Methods of Distinguishing Larval Alewife From Larval Blueback Herring

JAMES R. CHAMBERS, 1 J. A. MUSICK, AND JACKSON DAVIS
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

ABSTRACT: Larval Alosa pseudoharengus may be distinguished from larval A. aestivalis by differences in the relative termination of the vent. The number of myomeres between the insertion of the dorsal fin and the vent is diagnostic. The mean number is 8.0 in A. pseudoharengus and 11.8 in A. aestivalis. Also of use in distinguishing between larvae of the two species are the number of preanal myomeres, the regression of the distance from snout to vent on standard length, the regression of the distance from vent to tail on standard length. Methods of distinguishing larval A. pseudoharengus and A. aestivalis from commonly associated species in the Chesapeake Bay region are discussed.

Introduction
Methods have not been available for distinguishing larval alewife (Alosa pseudoharengus) from larval blueback herring (A. aestivalis), sympatric species over much of their ranges (Bigelow and Schroeder 1953), and both abundant in the estuaries of Chesapeake Bay. Identification of larvae from this area is complicated by the presence of American shad (A. sapidissima), hickory shad (A. mediocris), gizzard shad (Dorosoma cepedianum), menhaden (Brevoortia tyrannus) and bay anchovy (Anchoa mitchilli). Descriptions and illustrations of the yolk-sac larvae of alewives and bluebacks have been published (Kuntz and Radcliffe 1918; Hilgenbrand 1963; Mansueti and Hardy 1967). However, bluebacks between 5.2 and 20.5 mm TL, and alewives between 5.3 and 15 mm are undescribed. Moreover, the illustrations and alewives 15 and 16.5 mm (Prince 1907) are inadequate. This paper describes criteria for distinguishing larval alewife from larval blueback.

Materials and Methods
Larval clupeids were examined from 306 plankton samples collected from 23 April to 8 August 1967 in the Pamunkey (samples A6, B4), Mattaponi (A3) and Rappahannock (A3, A4, B2, B4) rivers in Virginia, and in the Potomac River (A1, A2, B1) in Maryland. Specimens were preserved in 5% buffered formalin and measured to the nearest 0.01 mm under a dissecting microscope with an ocular micrometer. Illustrations were made with the aid of a camera lucida. Terminology of life history stages follows that recommended by Ahlstrom and Ball (1954); methods of counting myomeres and measuring specimens adhere to procedures outlined by Mansueti and Hardy (1967). Length refers to standard length (SL) unless specified otherwise. Standard length is the distance from the snout to the posterior tip of the notochord before flexion and to the posterior tip of the urostyle after flexion. Notochord flexion occurs at about 9 mm (SL) in both alewife and blueback herring. Six samples of alewives (A1–A6), including 133 specimens, and four samples of blueback (B1–B4), including 125 specimens, were examined. Both species exhibited allometric growth. Consequently, data for larvae less than or equal to 12.0 mm (A1, A3, A5, A6, B1, B2, B4) were compared only with each other as were the data for larger specimens (A2, A4, B3).

Alevine and blueback are the predominant clupeid species found in tidal fresh water of the estuaries sampled. Alevines precede bluebacks on their spawning runs into fresh water.

1 Present address: U.S. Army Corps of Engineers, Lower Mississippi Valley Division, Vicksburg, Mississippi 39180.
by four to five weeks. Preliminary comparison of larvae collected throughout the spawning season indicated the presence of two similar but morphologically distinct groups. The first group, obtained early in the season, was tentatively identified as alewife, and the second group, appearing in collections late in the season, was designated blueback. Hatching larvae, collected in areas where gill nets caught only adult alewives, were morphologically similar to the early-spawned group. Yolk-sac larvae having the same morphology as the late-spawned group were obtained late in the season in areas where only bluebacks were known to be spawning. These findings support the identification of the first group as alewife and the second as blueback. Specimens from samples containing both types of larvae were identified by their morphological similarity to one of the two groups. Other species appearing in the collections (notably American shad and bay anchovy) were distinguished by criteria discussed later.

The number of complete myomeres was counted between imaginary vertical lines drawn at the termination of the posterior ray of the dorsal fin (or insertion of the dorsal fin anlage) and at the posterior margin of the vent. Fifty specimens of each species were used in the analysis. The range in standard length was 5.8 to 16.2 mm for alewives and 6.5 to 13.3 mm for bluebacks.

Two meristic characters, the number of preanal myomeres and the number of myomeres between the cleithrum and the vent, were subjected to an analysis of variance (Snedecor 1956). Since this test indicated significant mean difference (1% level), Duncan's Multiple Range Test (Duncan 1957) was conducted to group those samples whose means were not significantly different (1% level). Of 245 larvae used for morphometric analysis, 90 alewives and 62 bluebacks were suitable for meristic comparison. Specimens less than 5.7 mm long were excluded from the analysis because their anterior myosepta were poorly differentiated and one or more myomeres were liable to be missed in counting. Also excluded were 22 poorly preserved alewives (Sample A4) whose myomeres could not be counted accurately.

Regressions of the following measurements on standard length were computed: distance from the snout to the posterior margin of the vent, distance from the posterior margin of the vent to the posterior margin of hypural, and distance from the posterior margin of the vent to the posterior margin of the tail. All values were transformed to logarithms to reduce the correlation between the variance and the mean (Mottley 1951). Each sample was tested against each of the others by analysis of covariance (Snedecor 1956). After the significance level of intraspecific variation was determined, interspecific comparisons were made. These tests were conducted for individual samples and combined samples containing larvae of comparable length.

The following morphometric characters are unsuitable for diagnostic use because of their high intraspecific variability: distance between snout and cleithrum, distance between snout and origin of dorsal fin, head length, head width, head depth, snout length, eye diameter, body depth at cleithrum, and body depth at dorsal fin. Meristic characters unsuitable for discrimination between the two species are: total, post-anal, and predorsal myomeres; and the number of rays in the dorsal and anal fins of specimens of comparable lengths.

**Results**

The number of myomeres between the insertion of the dorsal fin and the posterior margin of the vent is 7 to 9 ($\bar{x} = 8.0$) for alewives and 11 to 13 ($\bar{x} = 11.8$) for bluebacks. The variation in number is not correlated with differences in specimen size.

The number of preanal myomeres and the number of myomeres between the cleithrum and the vent provide additional means of distinguishing alewives from bluebacks. Table 1 lists the range and mean number of myomeres for bluebacks and alewives (also American shad) at one mm size intervals. A decline in number of myomeres is evident at 14 mm for both alewives and bluebacks, a result of the forward migration of the vent as body depth increased prior to transformation. No decline in number of myomeres is evident for the shad examined (mode 48, $\bar{x} = 47.6 \pm 0.5 S_{x}$).

Analysis of variance indicates significant differences in the mean number of myomeres