 and distributed as described above. Most of these proved to be in their last instar. A second series of younger and smaller specimens was then collected on July 11, and of these, eleven experimental individuals were followed through one or more nymphal molts. In the second series, measurements were made not only of the gills, but also of the lengths of the head, wing pads, and last four abdominal segments. Altogether, thirteen experimental individuals were followed through a total of seventeen molts into later immature instars, then until their emergence or death.

Of the controls, which possessed all their gills, both *E. civile* and *L. d. australis* survived and emerged. In the experimental groups, *E. civile* adults emerged from all degrees of mutilation, including one naiad which was collected in its last instar with no gills at all. *L. d. australis* adults appeared less hardy, and all mutilated specimens died before emergence, although one lived for thirty days and molted once. It was concluded that lack of gills may impair the ability of a naiad to survive until emergence, but gills are not absolutely needed for respiratory exchange. This is in agreement with Pennak and McColl (1954) who found low mortality in damselflies from which gills had been removed. Bodine (1912) considered the gills chiefly useful in locomotion.

Only doubtful growth of gills was apparent between molts, the small variations which were observed being so slight that they may have been due to changes in the angle of carriage. After a molt, the increased length of the gill was immediately apparent, and did not change significantly until another molt had been completed.

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The rate of regeneration of gill length varied widely from one individual to another, and there was even variance between gills of the same individual. In general, it was found that much more regeneration of gill substance was made when the starting point was zero, that is, complete absence, than when regeneration commenced with a stump of a gill remaining. The rate of growth was greater from a small initial than from a large one.

LITERATURE CITED

- Bodine, J. H. 1918. Rectal respiration, Odonata. Proc. Acad. Nat. Sci. Philadelphia 70: 103-113.
- Pennak, R. W., and C. M. McColl. 1944. Oxygen consumption, damselfly naiads. Jour. Cellular and Comp. Physiol. 23: 1-10.
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