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Histology of Ovarian Development and Investigated Some Biological Aspects of Persian Sturgeon, *Acipenser percicus*, in Caspian Sea Iran

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Abstract: The Persian sturgeon, *Acipenser persicus*, is a vulnerable anadromous fish considered to biological conservation program in southern part of Caspian Sea. In present study we investigated some biological aspects of Persian sturgeon, including absolute fecundity, gonadosomatic index (GSI), egg diameter and also, developmental stages of ovary. Female Persian sturgeon was captured from southeast of Caspian Sea from May, 2011 to May, 2012. Absolute fecundity is estimated from the gonads in the final maturity stage. Mean absolute fecundity was 301.58±52.5 thousand oocytes per fish, with egg diameter from 3.2 to 3.8 mm. Absolute fecundity variation was better correlation with ovary weight (r^2= 0.856) than with fork length (r^2=0.765) and with body weight (r^2=0.565). Three developmental stages of ovary are recognized during development. Maturity condition was assessed by gonadosomatic index (GSI). The GSI of female Persian sturgeon was gradually increased during the development of ovary. GSI in stage II was very small (3.38±0.52%) and GSI in stage III and IV increased and reached 12.2±1% and 20.07±2.04%, respectively.

Key words: Persian Sturgeon · *Acipenser percicus* · Caspian Sea · Fecundity · Gonadosomatic Index

INTRODUCTION

Sturgeon fishery, the most valuable of Caspian Sea, is the major economic resource and plays a significant role in the income of Iranian south Caspian Sea fisheries. *Acipenser persicus* is one of the most important caviar producing fishes in the Caspian Sea and one of the endangered species of the sturgeon fishes so its propagation is under governmental programming using artificial methods [1].

Knowledge regarding aspects of the reproductive biology of a harvested or cultured fish is important for management. Successful management of sturgeon populations requires knowledge of the stock composition with regard to sex and maturational status [2]. For example policies developed to assist with harvesting rates are usually based on information of the species' reproductive biology such as duration and periodicity of spawning [3, 4].

Histology studies currently in many biological phenomena such as fish reproduction to invent new and effective methods for increasing efficiency of bloodstock, increasing fish production and ultimately increase efficiency and higher fish are predicted. Determine the peak period of spawning assessment and exploitation of fish, understanding the biological characteristics and life cycle of a species also supplies management and reconstruction is an important role [5].

Also, description of reproductive strategies and the assessment of fecundity are fundamental topics in the study of the biology and population dynamics of fish species and also for evaluation of the reproductive potential of individual fish species. Of course this will increase our knowledge about the state of a stock and improves standard assessments of many commercially valuable fish species [6, 7].

To improve the culture methods for sturgeon species and to facilitate captive breeding programs to support wild stocks through restocking, it is necessary to fully understand the reproductive biology. So, this study provides a brief summary of the biological data on this species.

MATERIALS AND METHODS

Fish and Condition: In this study, female Persian sturgeon (*A. persicus*) was captured in gillnets (length 18m, width 5.4 m and mesh size 15 cm) during year from May, 2011 to

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May, 2012 from southeast of Caspian Sea and transferred to Shahid Marjani sturgeon Propagation Center in Gorgan, Iran.

Total weight (kg) and fork length (cm) of the fishes were measured.

Histological Expremeants: The fish, after they had been sacrificed, the gonad samples were fixed in Bouin's fluid for 48h and then transferred to 70% ethanol for storage until processing for light microscopy. Paraffin sections of 4-7 µm thickness were stained with hematoxylin and eosin. The developmental stages of gonads were classified according to the system of Amiri *et al*. [5, 8].

Calculations of Some Biological Factors: Absolute fecundity is estimated from the gonads in the final maturity stage, by the number of oocytes having the largest diameter [9]. And egg size was determined by measuring the diameter of eggs per female at final maturity stage, along two axes using a calibrated eyepiece micrometer.

For determination of absolute fecundity, fresh gonads were removed from the fish and be weighed (g). Then 1g of egg material collected at each of fish and fixed in Gilson's fluid [10]. The formula F= n × w was used, where n is the number of egg per 1g wet weight and w is the weight of the gonad. Then, data were used to determine regressions for fecundity-length, fecundity-body weight and fecundity-ovary weight. The relation between the different studied parameters were statistically analyzed by computing the correlation coefficients(r) using Microsoft Excel (2003).

The Gonadosomatic Index (GSI) of female fish was calculated by dividing the ovaries weight (WG) by the whole body weight (WT) and multiplying by 100 [11].

$$GSI = WG / WT \times 100$$

RESULTS

In present study Persian sturgeons were investigated. The mean fork length of females examined was 154.48±17.52 cm and ranged from 108 to 177 cm, while the average weight was found 26.04±6.98 kg and ranged from 11 to 38 kg.

In these study three developmental stages of ovary of *A. persicus* are recognized during development.

- Cortical alveoli formation stage (II), this stage is characterized by the appearance of clear vesicles (cortical alveoli) in the cytoplasm. In this stage, a thin acidophilic zonaradiata or primary envelope became visible for the first time. Follicular layers were also seen at the first time to consist of simple cuboidal or columnar layer surrounded with stratified squamous thecal layer. In this stage oocytes in the ovaries appear to be in the oil droplet (Fig. 1-A).
- Vitellogenic (yolk) stage (III), small yolk granules were visible as a ring of deep eosinophilic in the cytoplasm and later incorporated the whole cytoplasmic area. The zonaradiata was clearly visible as a noncellular deep eosinophilic band (Fig. 1-B).
- Ripe (mature) stage (IV), in this phase of development, vitellogenesis has reached its peak, the cell has become larger and more hydrated and the nucleus has migrated toward the periphery of the cell and is in the process of dissolution (Fig. 1-C).

GSI in stage II was very small (3.38±0.52%) and GSI in stage III and IV increased and reached 12.2±1% and 20.07±2.04%, respectively (Fig. 2).

The mean total number of ripe eggs in ovary (absolute fecundity) in this study was 301.58±52.5 thousand eggs. The correlation between fecundity-ovary weight expressed relationship was bigger (r^2= 0.856)

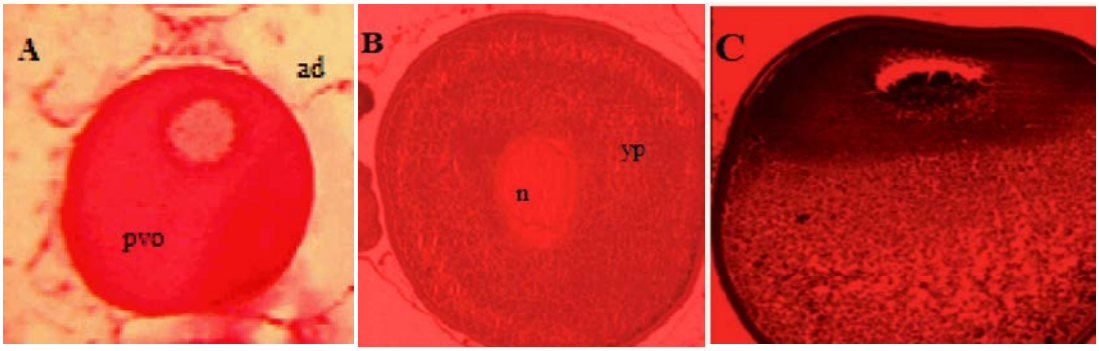

Fig. 1: Histological sections of *A. persicus*. Cortical alveoli formation stage (A), Vitellogenic (yolk) stage (B), ripe (mature) stage (C). ad: adipose tissue, pvo: previtellogenic oocyts, n: nucleus, yp: yolk platelets

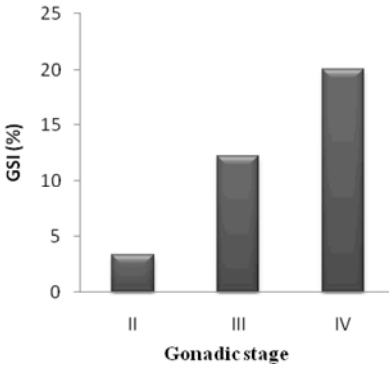

Fig. 2: Variation in GSI correlated with Gonad development of *A. persicus*

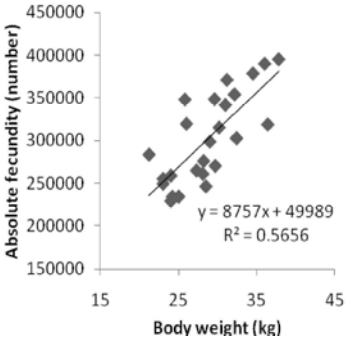

Fig. 3: Relation between fecundity and body weight of *A. persicus*

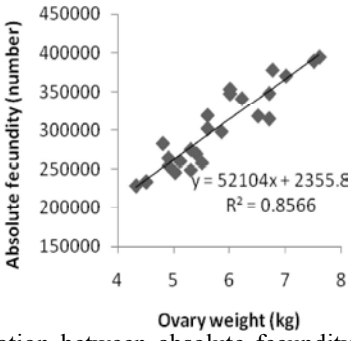

Fig. 4: Relation between absolute fecundity And ovary weight of *A. persicus*

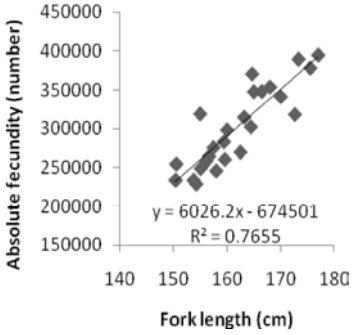

Fig. 5: Relation between fecundity and fork Length of *A. persicus*

than the fecundity-body weight correlation (r^2= 0.565) and fecundity-fork length correlation (r^2= 0.765). Generally, fecundity increased liner with increasing fish ovary weight, fork length and body weight (Fig. 3, 4, 5).

DISCUSSION

Histological changes in ovary during the reproductive cycle were similar in another species. Briefly oogonia proliferate through mitotic division of primary germ cells and transform into previtellogenic oocytes, characteristic of the immature ovary. The elaboration of yolk in the oocyte marks the beginning of vitellogenesis at the end of which the cell attains its maximum size and undergoes maturation/ ovulation, followed by the extrusion of egg to the exterior [12].

In generally, regarding the seasonal variation in gonad maturity stage, the breeding season of Persian sturgeon take place in late winter and spring, between March and May, [13].

Female reproductive maturity was commonly quantified by the GSI [14]. Our results show that the GSI of female Persian sturgeon was increased during the development of ovary. For Persian sturgeon under vitellogenic oocytes due to increasing GTH secretion from pituitary gland and its effects, biosynthesis of sex steroids, GSI and oocyte diameter significantly increased. According to the seasonal variation of GSI, the gonads start to develop in summer and mature in spring, when the highest values of GSI (20.07%) were recorded.

However, determination of reproductive maturity using only the GSI is not enough because the structures within the ovary such as oocytes at different stages, interstitial tissue with accumulation of yolk materials, con not be interpreted by weight [15]. Fecundity associated with biological parameters such as length, weight and ovarian weight in fish, Persian sturgeon in accordance with the general rule of law is [10], so that, increasing the length, weight and ovarian weight, increases fecundity. Based on the results obtained in the present study we found correlation between the ovary weight, fork length and body weight with fecundity. The correlation was positive indicate by increasing the ovary weight, fork length and body weight, will increase. Our results are similar to studies of *Acipenser persicus, Rutilus ferissi kutum* and *cyprinus carpio* [16].

Sturgeons exhibit a 'periodic strategy' life-history, which is typical for large fishes with high fecundity [17]. Fecundity reported in the literature for various sturgeon species ranges from as few as 8000 eggs in an *Acipenser ruthenus* specimen [18], to as many as 7,700,000 eggs in

a *Huso huso* specimen [19], though the number of eggs an adult female sturgeon carries has been traditionally reported as the number of eggs per kg of body mass. The number of ripe eggs in the ovary (Fecundity) in this study was averaged 301.58±52.5 thousand eggs.

Within a given species, fecundity may vary as a result of different adaptations to environmental habitats [20]. Even within a stock, fecundity is known to vary annually, undergo long-term changes [21] and has been shown to be proportional to fish size and condition.

Thus, fish size and condition are key parameters to properly assess fecundity at the population level (Murua *et al*. 2003). In present study, absolute fecundity variation was better correlated with length than weight so; length in contrast with weight was the best predictor of fecundity.

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