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Original article

Determination of larval development stages in beluga (*Huso huso* Linnaeus, 1758)

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ABSTRACT

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The study of egg and larvae stages in fishes is one of new fields in Ichthyology. There are many changes in larvae stage and the study of fish bio-history can provide some information about the changes of this stage to us. In this study, the larvae development stages on 44 samples of Bluga larvae investigated based on the morphological observations, the pigments scattering pattern and fins development patterns. From the viewpoint of pigments pattern, the highest pigments were concentrated on the rear of head and between eyes and the lowest was on fins bud, the tip of snout and under of lateral line of body. The morphological observations in larvae stage indicated that larvae in early stage has different shape than its puberty and its appearance will change in parallel to its development during the time, so that at the end of this stage it is so like an adult fish. In same performed researches on larvae of other sturgeon species, there are relative similarity based on pigment scattering pattern but there are significant differences in morphological observation and also the pattern of fins development.

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1. Introduction

Our knowledge about fish biology is incomplete without information about larvae biologic history (Rabbaniha, 2007). Studying biologic history of fish provides information on different status and reactions of fish larvae in the early stages of life. This general description indicates anatomic, physiologic, behavioural, and ecologic changes during fish development (Helfman et al., 2005). Larval stage commence from roe hatching or yolk sac reduction to evolution of fin rays, countable plates, and elimination of larval traits. Various applications have been considered for larval studies of which fish systematics (Helfman et al., 2005), fisheries stock assessment (Urho, 1996) and fish population dynamics (Rabbaniha, 2007) can be mentioned. Jafari et al. (2009) studied larvae stages in Caspian kutum (*Rutilus frisii kutum*) in terms of morphologic characteristics. They divided larvae stage into 3 sections and 18 subsections and described morphologic traits of the larva. Their results showed that the highest variations occur during changing from internal feeding to external feeding. In a study on fetus and larvae stages in Asian stinging catfish (*Heteropneustes fossilis*), Puansuari et al. (2009) found results about roes hatching time, onset of larvae period, end of this period, and variations in these stages. Gisberi et al. (2002) investigated morphologic changes and larvae growth pattern in halibut (*Hippoglossus hippoglossus*). Their results pointed to the highest transformations during larvae internal feeding, early, and mid larvae period, such as evolution of sensory receptors, evolution of digestive system, respiration, and progress in swimming.

Sturgeons are one of the oldest and most valuable species in Caspian Sea. Beluga (*Huso huso* Linnaeus, 1758) is the largest sturgeon in Caspian Sea which is of a great interest due to fast growth and bearing adverse environmental status. On the other hand, it is very important owing to caviar production (Bahmani, 2005). However, the species has been recently brought in to endangered species list due to increased overfishing rate for this species and environmental pollutions. Considering high value of this species and necessity of attention to preservation and management of its stocks, the present study aimed at determination of larval stages development in Beluga.

2. Materials and methods

Beluga larvae were purchased from Rainbow Trout Breeding and Farming Center of Gorgan (longitude: 53° 45' 45.32"; latitude: 36° 49' 26.35") in 2012. The larvae were kept in 42.5×42.5×20 m troughs at 8.5°C. They were fixated in formalin 4% in different sizes and were transferred to lab for biometry. Biometry was performed on 44 larvae by use of micrometer M6C-10-equipped loop with accuracy of 0.5 mm as well as a caliper. Imaging, also, was executed by means of a SZX12 loop (micron-measured). The pattern proposed by Nikolsky (1963) was adopted in order to determine larvae period. The pattern determines larvae period from yolk sac reduction to evolution of fin rays, countable plates, and elimination of larval traits. Furthermore, to achieve a better insight into this period, pigment pattern (form and distribution), morphologic observations (morphologic variations during larval period), and fin development pattern (fins formation time and process) were determined.

3. Results

3.1. Pigment pattern

Pigments were seen in the whole period in on dorsal and lateral areas of body while ventral area lacked pigments. The pigments are melanophores. In the early stages after yolk sac reduction, pigments are mostly distributed in dorsal areas of body, back of head, between eyes, on nose, and on the back of operculum to the beginning of caudal fin bud with the highest distribution being on back of head. Furthermore, pigments are seen on skin wrinkles caused by yolk sac reduction. Fin buds lack pigment in this stage. Pigments gradually distribute from dorsal areas to lateral areas of body which shows pigments development from frontal areas of body sides toward the caudal part of body. No pigment distribution was seen on dorsal, lateral, and pectoral scutes while it was detected on the base of and between the scutes (except for ventral scute) in the whole period. As larvae grow, pigments appear on fins; the highest pigment distribution was detected on caudal, pectoral, and dorsal fins, respectively. During the whole period, ventral fin lacks pigment. In the beginning of this period, larvae body is yellowish black and it gets darker with more melanophores as larvae grow; nonetheless, in Persian sturgeon (*Acipenser persicus*), although pigment distribution increases as larvae grow, larvae body is black from the onset of larval period (Yousefian et al., 2010). In a nutshell, the highest accumulation of pigment in larval development of

Beluga is on back of head, on operculum, between eyes, and lateral areas of body (above lateral line) while the least accumulation of pigments seem to be on fins, nose, and under lateral line.



Fig. 1. Depicts larval development stages in Beluga larvae.

3.2. Morphological observations

In the beginning of the period, larvae body was long and slender with impacted head from up to down; as larvae grow, the end of body becomes compacted; on the contrary, in white sturgeon (*Acipenser transmontanus*), back of head in the first days of larval period is very wide and broad while it gradually becomes narrower as larvae grow (McCabe & Tra, 1994). In the first days after yolk sac reduction, operculum is thin and tender while it gradually gets thicker. This thickening is so clear that morphologic observations may find distinct differences in larvae head width in different times of larval period. In the beginning of the period, scute buds are formed. The buds grow with larvae growth and they can be counted and they reach 14 buds which is an indicative of

completion of larval period. Lateral scute buds are lacking in the first stages while the buds can be seen as larvae grow; this can also be detected in Atlantic sturgeon (*Acipenser oxyrinchus*) (Avil et al., 1984). The buds grow very slowly so that lateral scute buds grow very little in the size 44 mm when there are 11 dorsal scutes and unlike dorsal scutes, they cannot be counted. This is the case until the size 56 mm when there are 14 dorsal scutes; finally, lateral scutes can be macroscopically counted in the size 63 mm. Larvae nose is very low and lunate and it gradually becomes triangular; in the final stages, the nose will be sharp which is also seen in white sturgeon and Atlantic sturgeon larvae. Larvae mouth is inferior from the beginning of yolk sac reduction and it is the case until the end. However, larvae mouth is semicircular in the first stages and it turns to be lunate at the final stages.

3.3. Fin development pattern

Pectoral, dorsal, caudal, and ventral fin buds are seen from the beginning of larval period. The highest area is for pectoral, dorsal, and ventral fins, respectively while at the end of the period, it is pectoral, caudal, dorsal, and ventral fins, respectively which is an indicative of high growth rate of caudal fin. Dorsal fin growth rate is very slow during the period so that it enlarges from 6 mm in the primary size to 13 mm in the final size. Like dorsal fin, ventral fin growth rate is slow (on the basis of morphologic observations). Pectoral fins are deviated upward with 20-30° from body in the primary sizes while it increases to 45° in the final stages.

4. Conclusion

The latest data published in 2012 by the biggest Breeding and Farming Center for Sturgeons in Guilan Province indicates extinction of Beluga in the south of Caspian Sea. Therefore, the species should be under more breeding operations in order to preserve its stocks. For this, information on biologic history of the fish will be very helpful.

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