Interrelationships among Egg, Larvae and Maternal Characteristics in Persian Sturgeon *Acipenser persicus*

Rajab Mohammad Nazari[1]**, Mohammad Reza Ghomi**[2*] **and Laura Aquiloni**[3]
[1]*Rajaei Sturgeon Fish Farm; Sari - Iran.* [2]*Department of Fisheries Sciences; Islamic Azad University - Tonekabon Branch; 46817; Tonekabon - Iran.* [3] *Department of Evolutionary Biology; University of Florence; Italy*

ABSTRACT

This study was aimed to observe the correlations among egg, larvae and maternal characteristics of Persian sturgeon. A total of 41 females were used and the variables including fertilization rate, incubation survival rate, larvae survival rate during yolk sac absorption (before feeding), and larvae survival rate after first feeding were determined. As a result, fertilization rate was positively correlated with three variables: incubation survival, larvae survival during yolk sac absorption, and GSI (gonadosomatic index). Also, maternal size (age, weight, total length) did not show a significant relation (P > 0.05) with incubation survival, larvae survival during yolk sac absorption and larvae survival at first feeding stage.

Key words: Egg, Interrelationship, Larvae, Maternal characteristics, and Persian sturgeon

INTRODUCTION

Several species of sturgeon have become endangered due to the damages of their natural spawning environments and elevation of international trade in caviar. For increasing the survival rate at different stages of these fishes, it is necessary to study the potential factors affecting the growth and survival rate of incubating eggs, larvae and other larger stages (Nazari et al., 2009). Artificial reproduction of sturgeons for restocking of Caspian sea extremely increased during last decades in Iran, however, stocks of sturgeons has been decreased dramatically (Ronyai and Varadi, 1995). The total sturgeon catches and caviar production in Iran in 1993 was 1710 and 106 t, while in 2006 it decreased to 330 and 31.3 t, respectively (IFO, 2007).
Sturgeon fingerling production is considered to be one of the most difficult phases of hatchery rearing (Gisbert et al., 2000). As a result, substantial

efforts were focused on the early life development stages of this group of fishes in order to understand how to increase their survivorship and improve hatchery efficiency (Gisbert et al., 2000). The objective of this work was to study the correlations among egg, larvae and maternal characteristics of Persian sturgeon.

MATERIALS AND METHODS

In this study, 41 female Persian sturgeon were captured at the end of winter from south-east of Caspian sea and transported to Rajaei sturgeon fish farm (Sari, Iran). A group of males breeder was captured during reproduction season (spring) and all broodstocks of both sexes were maintained in several separate circular tanks (8 m diameter, 1 m depth, 50 m^3 volume). They were injected intramuscularly with acetone-dried sturgeon pituitary at water temperature in the range of 17-

---
* Author for correspondence: mghomi@tonekabon.iau.ac.ir

20 ˚C (45-50 mg for female and 35 mg for male). These broods showed the polarization index (PI) less than 7% (Dettlaff et al., 1993). For measuring GV (germinal vesicle) position by polarization index (PI), a sample of 15-20 eggs for each female were boiled for 2 minutes and were cut along their animal-vegetal poles axis and observed under a dissection microscope with a micrometer eyepiece. The oocyte polarization index (PI) for GV position was calculated by the formula PI = a/A × 100, in which a: distance between GV and cell membrane, and A: diameter of oocyte along animal-vegetal axis (Dettlaff et al. 1993).

During the study, the variables including fertilization rate, incubation survival rate, larvae survival rate during yolk sac absorption (before feeding), and larvae survival rate after first feeding were determined. Female's ripening was examined according to Dettlaff et al. (1993) regarding mainly to water temperature and observed every hour after first examination. Before each insemination, the excess of coelomic fluid was removed by pouring the eggs onto a screen suspended over a beaker. The eggs were then inseminated with milt and after eliminating eggs adhesiveness, eggs were placed in Yushchenko incubators in running freshwater system at 17-20 ºC and in the presence of dissolved oxygen more than 6 ppm.

Three hours after fertilization at 17-20 ˚C, 100 eggs were randomly removed and preserved in formalin 10% solution. In order to calculate the fertilization rate, monospermic percentage was considered only for the eggs containing four cells (Dettlaff et al., 1993). Also, the amount of larvae (for measuring the incubation survival) and malformed larvae were measured after 4 days incubation period in incubators and dead eggs were counted daily.

Gonadosomatic index (GSI) was calculated for each gonadal stage using the formula $GSI = Wg/W \times 10^2$, where Wg: gonad weight, W: fish weight. In order to measure the survival of larvae during yolk-sac absorption period, 300 larvae were randomly sampled from each female (at the middle of hatching time) and reared separately in a small plastic tank (20 l volume) with having running water (0.5 l min^{-1}). In every morning the excreted materials were discharged by siphoning and the mortality rate for every tank was recorded. At the beginning of the exogenous feeding, larvae were fed *Artemia* nauplii six times per day at the rate of 30% body weight per day and reared for two days for measuring the survival rate during this final stage. The distribution of the data was tested for normality using the Kolmogorov–Smirnov test. Correlations between the variables were established by Pearson's coefficient for linear correlation (r) at $P < 0.05$ by SPSS 16.

RESULTS AND DISCUSSION

Descriptive data (range, mean and standard deviation) for egg, larvae and maternal characteristics in Persian sturgeon are shown in Table 1 and the interrelationships among them have been presented in Table 2. As shown in Table 2, fertilization rate was positively correlated with three variables: incubation survival (r = 0.82, $P <$ 0.01), larvae survival during yolk sac absorption (r = 0.61, $P < 0.01$) and GSI (gonadosomatic index) (r = 0.36, $P < 0.05$).

Table 1 - Characteristics of female, egg, hatching and larvae stages in Persian sturgeon.

Variables	*n*	Range	Mean	SD
Fertilization rate (%)	41	3.00-93.20	63.96	31.27
PI for GV (%)	41	5.20-7.80	6.60	0.72
Incubation survival (%)	32	0-99.50	49.38	40.14
Larvae survival (I) (%)	27	70.00-95.60	86.84	6.83
Larvae survival (II) (%)	24	74.10-97.40	90.55	5.87
GSI (%)	33	17.2-33.1	24.69	3.56
Female weight (kg)	31	18.65-43.19	30.18	5.77
Female total length (cm)	31	152.0-194.0	175.00	9.82
Female age (year)	31	15.00-23.00	17.90	2.18

Table 2 - Pearson's correlation (*r*) among maternal and larvae and egg characteristics in Persian sturgeon.

Variables	Fertilization rate	PI for GV	Incubation survival	Larvae survival (I)[a]	Larvae survival (II)[b]	GSI
Fertilization rate	1	-0.2	0.82**	0.61**	-0.13	0.36*
PI for GV		1	-0.06	-0.22	0.16	-0.03
Incubation survival			1	0.57**	-0.08	0.32
Larvae survival (I)				1	-0.18	0.1
Larvae survival (II)					1	-0.32
GSI						1
Female weight	0.03	0.13	-0.06	0.12	-0.03	0.16
Female total length	0.01	0	0.04	0.17	-0.18	0.28
Female age	-0.16	0.02	-0.07	-0.02	-0.03	0.14

[*] Significant at $P < 0.05$, [**] Significant at $P < 0.01$, [a] during yolk sac absorption, [b] after first feeding.

Yolk sac absorption and first feeding stage are critical stages of development in most of fishes (Johns et al. 1981; Govoni et al. 1986; Mani-Ponset et al. 1996). In this work, maternal size (age, weight, total length) had not a significant relation ($P > 0.05$) with incubation survival, larvae survival during yolk sac absorption and larvae survival at first feeding stage (Table 2). Similarly, Gisbert et al. (2000) in early stage of Siberian sturgeon *Acipenser baeri* reported that mortality was independent of the source female and egg size. Nazari et al. (2009) concluded that smaller female broods did not cause more mortality than larger ones in larval production and they could be used in reproduction procedure of Persian sturgeon. They found that the mortality rate during yolk sac absorption was higher with increased female weight but their correlation was not significant (r = 0.40, P = 0.076). They also reported that during the first feeding stage, there was no significant correlation between the mortality rate and female weight (r = -0.12, P = 0.613). Gisbert et al. (2000) reported less than 2.5% of total mortality in Siberian sturgeon *Acipenser baeri* occurred during the endogenous feeding phase and the mortality rate after first feeding stage were elevated 2.1-23.5% of total mortality and mainly occurred between 9 and 18 days post-hatching. Also, they pointed out that the change from endogenous to exogenous feeding caused the observed mortality fluctuations, while in the present work, it did not extremely affect either stage of survival rates with no high fluctuations (survival for yolk sac absorption was 70.00-95.60%, and survival of first feeding was 74.10-97.40%, Table 1).

REFERENCES

Dettlaff, T.A., Ginsburg, A.S. and Schmalhausen, O.I. (1993), Sturgeon fishes, developmental biology and aquaculture. Springer Verlag, Berlin Heidelberg, 300 pp.

Gisbert, E., Williot, P. and Castello–Orvay, F. (2000), Influence of egg size on growth and survival of early stage of Siberain sturgeon (*Acipenser baeri*) under small scale hatchery condition. *Aquaculture*, **183:** 83-94 .

Govoni, J.J., Boehlert, G.W. and Watanabe, Y. (1986), The physiology of digestion in fish larvae. *Environ. Biol. Fishes*, **16**: 59–77.

IFO, (2007), Production reports of Iran fisheries organization. Iran Fisheries Organization, Tehran, Iran.

Johns, D.M., Howell, W.H. and Kklein-MacPhee, G. (1981), Yolk utilization and growth to yolk sac absorption in summer flounder, *Paralichthys dentatus* larvae at constant cyclic temperatures. *Marine Biol.,* **63**: 301–308.

Mani-Ponset, L., Guyot, E., Diaz, J.P. and Connes, R. (1996), Utilization of yolk reserves during post-embryonic development in three teleostean species: the sea bream, *Sparus aurata*, the sea bass *Dicentrarchus labrax*, and the pike-perch *Stizostedion lucioperca. Marine Biol.*, **126**: 539–547.

Nazari, R.M., Sohrabnejad, M. and Ghomi, M.R. (2009), The effect of maternal size on larval characteristics of Persian sturgeon *Acipenser persicus. Aqua. Res.*, **40**(9): 1083-1088.

Ronyai, A. and Varadi, L. (1995), The sturgeons. In: Reproduction of Aquatic Animals: Fishes, (eds. by C.E. Nash and A.J. Novotny), World Animal Sciences C8. Amsterdam, Elsevier, pp. 95–108.