A compound artificial nest designed for oviposition of various fish

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Abstract. Due to the influence of human factors and natural factors, the oviposition grounds and living environment of fish have been seriously damaged, and the decline of fishery resources is obvious. In recent years, artificial fish nests are widely served as a good means to restore fisheries resources and their degraded habitats, summarizes the materials, structure, nesting methods and existing problems for artificial fish nest, according to the artificial fish nest which is complicated to make, has a short service life and the existing artificial fish nest only aiming at the shortcomings of the herbaceous oocytes, we designed a compound artificial fish nest. The complex artificial fish nest consists of a frame, which is provided with two kinds of soft and hard egg adhesive medium to provide ecologic spawning conditions for grass spawning, gravel spawning and water spawning fish whose spawning ground is damaged, so as to increase and improve the population structure and quantity of wild fish.

1. Introduction
In recent years, due to human overfishing, implementation of hydropower project construction, and the problem of seriously pollution makes China's offshore lakes, rivers and freshwater ecosystems affected by different degree. The living environment, close to the coast and freshwater fish spawning grounds suffered huge damage, lead to the serious attenuation of aquatic biological resources in our country, the number of fish has decreased significantly. Therefore, China has adopted a series of fish breeding and releasing activities to maintain the ecological balance near the coast, rivers and lakes. However, it was found that artificial proliferation has certain ecological risks in reality, and it is difficult for captive fish that originally live in nature to survive in changed environment, the survival rate is very small. At present, one of the main ways to repair fishery resources and their habitats is to construct artificial fish nest, which can provide pseudo-ecological spawning conditions for fish whose spawning grounds have been destroyed, just making up for the deficiency of artificial proliferation[1]. However, the existing artificial fish nests are almost only set for fish producing glutinous eggs on grass, and the soft adhesive medium needs a series of treatments such as disinfection and soaking in advance, so it is complicated to make and has a short service life. The design of the composite frame structure of the artificial fish nest on a soft and hard two warm sticky dielectric layer, it offers spawning grounds for the fish to lay eggs on damaged grass, fertile and water provide ecological condition, and solves the existing artificial fish nest only into the problem of fish producing glutinous eggs on grass. It provides well environment for compound model of artificial fish nest for fish bait, spawning, provides suitable hydrodynamic environment for all kinds of aquatic organisms and fish. What’s more, it effectively improve the fish population quantity and structure, gradually restore fishery resources and the degradation of habitat[2].
2. Types and existing problems of artificial fish nests

Artificial fish nests are built artificially by simulating the living environment of fish and using alternative materials. They are set in specific water areas where fish spawn, providing artificial spawning and breeding places for fish whose spawning grounds have been damaged, and ultimately achieving the reconstruction and restoration of freshwater habitats and the enrichment of fishery resources[2]. There are various kinds of artificial fish nests, they correspond to different functions through different materials, structures and ways of releasing the nests. Three kinds of artificial fish nests according to different ways of releasing the nests, materials and structures.

According to the different materials of artificial fish nests, it can be divided into artificial plant fish nest, natural plant fish nest, and other three categories. Fish nests of natural plants are generally made of wood materials, which are tied into bundles with matrix materials, and then tied to structures such as wood or bamboo poles with nets, ropes, etc., so as to serve as habitats for aquatic organisms indirectly or directly[3]. Artificial plant fish nests provide attachment for fish spawning by using polypropylene or polyethylene as a substrate to mimic the shape of the leaves and cattails of the plant. Santas et al. have shown that artificial plant fish nests may be a better choice to expand the habitat of small fish, and artificial plants can provide underlayer spawning and create protection areas for fish in sufficient quantities[4]. Others mainly include the use of discarded plastic bottles, PVC plastic pipes and plastic woven bags to make artificial fish nests, and strive to achieve ecological and environmental protection, which is also the focus of the future development of fisheries.

According to the different structure of the artificial fish nests, it can be divided into three main categories: floating frame artificial fish nest, fish-nest brick, net piece artificial fish nest and so on. Floating frame artificial fish nest is a modern and new material and structure, which is mainly composed of fixed pile, floating frame, falling rope and matrix[5]. The fish nest brick is a riverbank revetment measure, which can combine the basic function of ecosystem with the function of safety protection. There are three common types at home and abroad: concrete interlocking block pavement revetment[6], permeable concrete box revetment, and grass-planted revetment. The net piece artificial fish nest is composed of the net and the frame structure which can make the fish nest suspend the specific water layer or make the fish nest fixed, such as the bamboo. Its main shapes are "herringbone", "plane shape" and flake[7].

According to the different ways of putting artificial fish nest, it can be divided into two types: horizontal artificial fish nest and suspended artificial fish nest. The advantage of the suspended artificial fish nest lies in its ability to record and observe the growth of fish eggs at any time during the later management, while its disadvantage lies in its strong instability and inconvenient operation. Therefore, the horizontal artificial fish nest is mostly adopted at present, with a relatively high attachment rate of fish eggs, and it is conducive to the reproduction of submerged eggs[8].

Although artificial fish nests have been developed for a long time, there are still some problems in artificial fish nests. Although there are various kinds of artificial fish nests, they are mainly aimed at the fish that produce eggs on grass, and the oviposition fish species is single, which cannot effectively improve the fish population structure. Moreover, the soft adhesion medium needs to be processed in advance through a series of treatments such as disinfection and submersion, and the production is complicated and the service life is short. Artificial fish nest in the material selection although there are natural plant materials and polyethylene, polypropylene, but natural plant materials in the water after the time will soon decay. Polyethylene, polypropylene although will not be water erosion, after all, it is chemical materials, spawning fish will also have been impacted by them. Artificial fish nest in later management requires a lot of manpower and financial resources. To maintain the artificial fish nest is not attached to pollutants, every 3 ~ 5 days to conduct a comprehensive cleaning to make its use for a long time. At the same time, the artificial fish nest should be monitor in the morning and evening, the incubation process of fish nest and spawning quantity monitoring record on a regular[9]. They all are problems wait for solving in current artificial fish nests.
3. The design of compound artificial fish nest

The existing artificial fish nests are only for the fish that produce eggs on grass, and the production is complicated and the service life is short, while the composite artificial fish nest is equipped with soft and hard two warm and sticky medium on the structure, which can adapt to different fish to lay eggs, and the service life is greatly extended compared with the easy production. In previous general selection of artificial fish nest material is natural plant material or polymer materials, composite artificial fish nest selected live submerged plant. According to the actual water level condition, puts compound artificial fish nest under water line, the submerged plant completely submerged in the water, fish eggs are conducive to the breeding by submerging in the water for it has provide better bionic ecology spawning ground. In the later stage of management, the cleaning process of compound artificial fish nest does not need to be particularly frequent, and only the withered submerged plants need to be removed regularly.

FIG. 1 The utility model relates to a structure diagram of a new compound artificial fish nest

As shown in FIG. 1, the compound artificial fish nest consists of a structure, which consists of four vertical rod 1, upper and lower long horizontal rods 2 and 3 fixed on the vertical rod 1. The structure had soft and hard viscous medium with eggs. The soft viscous medium with eggs is located on the top of the structure, and a floating bed 4 is fixed, on which soft viscous medium with eggs 5 is planted. The hard viscous medium with eggs is located at the bottom of the structure, and it is composed of six fixed poles of viscous medium arranged at intervals, on which hard viscous medium with eggs 7 is fixed. The soft viscous medium with eggs 5 was leaf-shaped submerged plants. Hard viscous medium with eggs 7 is stone cage; Float 8 is provided on the structure, and the buoyancy generated by float 8 can make the structure float in water. The structure is connected with a cable 9, the other end of the cable is provided with an anchor hook 10. The structure is fixed in the water by cable 9 and anchor hook 10. The structure and viscous medium fixed pole of hard viscous medium are all made of bamboo.

When the composite artificial fish nest is set, the artificial fish nest can be set about 30-50cm below the water level according to the actual water level, so that the submerged leaf-shaped plants can be completely submerged in the water. There is a certain distance from the water surface to ensure their good growth and to provide spawning grounds for floating spawning fish.
4. Conclusion
Compound artificial fish nests mimic ecologic spawning conditions for multi-ecological fish whose spawning grounds are destroyed. The materials selected are uninjurious and recyclable, the structure with good egg-laying and low cost is simple and light. The structure and quantity of a variety of wild fish can be improved effectively by soft and hard viscous medium. We should fundamentally protect aquatic biodiversity and enhance the awareness of ecological and environmental protection, to achieve the restoration of degraded habitats of fish and fishery resources. The proliferation of artificial fish nest is an important measure to restore fishery resources and their degraded habitats, which is helpful for maintaining regional biodiversity, protecting aquatic environment and generating good ecological, economic and social benefits.

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