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ELECTRO-OPTICAL DEVICES FOR FEEDING FISHES WITH INSECTS

Research article

Abstract

The article discusses the problems of supplying fish farms with feed and increasing the proportion of live feed in the fish ration. The possibilities of use the natural forage base of ponds for these purposes are shown. A review of electro-optical devices for feeding fish based on attracting flying insects to ponds using optical radiation is carried out. Stimulating the attraction of insects by creating optical radiation with different colors allowed us to increase the efficiency of the devices. The use of these electrical devices leads to an increase in the productivity of ponds and a decrease in the cost of artificial feed for fish.

Keywords: fish feeding, living feed, flying insects, attraction of insects, electro-optical device, color stimulus.

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ЭЛЕКТРООПТИЧЕСКИЕ УСТАНОВКИ ДЛЯ ПОДКОРМКИ РЫБЫ НАСЕКОМЫМИ

Научная статья

Аннотация

В статье рассмотрены проблемы снабжения рыбоводческих хозяйств кормами и увеличения в рационе рыбы доли живых кормов. Показаны возможности использования для этих целей естественной кормовой базы водоемов. Проведен обзор электрооптических установок для подкормки рыбы, основанных на привлечении летающих насекомых к водоемам с помощью оптического излучения. Стимулирование привлечения насекомых за счет создания оптического излучения с различной цветностью позволило повысить эфективность устоновок. Применение данных электроустановок приводит к увеличению продуктивности прудов и снижению расходов на искусственные корма для рыбы.

Ключевые слова: подкормка рыбы, живые корма, летающие насекомые, привлечение насекомых, электрооптическая установка, цветовой стимул.

Introduction

The fishery complex is one of the most important sectors of the food industry of the Russian Federation, aimed at providing the population with fish products and maintaining the country's food security. Fish is one of the sources of complete proteins. Their intake supports the normal course of such processes in the human body as growth, metabolism, regeneration of the nervous system, reproductive function and thinking [1].

Currently, in Russia, the amount of fish caught satisfies the consumption standards of the Ministry of Health (18 ... 22 kg per person per year). At the same time, a significant part of the catch is exported abroad, while the remaining part of domestic-produced fish is able to satisfy the needs of the population by only 8.2 ... 10.5 kg. The large outflow of fish to foreign markets, the depreciation of the ruble against the dollar and the transfer of prices from the foreign market to the domestic one caused a significant increase in the cost of fish products and a decrease in demand for it. One of the ways to establish the supply of high-quality and affordable fish is the development of fish farms. Fish breeding enterprises established on the basis of Russian

ponds can eliminate the shortage that has arisen on the market. However, the difficulty of providing farms with fodder, causing limited fish landing, leads to low profitability of production [2].

The role of feed in artificial fish farming

Feeds are designed to satisfy the needs of living organisms in structural elements and energy to support life. Fodders for fish and other farm animals use components such as waste from crop production, animal husbandry, fisheries, microbiological and food industries. Such a composition can become the basis for the intensive development of harmful microorganisms and the accumulation of heavy metals, pesticides and carbohydrates in fish. All this can lead to a decrease in the profitability of production and to a threat to the health of the consumer of fish products [3].

In fish, the need for protein and its assimilation are determined by the species, age, puberty, size, and parameters of the aquatic environment. The degree of assimilation of protein received with food in adult fish reaches 80 ... 95%, in juveniles - lower. In addition, the relative need of fish for proteins and lipids significantly exceeds the needs of warm-blooded animals. Compared to them, fish are not able to efficiently digest plant foods rich in lysine, methionine and polyunsaturated fatty acids. The use of unbalanced feed leads to unreasonably high feed intake, slower fish growth, the occurrence of diseases of the digestive system, the accumulation of fats and, consequently, a decrease in the nutritional value of the product. This is due to the additional costs of the fish organism for the assimilation of those substances that cannot be completely used for weight gain. Also, do not forget about the requirements for the technological properties of feed. Inadequate water resistance and particle bonding between each other can lead to significant losses of feed, increase the risk of diseases and pollution of the reservoir [1], [3], [4].

Electrical devices for feeding fish with flying insects

In order to enrich the ration of fish with necessary nutrients and reduce the consumption of concentrated feed, you can actively use the resources of the natural forage base of ponds. By attracting insects with optical radiation, the proportion of live feed in the fish ration is increased, which strengthens its immunity and accelerates the gain in live weight. For this purpose, various electro-optical devices can be used to attract insects to a reservoir [5], [6], [7].

Autonomous electro-optical device [5], presented in Fig. 1, is intended to attract mosquitoes in order to increase the number of eggs laid by them in ponds. The optical radiation of attractant lamps affects the visual organs of mosquitoes, attracting them to the device. A floating platform 3 is located near it (Fig. 1), which creates favorable conditions for swarming insects. Attracted by light, mosquitoes sit on the platform and lay eggs, from which the larvae going to feed the fish subsequently hatch.

The electro-optical device (Figure 1) has an LED optical source 2, which is switched on in the evening and morning hours during the active flying of mosquitoes. The power is supplied by a rechargeable battery, which is charged by solar module 1 during the day. The color of the optical radiation attracting mosquitoes is adjusted to the optimal color coordinates (x_{OPT} = 0.2294; y_{OPT} = 0.2366), corresponding to the maximum phototaxic effect.

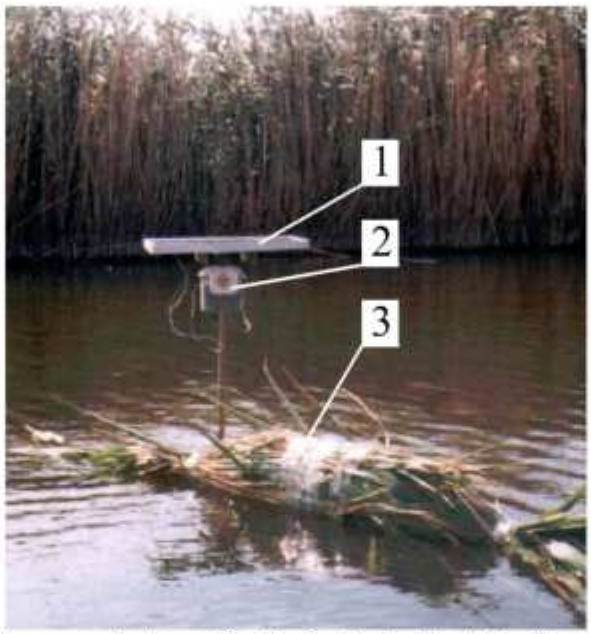


Figure 1 – Autonomous electro-optical device for feeding fish with mosquito larvae

Insects are influenced by various environmental factors: temperature and humidity, wind strength, natural light levels, etc. During operation of electro-optical devices for feeding fish with flying insects, environmental conditions are constantly changing. This also affects the manifestation of the motor reaction of insects to the light stimulus. It was found that optical radiation ambient temperature [8] has a significant effect on the optimum color of mosquito-attracting optical radiation. In the air temperature range of 14 ... 38 ° C, corresponding to the active flying of mosquitoes, the optimal chromaticity coordinates

change significantly (Δx = 0.5330 ... 0.1862, Δy = 0.3073 ... 0.1437): when the air temperature rises, the optimum color shifts from orange -red shades in the region of blue-violet (Figure 2) [9].

The influence of ambient temperature on the color of optical radiation attracting mosquitoes was taken into account in the design of an electro-optical device with adjustable color of radiation for feeding fish with mosquito larvae [6]. Three high-power PL6N-3LFE RGB-LEDs with Cree light-emitting crystals were used as attracting sources. Using RGB-LEDs and PWM-drivers to change the currents passing through the R-, G-, B-crystals allows you to adjust the color of their radiation over a wide range. Ambient temperature is controlled by a digital temperature sensor. The overall control of the device is carried out by a microcontroller that controls the color of the radiation; provides switching on and off the emitter during the evening and morning phases of the active flying of mosquitoes, as well as its switching off at air temperatures outside the range of 14 ... 38 ° C. For autonomous operation of the device, a rechargeable battery is used in conjunction with a solar module.

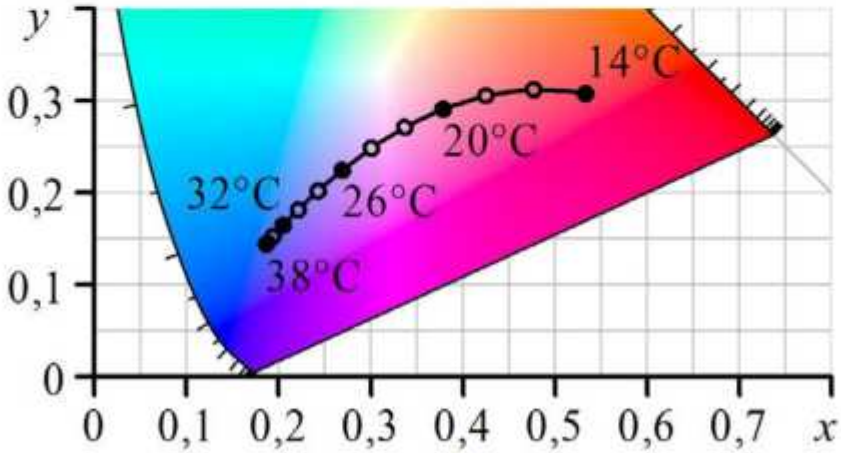


Figure 2 – Change in the optimal color of the optical radiation at the CIE 31 color atlas from air temperature

The use of an electro-optical device using a color stimulus for insects [6] allows one to increase the efficiency of mosquito attraction by 21 ... 33% [9].

In addition to increasing the number of larvae deposited by mosquitoes that are eaten by fish, adult individuals (at the stage of development of adults) can also be used to increase the proportion of live feed. In electro-optical devices that attract flying insects to feed fish, a rotating organ (flexible fishing line, fan, etc.) is mainly used as a means of destruction. The operation of these devices is associated with the need for regular cleaning of the fishing line, fan, emitter, replacement, emptying of the storage for caught insects, etc. The shading of the radiation source by insects reduces the efficiency of the installation. The use of an attractant source immersed in water in an electro-optical device for feeding fish [7] makes it possible to simplify the operation of this device by only seasonal cleaning of a sealed RGB-LED strip.

Under the influence of optical radiation of an attractant source immersed in water, insects are forced to direct their flight path to the surface of the pond. Insects of various species that fall onto the water or fly close to its surface become prey for fish. This solution allowed us to significantly simplify the design of the device and improve the practicality of its use in the conditions of inland ponds of fish farms.

An analysis of mosquito vision shows that their eyes perceive close monochromatic colors in the middle of the spectrum: green and blue-violet. Mosquitoes, like all insects, are highly susceptible to UV-radiation. In addition, the sensitivity of the mosquito eye is increased to red radiation. Many other flying insects also have color vision and perceive a wide range of wavelengths of optical radiation.

Results

Currently, the fish farming industry has problems with providing feed to farms for artificial fish cultivation in inland ponds. One of the ways to improve the quality of fish feeding is to increase the proportion of live feed due to the natural forage base of ponds. For this purpose, it is advisable to use electro-optical devices for feeding fish with flying insects. In these electrical devices, LEDs are used as attractant sources. With their help, you can create optical radiation of various colors. This allows the use of a color stimulus to increase the efficiency of attracting flying insects. Convenient in operation is the use of immersed in water sources of optical radiation.

An increase in the share of live feed has a positive effect on the health and development of fish, increases the productivity of ponds and reduces the cost of artificial feed.

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

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