

TECHNIQUES AND APPROACHES

Early Life History Descriptions

E. M. SANDKNOP, B. Y. SUMIDA AND H. G. MOSER

FISHERIES studies require accurate identification of subject species. Identification of the developmental stages of fishes is complicated by the small size of the specimens, their fragility, and the relatively great changes in their structure and pigmentation. Experience has shown that major changes can occur over very small growth increments and these can only be documented by a continuous growth series. Published descriptions of developmental series vary in quality, perhaps more than do species descriptions of adults. Prior to Bertelsen (1951) and Ahlstrom and Ball (1954), most published descriptions were based on relatively few specimens, which were described individually. In their study of the early life history stages of the jack mackerel (*Trachurus symmetricus*), Ahlstrom and Ball (1954) used over 500 eggs and a series of about 250 larvae, transforming specimens, and juveniles to describe development. Changes in structure and pigmentation were thus described as a dynamic continuum, with emphasis on variation, in contrast to the approach of most previous workers. Developmental osteology was considered an integral part of the description as were seasonal and geographic distributions of eggs and larvae. This paper was followed by several others (Ahlstrom and Counts, 1955, 1958; Uchida et al., 1958; Kramer, 1960) and these became models for subsequent descriptive papers, including some which treated several species in various taxonomic groups (Moser and Ahlstrom, 1970; Ahlstrom, 1974; Ahlstrom et al., 1976; Moser et al., 1977; Kendall, 1979; Brownell, 1979; Richardson and Washington, 1980; Fahay, 1983; Leis and Rennis, 1983). The following is a brief account of the elements involved in preparing early life history accounts of teleosts.

SOURCES

The major source of material is plankton collections. Typical survey tows strain a column of water 200 m to the surface and sample eggs and subsequent larval stages of a major portion of the fish fauna (Smith and Richardson, 1977). Fishes which have highly stratified vertical distributions are undersampled by oblique tows and require special gear or tow strategies. For example, surface dwellers can be sampled by neuston nets (Zaitsev, 1970; Nellen and Hempel, 1970; Hempel and Weikert, 1972; Nellen, 1973a; Ahlstrom and Stevens, 1976) and those species residing near the bottom may be sampled by epi-benthic plankton nets (Schlotterbeck and Connally, 1982). Larger larvae and transforming stages are poorly sampled by typical survey tows principally because of accumulated mortality, increased avoidance capacity, and migration out of the sampling zone. These stages are more effectively sampled by trawls (Tranter, 1968), dip-netting with attractor lights (Klawe, 1960), light traps (Faber, 1982), and fish predators (Haedrich and Nielsen, 1966). Recently, scuba divers have collected oceanic larvae with their delicate structures intact (Harbison et al., 1978; Govoni et al., 1984). Developmental series may also be obtained by rearing

larvae from eggs collected at sea or from captive brood stock (Houde et al., 1970, 1974; Houde and Swanson, 1975; Richards et al., 1974; Houde and Potthoff, 1976; Moser and Butler, 1981). This method becomes essential when working with speciose faunas (e.g., *Sebastes*, warm water shorefishes), if only to determine which species cannot be identified.

USE OF SPECIMENS

The characters and techniques used in identifying developmental stages are discussed elsewhere in this volume (see Kendall et al.; Matarese and Sandknop; Powles and Markle). From the continuous developmental series two subseries are assembled and these form the basis for the description. The first series is used to describe morphology and pigmentation. Specimens in the second series are cleared and stained by a variety of techniques to describe the development of cartilaginous and osseous features (Potthoff, this volume).

The number of specimens used to construct these series is dependent on several factors: 1) specimen availability, 2) length (duration) of the development period, and 3) complexity of developmental change. A guideline is that there should be enough specimens to demonstrate the beginning, progression and completion of significant developmental changes in morphology and pigmentation. Usually more specimens are required for species which have extended larval periods; however, many fishes which transform at small sizes undergo great change over small length intervals. For example, lined sole (*Achirus lineatus*) hatch at 1.6 mm, transform at about 4.0 mm, and complete a large suite of developmental changes over a 2.5 mm length interval (Houde et al., 1970). The majority of marine teleosts transform between 10 and 30 mm and, for these, major developmental events can be documented by specimen length increments of 0.5–1.0 mm. Multiple samples representing 1 mm-intervals are required to study fine-scale character variation; however, such studies have rarely been done (Ahlstrom and Moser, 1981).

A table of morphometric measurements constructed from the unstained series provides data on the size at important developmental milestones (e.g., hatching, notochord flexion, fin formation, transformation) and provides a basis for analyzing structural change and allometric growth. These specimens can be used to construct character matrices of complex or diagnostic pigment changes. Illustration specimens chosen from the series provide an integrated view of major characters and also, if accurately executed, are themselves morphometric and meristic documents (Sumida et al., this volume).

The stained series is used to construct a meristic table that forms the basis for following the development of fin rays and supporting elements, the axial skeleton and cranial bones (Dunn, this volume). Fine bony structures, such as cranial spines are also apparent in these preparations.

Published descriptions employing these basic elements are

the basis for ontogenetic studies of fishes. These are essential for the identification of ichthyoplankton collections, and also present characters for systematic analysis. Data provided in

these descriptions have proved useful in studies of the physiology, behavior and ecology of the early stages of fishes.

NATIONAL MARINE FISHERIES SERVICE, SOUTHWEST FISHERIES CENTER, P.O. BOX 271, LA JOLLA, CALIFORNIA 92038.