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Effect of Light on the Development of the Hard Roe of ACIPENSER BAERII BRANDT, 1869

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Abstract

The goal of conducted experiment was to study the larval development of Siberian sturgeon *Acipenser baerii* Brandt, 1869 when influenced by light. The rate of hard roe development is almost independent on light intensity and spectrum. However, the survival rate and size of larvae at certain light intensity and color increase. The author revealed beneficial effect of green-blue light on noted indicators.

Keywords: Acipenser Baerii, Development, Light, Light Color, Light Intensity, Siberian Sturgeon

1. Introduction

Light, as a primary abiotic factor plays a big role in the development of juvenile specimen and imago of most species with the exception of species that inhabit in the caves, very muddy waters and at great depths. In literature there is some information regarding the effects of light on the early development of sturgeons[1–14]. The development of hard roe in sturgeon and thorn sturgeon was better at the light intensity of 10-20 lx, while in starred sturgeon – at 20-100 lx[3] and Kasimov. [5]Determined the optimal lighting conditions for the development of the sturgeon embryos of the Kura population: For sturgeon and thorn sturgeon the most optimal conditions were achieved at the light intensity of 10-20 lx, while for starred sturgeon and great sturgeon – at 20-100 lx. The abnormalities in the development and survival of sturgeon and thorn sturgeon were revealed at the light intensities over 40 lx, while in starred sturgeon and great sturgeon – at 100 lx. At that, the embryos and prolarva were more sensitive to light than juvenile species. We consider the results of experiments conducted with the roe of Siberian sturgeon (*Acipenser baerii* Brandt, 1869) one of the main aquaculture objects in the industrial sturgeon breeding.

2. Materials and Methods

Siberian sturgeon is being used in aquaculture since 1973. Brood stocks are established in several warm-water farms. At a temperature of 15-25^{0}C, a bottom-dwelling fish grows most intensively and feeds mainly with benthic organisms, being very plastic species[8]. For the experi-

Table 1. The duration of the early development stage of Siberian sturgeon at different light intensities (M+m)

light intensity, lx	A day after fertilization		Mortality at the stages, %		Larva body length
	Appearance of pre-larva	Stage of active feeding	Embryonic species	Pre-larva species	
0	5.96±0.17	14.11±0.46	18.2	28.2	16.62±0.31
1	5.65±0.17	13.57±0.42	18.2	16.5	18.26±0.16*
10	5.96±0.10	13.86±0.57	20.0	13.3	17.62±0.15*
700	6.47±0.15	14.58±0.54	56.7	91.7	16.80±0.50
1500	6.39±0.14	14.83±0.85	36.7	100.0	-

* - significant at $p<0.05$

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ments, Siberian sturgeon eggs were selected from a pair of hatchery producers. Each option of the same series included 10-15 eggs from a single laying placed on the same Petri dish. The temperature was maintained at the level of 20+10°C, the oxygen content in water was 7.0-7.5 mg/l. Development stages were recorded every 2-4 hours according to the method described in[2]. Selection of dead eggs was conducted on a day-to-day basis (taking into account mortality). In the "dark" conditions, all manipulations were performed daily at very low (0.001 lx) scattered light. The experiments were stopped after the transition of larvae to active feeding. The body length of hatched larvae was measured by ocular micrometer with accuracy of 0.01 mm. The lighting was created using fluorescent lamps. The light intensity was measured at the water surface by Yu-116 luxmeter. The experiments were performed in 4-7-fold repetition. The data in the tables were averaged for all series of experiments. The lighting technique was described previously[9,10,12].

3. Results

It turned out that a slight acceleration of pre-larval development was observed at a light intensity of 1-10 lx and in complete darkness [Table 1]. In these modes the species mortality rate decreased as well by 57-60 % on average as compared with that at high values of light intensity (700 and 1500 lx). Besides, in the modes high light intensity (1500 lx) at the stages of pre-larval development, a total mortality of evolved species was observed. The body length of sturgeon larvae that reached the stage of active feeding was significantly higher ($p<0.05$) at the light intensity of 1 and 10 lx than that in complete darkness.

Separate spectral zones had no significant effect on the duration of the early development stage of Siberian sturgeon [Table. 2]. Mortality of sturgeon at embryonal stages (before leaving the shell) was almost the same in different options except of the option with blue light. In the latter case, embryo survival was increased drastically almost 3-fold.

A major percentage of mortality accounted for pre-larval development stages. During this period there a significant mortality rate was observed at red lighting. On the other hand, the mortality rate at the green lighting decreased by 2.23 times and at dark blue lighting – by 4.87 times. However, despite better survival rate, the larvae in the latter case had nearly the same linear dimensions as compared to control species.

4. Discussion

Our results are partially consistent with data available in literature. For example, a strong dimming during the first month of species life had a negative impact on post-embryonic development of the Kura sturgeon: A delay in linear growth, inhibition in development of the skeleton, as well as the disproportion in size of head and body were revealed[4]. Study of the effect of different light intensity on the development of Kura salmon embryos during the roe incubation period showed that the light intensity exceeding 20 lx has a negative impact on the embryos development and survival. Within the light intensity range of 10-20 lx the embryos develop normally and have higher survival rates than in high light intensity conditions (60-65 and 100-105 lx). Non-conformity of light intensity conditions to the needs of the embryos before their hatching from the eggs leads to the indications of anxiety, increased motor activity inside the shell that is accompanied by increased energy expenditure and leads the organism to exhaustion and death. Under high light intensity conditions the period of embryonic development is reduced, however, such larvae have a number of

Table 2. The duration of the early development stage of Siberian sturgeon at different colors of light (M+m)

Color of light	A day after fertilization		Mortality at the stages, %		Larva body length
	Appearance of pre-larva	Stage of active feeding	Embryonic species	Pre-larva species	
Control	6.54±0.17	15.02±1.07	20.0	37.5	19.14±0.22
Red	6.56±0.16	15.28±1.10	18.4	65.7	18.82±0.24
Yellow	6.36±0.10	14.78±0.87	25.7	36.7	18.55±0.18
Green	6.04±0.14	14.75±0.89	20.0	16.8	20.04±0.14*
Blue	6.81±0.24	14.86±1.26	23.4	32.0	17.99±0.19*
Dark blue	6.22±0.17	14.89±1.22	6.7	7.7	19.18±0.28

* - significant at $p<0.05$

developmental anomalies. This reaction is retained in the larvae after hatching during the first month of life. With the development of the pigmentation of the body and eyes the juveniles are becoming more light-demanding and respond positively to high light intensity[1]. Evidence from the roe of the Russian sturgeon, [7]has shown that greater rate of mortality at a temperature of 20^{0}C was observed before hatching, while the mortality at pre-larval development stage was usually minimal. A similar phenomenon was noted in experiments on the eggs of another species of sturgeon, namely the light-demanding sevruga sturgeon[6]. We have obtained similar results. Thus, the adaptive features of the fish ontogeny are closely related to species-specific conditions of sturgeons during all stages of their development.

The largest dimensions were recorded in the larvae reared under green and blue light. Similar data were obtained in experiments of[11], who showed that development of larvae of Russian sturgeon from hatching to transition to the active feeding stage takes place typically under the conditions of low-intensity day light and color light as well as full darkness. Red lighting had the opposite effect. Over the 17 days of cultivation, the best growth rate of larvae was recorded when using blue and green light spectrums, while the worst case corresponded to the direct sunlight.

5. Conclusion

The pace of development of Siberian sturgeon, held under tightly controlled conditions, mostly slightly dependents on the light intensity and spectrum. On the other hand, the light intensity and spectrum have a significant impact on survival of the species. The size of larvae of the Siberian sturgeon at specific values of light intensity and color significantly increase. Accordingly, the light intensity has a main influence on the survival rate of embryos and pre-larvae, which increases at small values of the light exposure and decreases in darkness.

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