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Body shape changes during the early development of the Beluga (*Huso huso*)

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Abstract: Early body shape changes of beluga sturgeon were studied using landmark-based geometric morphometric approach to recognize its allometric growth pattern. Sampling was done from hatching up to 50 days post hatching (DPH). Left side of specimens were photographed using digital camera and nine landmark points were digitized on two-dimensional images. Total length (TI) was measured using the software ImageJ. To study of the body shape changes during early development, the mean procrustes distance between all specimens of same age, for all age groups, was calculated. The scores of relative warp analysis (RW) were used as descriptors for the variation in shape. RW analysis revealed a sharp body shape change during early ontogeny on 18 DPH. Growth trajectory was computed by plotting RW against TL. The inflection point of body shape corresponds to a TL of 23.3 mm (18 DPH). Results showed that ontogenetic shape changes encompassed a pre-inflection shape changes, which included the elongation of the head and tail regions i.e. positive allometric growth pattern and post-inflection shape changes, with a nearly isometric growth pattern.

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Introduction

The early development of fish larvae is accompanied with very complex shape changes. Different growth rates of various parts of the body or allometric growth is a common phenomenon during this period (Osse and van den Boogaart, 1995). During the early development, changes in body shape are related to the functions of different organs such as respiration, feeding and swimming (Simonovic et al., 1999; Russo et al., 2007). Recognition of morphogenesis process and growth pattern of fishes may lead to better understanding of biological priorities during the early developmental stages and gives insights into biological, behavioral and ecological characteristics (Gisbert, 1999).

Many studied have been carried out on change of the body shape during the early ontogeny of various fishes using traditional morphometric approaches but recently, geometric morphometric techniques have been applied (Bookstein, 1991; Rohlf, 1998; Zelditch et al., 2004). Geometric morphometric methods are useful tools in developmental biology to extract shapes data and analyze using multivariate statistical tests, explaining how morphological structures are generated (Zelditch et al., 2004). Hence, this study was conducted to study the changes of the body shape in Beluga sturgeon (Huso huso) using landmark-based a geometric morphometric method covering a period from hatching up to 50 days post hatch (DPH) that is synchronized with the transition of larvae from internal to external feeding.

Material and methods

Specimens were obtained from the Dadman International Sturgeon Research Institute (Guilan, Iran). Newly hatched larvae were stored in 500 L fiberglass tanks with a water depth of 20 cm and

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