

melanophores in the first pelvic interrarial membrane and no melanophores on the following interrarial membranes. The fin pigment index for this hypothetical specimen would be  $3+1=4$ . In addition to this index, subjective features such as intensity and pattern of fin pigmentation are also significant but are not expressed quantitatively.

Fin pigment differences within the *roseipinnis* complex are determined genetically. Nevertheless, it is evident that melanophore concentrations vary phenotypically in response to some environmental factors. For example, pigment usually is better developed in specimens from dark-stained water. To compensate for the variation introduced by ecological differences, large samples of breeding specimens from many different collecting sites within each drainage were studied. To elucidate patterns of ontogenetic change in the fin pigmentation index, regression analyses were performed, considering the total fin pigment index as the dependent variable and standard length as the independent variable.

**BREEDING COLORATION.**—Two major difficulties in treating breeding coloration objectively in *Notropis* are: (1) color is developed best in breeding males, and the intensity, quality, and pattern of coloration may vary according to the state of sexual ripeness; and (2) coloration may be influenced by environmental conditions. Despite these drawbacks, breeding coloration has proved useful in several investigations of *Notropis* (e.g., Gibbs, 1957a; Gilbert, 1964; Snelson, 1968).

In *Lythrurus* coloration was helpful in separating *N. fumeus*, which has yellow pigment limited to the rays of the fins. With the exception of *N. lirus*, the remaining species are characterized by having red pigment developed primarily on the interrarial membranes of fins and in varying amounts on the head and body. *N. lirus* apparently develops weak, ephemeral coloration ranging from yellow or gold through pink or red.

**BREEDING TUBERCULATION.**—In recent years considerable emphasis has been placed on tuberculation as a systematic character, not only in cyprinids but in other groups as well (e.g., Vladykov, 1963, for Salmonidae; Collette, 1965, for Percidae; and Huntsman, 1967, for Catostomidae). The evaluation and practical use of tuberculation characters are complicated by several factors. First, tubercles are usually found only in, or are best developed in, adult males captured during the breeding season. Only a few large cyprinids (e.g., *Nocomis*, Lachner and Jenkins, 1971) have tubercle "spots" evident in both sexes throughout the year. A number of series must be surveyed to assure that maximum tubercle development has been observed. Koehn (1965) documented the developmental sequence of tuberculation for *Notropis lutrensis* (Baird and Girard) and showed that patterns differ according to the state of sexual