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Effects of Different Environmental Factors and Hydrological Conditions on Fish Reproduction

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ABSTRACT

Reproduction is an important life activity of fish. At the current stage, due to changes in the environment and the impact of human activities, the reproduction of fish has been greatly affected. If its reproduction performance is severely damaged, it means that it will be unable to reproduce, its number will continue to decrease, or even die. Therefore, the study of fish reproduction is not only conducive to protecting species diversity, maintaining the stability of fish populations, but also maintaining the balance of the aquatic ecosystem. This article focuses on the effects of environmental factors such as light, environmental hormones in water, and hydrological conditions such as flow rate and temperature on fish reproduction.

Keywords: Fish reproduction; Environmental hormones; Release of cold water

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1. Introduction

Fishes are a group of temperature-changing vertebrates that live in water for life. Its living environment is water. Different fish populations live in specific water environments, and different water environments live with different fish populations. The relationship between fish and the surrounding environment is opposite and unified. On the one hand, fish take the environment as a factor of their own lives; on the other hand, fish affect the environment as part of the environment. Fish have lived on the earth for millions of years. Currently, there are about 20,000 known fish species in the world, accounting for about half of the total number of vertebrates. The prosperity of fish stocks depends mainly on its ability to reproduce in a certain environment [1]. The aquatic environment on which fish depend is mainly composed of two aspects, namely the biological environment and the abiotic environment. The biological environment mainly includes plankton, benthic animals, fish and amphibians. The abiotic environment mainly includes temperature, salinity, pH, oxygen, water flow, water pressure, and light. Fish has certain adaptability to environmental conditions, but this adaptation has a certain range. Any change of any factor beyond the range will affect the growth and development of fish, especially in the aspect of reproduction. The impact of ecological environment on sexual maturity of fish Environmental conditions determine the growth of fish, and the growth of fish is directly related to sexual maturity.

2. Impact of different factors and conditions

2.1 Impact of environmental factors

2.1.1 Effects of environmental hormones

Environmental hormones are also called environmental endocrine disruptors and environmental hormones. They have a wide range of sources, diverse species, diverse states, and complex pathways. They have important effects

on the immune system, reproductive system, endocrine system, and nervous system of animals and humans [2-3]. At present, environmental hormones can be detected in all environmental matrices and human tissues, and more than 70 compounds have been listed on the environmental hormone blacklist [4]. The influence of environmental hormones on fish reproduction has become one of the frontier and hot topics of environmental science, chemistry, ecology, biology, anthropology, and so on. The male-female ratio of fish is an important factor affecting fish reproduction. Related studies have shown that some environmental hormones in the water body can affect the male-female ratio of fish, thereby affecting fish reproduction. In addition, environmental hormones can also affect the reproductive organs and gonads of fish. In fish exposed to environmental hormones, delayed testicular development in males can be observed [7]. The estrogen compounds methoxychlor and chlordecone can bind to egg cell receptors and inhibit egg cell maturity [6]. Therefore, keeping the concentration of various substances in the water body within a proper range is particularly important for fish reproduction.

2.1.2 Effects of Light

The length of light is related to the development and maturation of fish gonads. Light stimulates fish's visual organs, and through the central nerve, causes secretory activities of the pituitary gland, which affects the development of gonads. The reproductive cycle of fish is largely regulated by the length of light. Fish that lay eggs in spring can promote gonad development as long as the light period is prolonged, so that broodstock can mature early and lay eggs. For fish that lay eggs in autumn and winter, shorten the light period to promote gonad development and early egg production.

2.2 Impact of hydrological conditions

2.2.1 Influence of temperature

Fish is a variable-temperature aquatic animal, and its ability to regulate body temperature is not strong. Generally, the temperature of fish is 0.5 to 1.7 °C [5], which is an important factor affecting fish reproduction. Fish spawn usually has a fixed temperature, called the temperature threshold. When the temperature of the water body is lower or higher than this value, the fish will stop spawning. For example, the temperature of spawning water for domestic fish in the Yangtze River Basin is 18 °C. [8] Fish that are spawning often experience a sudden drop in water temperature and often stop producing fish.

2.2.2 Impact of the barrage

The construction of the reservoir has formed a huge stagnant water area. Due to the solar radiation and the physical and chemical characteristics of the water, a completely different water environment from the original natural river has been created, and the water temperature has a distinct seasonal stratified distribution along the water depth. Reservoir, especially large deep reservoirs, the low-temperature water that is drained by the traditional bottom-fetching method, will lower the water temperature of downstream rivers. The deep water of the reservoir has a low dissolved oxygen (DO) content and the water body is anaerobic. The low-temperature underwater discharge has a great impact on the temperature and dissolved oxygen of downstream river sections, thereby affecting the reproduction of fish. The breeding area of fish is not arbitrary. Fish usually spawn in spawning grounds, which have certain hydrological conditions such as flow velocity and water depth. After the barrage dam was built, the rising water level in the upstream caused the water in the upstream to return, and the water level in the downstream dropped. The hydrological conditions in the upstream and downstream have changed, and the fish spawning ground has been destroyed. In addition, the reproduction and spawning of fish requires a certain water flow speed

to stimulate the fish. The construction of the barrage dam causes the river to slow down and the spawning of fish is affected.

3. Consequences of destruction of environmental factors and hydrological conditions

Environmental hormones have become the third major environmental problem after the destruction of the ozone layer and global climate change, and have been hailed as a time bomb that threatens the continued survival and reproduction of humankind. In addition to affecting the reproduction of fish, environmental hormones also affect the growth and development of fish, leading to a decline in fish population viability and fishery resources. Salmon lay their eggs in freshwater rivers. After hatching, the small fish migrate to the sea. During the migration, salmon adjusts the osmotic pressure in the body through estrogen to adapt to water environments with different salt contents. The high concentration of NP in the river interfered with the osmotic pressure regulation system, so that the small salmon could not change the osmotic pressure after entering the sea, and the Atlantic salmon population was almost extinct. Environmental hormones can be transferred from low-latitude regions to high-latitude and polar ecosystems by means of atmospheric circulation and ocean currents. In addition, biological migration is another effective way to spread environmental hormones. Salmon (*Oncorhynchus*) migrates environmental estrogen from the ocean to freshwater lakes in Alaska by migrating, resulting in environmental estrogen concentrations that are twice as high as in the control lake. Environmental hormones are increased in concentration through bioconcentration, bioaccumulation, and biomagnification to achieve greater harm to living beings and humans. Among them, the bioconcentration factor BCF values of NP in Atlantic salmon (*Salmo salar*) and *Gasterosteus aculeatus* are for 280, 1300. Considering the enrichment of environmental

hormones in fish, the redistribution of environmental hormones caused by biological migration has more important ecological significance than atmospheric circulation and ocean currents. The concentration of environmental hormones in China's water environment is at a relatively high level, and in-depth research on the migration and transformation of environmental hormones, bioaccumulation, metabolic pathways, mechanisms of action, risk assessment, and detection methods is urgently needed.^[8] Fish reproduction is an important way to ensure the stability of fish populations. Changes in the environment and the impact of human activities have severely affected the reproduction of fish. Due to the deterioration of the environment and the destruction of human activities, the baiji in the Yangtze River has disappeared and is almost extinct. Due to the construction of river dams such as the Three Gorges Water Conservancy Project and Gezhouba, fish migration and spawning are isolated, such as Chinese sturgeon. In addition, each species has a relationship with each other. The ecosystem is a unified whole. The extinction of one species will inevitably affect other species, which will cause a vicious circle. Therefore, it is necessary to take necessary measures to solve the problem of fish reproduction.

4. Countermeasures to improve fish breeding conditions

4.1 Strengthening water body monitoring

Excessive environmental hormones in the water have an important impact on fish reproduction, which not only affects the spawning of fish, but also affects the gamete quality of fish, which in turn affects offspring. For the improvement of the water environment, it is necessary to strengthen the monitoring of the water body, detect problems in time, and control in time. In addition, environmental hormones in the water body are mainly produced by sewage discharge and algae release in the water. Sewage outlets should

be strictly controlled, and the discharged sewage should be treated to meet discharge standards to prevent eutrophication of the water body.

4.2 Improving fish migration pathways

For the impact of the barrage dam, the way of building fish facilities, such as the construction of fish passages and fish lifts, can be adopted to enable fish to migrate and spawn again. However, for some species of fish, the construction of a fish facility cannot effectively solve the impact of the dam. For this kind of fish, it is necessary to establish a special research institute to cultivate a fish sperm bank and put fry into the water body, such as Chinese badger.

4.3 Mitigating the impact of water temperature changes on fish reproduction

At present, there are not many mitigation measures with significant effects in response to changes in water temperature in the reservoir area. Attention is mainly focused on mitigating the impact of water temperature under the reservoir.

(1) Artificial destruction of water layers

In the local water area of the water intake, manually agitate the water body, or inject gas or water flow, to convect the water body up and down, destroy the water body layering, and thereby increase the water temperature of the water intake. This method has few applications and is limited to small reservoirs. There are no examples in China. For example, the Ennisga Reservoir in Ireland adopts the method of installing air pressure water guns to promote water convection and destroy the water temperature stratification. The Oxining Reservoir in New York, United States uses the method of injecting compressed air into the reservoir deep to eliminate water temperature stratification.

(2) Ecological scheduling

Through reservoir dispatching, control the discharge flow or organic combination of different elevation drain holes to mitigate the impact of the

temperature change of the discharge water. Ecological dispatching is gaining more and more attention in China, and hydrological process restoration is often the key goal of ecological dispatching. However, experimental research has been started to mitigate the effects of temperature changes in the water discharged from reservoirs through reasonable dispatching.

(3) Layered water intake

According to the vertical water temperature distribution characteristics of the reservoir, certain engineering measures are adopted, and the water layer with appropriate temperature is taken to achieve the measures to mitigate the influence of the temperature change of the discharged water. Mainly divided into porous, multi-section layered water intake and water temperature control curtain wall [9-10].

5. Conclusion

This article discusses the impact of environmental factors and hydrological conditions on fish reproduction performance. From the current situation, the environmental pollution situation is still relatively bad, and many tasks have not achieved the standards required. There is a downward trend, and the reproduction of some fish has to be carried out by hand. In the future fish breeding work, a series of positive measures must be taken to control environmental pollution and provide a good environment for fish breeding as a whole, so as to promote the stability of the ecosystem. In addition, the factors affecting fish reproduction are not limited to the factors described in this article. Because the author is limited, this article only discusses environmental factors and hydrological conditions. It needs a systematic understanding of fish reproduction and further research is needed.

References

1. Hongxian Yu, Yidan Ma, Fangying Chai and Wenbin Xu. Effects of ecological environment on fish reproduction [J]. Wildlife, 1997 (01): 14-17.
2. Menghou Gan. The characteristics of poultry infectious diseases in China and countermeasures [J]. Chinese Poultry, 2011 (01): 29-31.
3. Aishu Long. Highlights and Difficulties of Grassroots Animal Quarantine and Quarantine [J]. Beijing Agriculture, 2011 (27): 32-33.
4. Zaifu Yang and Xiaoxiang Zhao. Research progress on the effects of environmental estrogens on aquatic animals [J]. Ecological Environment, 2005, 14 (01): 108-112.
5. Huan Lei, Feng Chen, and Daoming Huang. Ecological effects of water temperature on fish and effects of reservoir temperature change on fish [J]. 39 (04): 1-2.
6. Yingchen Dong and Hui Yu. On the standardized management of epidemic prevention and quarantine in livestock and poultry farms [J]. Henan Animal Husbandry and Veterinary Medicine (Comprehensive Edition), 2010 (11): 32-34.
7. Susan Jobling, John P. Sumpter, David Sheahan, et al. Inhibition of testicular growth in rainbow trout (*Oncorhynchus mykiss*) exposed to estrogenic alkylphenolic chemicals [J]. Environmental Toxicology and Chemistry, 1996, 15(2): 194-202. DOI: 10.1002/etc.5620150218.
8. Tao Xu. Effect of environmental hormones on fish reproduction [J]. Agriculture and Technology, 33 (09): 149-150.
9. Xiaoyan Du, Weiqi Yu, and Jianliang Rui. Hydropower ecological practice — layered water intake structure [J]. Hydropower, 2008, 34 (12): 28-32.
10. Lianfang Xue, Hongbin Gu, and Yunhai Feng. Regulation measures and suggestions for mitigating the influence of water temperature in hydropower projects [J]. Environmental Impact Assessment, 2016, 38 (3): 5-8.

