

Skeletal variation in shortnose sturgeon (*Acipenser brevirostrum*) from the Connecticut River: Implications for comparative osteological studies of fossil and living fishes

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Abstract

To better understand an extreme case of individual skeletal variation, we examined in detail a new collection of thirteen shortnose sturgeon (*Acipenser brevirostrum*) from a single, well-characterized population in the Connecticut River of western Massachusetts. We discovered and analyzed four types of variation: 1) lateral line and anamestic ossifications of the dermal skull roof; 2) development of scutes; 3) chondral ossifications in the scapulocoracoid; and 4) chondral ossifications in the neurocranium. Variation within the skull roof is extreme, even more than that of other non-teleostean actinopterygians studied to date. Each individual in our sample displays a unique pattern of ossification in the skull roof. Scute formation is variable, with some individuals possessing poorly developed or incomplete scutes. However, the number of individuals with such extreme variation in scute morphology was small relative to the number showing other forms of skeletal variation. The degree of ossification of the scapulocoracoid differs, even between animals of similar fork-length and estimated ages. Some right-left differences in scapulocoracoid ossifications also occur. The number of discrete ossification centers within the neurocranium also varies greatly and is not correlated with size or age. This study offers several insights for studies of fossil and living fishes. First, it illustrates an extreme example of individual skeletal variation. Second, it shows how little is known about the regulatory mechanisms that control patterns of chondral and dermal ossification during the ontogeny of an individual. Third, it indicates potential problem areas in determining the homologies of skeletal elements. These insights suggest caution in the interpretation of small samples in comparative and descriptive osteological studies, both of fossil and living fishes.

Introduction

Individual variation may be defined as variation between individuals of the same species at similar stages of development. This differs from other types of intraspecific variation, such as ontogenetic or gender variation, because the variation is not predictable based on sex, size, age, or degree of development. This sort of variation can greatly complicate comparative and systematic studies of both fossil and living vertebrates. Individual skeletal variation within species of extant vertebrates has often been noted (e.g., variable pelvic elements of sticklebacks, NELSON 1971; cranial roofing bones of plethodontid salamanders, HANKEN 1984; vertebral number in sticklebacks, REIMCHEN & NELSON 1987; skulls of tamarin monkeys, HUTCHISON & CHEVERUD 1995). In a particularly famous study, HUBBS & HUBBS (1945) described bilateral variation in such skeletal structures as paired fin rays and branchiostegals for several species of fishes. Much of the focus on individual skeletal variation emphasizes morphometric or meristic features, differing from the discrete (i.e., presence or absence of a particular structure) features discussed in the present study.

HANKEN & HALL (1993) described three forms of intraspecific variation: gross malformation, epigenetic polymorphism, and trophic polymorphism. Gross malformations include deformities that are far outside the typical pattern of a species' skeletal structure, such as cycloopia. Epigenetic polymorphisms

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