

# EXPERIMENTS IN THE ARTIFICIAL INCUBATION OF *LUCIOPERCA SANDRA* CUV. ET VAL. EGGS

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In the aim of adding continuously to the supply of *Lucioperca sandra* CUV. et VAL. in Lake Balaton, the Alsóörs *Lucioperca* Incubation Station was built, in 1949. The mission of this station is to hatch the *Lucioperca* eggs spawned on artificial nests laid out in the *Lucioperca* spawning grounds of Lake Balaton, in places protected from mud and the depredations of fish and insects. The incubating larvae stay in the nursery basins, until they are 5—7 days old. During this time they consume most of their yolk.

The ripening of the eggs deposited in the nests takes place in constantly changing water. The eggs ripe for hatching are transferred to a basin with standing water, where they hatch out in a short time. The *Lucioperca* larvae pursue a pelagic mode of life until they are about 3 days old and develop here for at least 5 days. The water in the nursery basins cannot be changed, because the current of water flowing off would press the larvae against the enclosing grills and destroy them, as they are very sensitive to mechanical influences.

Incubation of the eggs, as we have already said, should take place in changing water. The eggs, attached to the hairy fibres of the „nests“ (ENTZ and WOYNÁROVICH 1948, p. 35) get sufficient oxygen only if they get a generous water current. This makes the incubation considerably expensive, as it means pumping the water by electric power.

To lower these expenses and to increase the reliability and efficiency of the hatching, in 1947—1949 we worked out a process for ripening the eggs out of water. In the following pages we describe one of the methods, suitable for the hatching of eggs in large quantities.

Based on experiments made in 1947—48, we have communicated already in two papers (ENTZ and WOYNÁROVICH, 1947 and 1948) a practicable way of hatching *Lucioperca* eggs which takes place without water but in a vapourous atmosphere where the surface of the eggs cannot dry out (Souvorov, 1939).

Experiments carried out at the Tihany Biological Research Institute in 1948 proved that a vapour atmosphere chamber could easily be constructed in small dimensions up to about half a cubic meter. In this case the moisture on the eggs can be controlled only by spraying them at least three times a day with a sprinkler.



Incubation of nests in large quantities by this method is complicated and not sufficiently certain, considering that if the hatching chamber should lose 100% of its vapour saturation the water adhering to the surface of the eggs would also evaporate and the eggs would die.

In 1948 we had tried out and in 1949 we perfected a method, for ripening the *Lucioperca* eggs under a fine spray. With this method, nests covered with several hundred eggs could be hatched at a time with technical precision and precise hatching temperature, and thereby the duration of the incubation varied almost at will.

The apparatus used for this method is a sprinkler provided with three heads, as employed in agriculture for watering beets and other hoed plants. The diameter of the openings of the sprinkler heads was 0.5 mm. Water from these narrow openings is distributed in such fine, mist-like particles that drops of it falling on the skin can scarcely be felt. These three sprinkler heads spray an area of about 5–6 m<sup>2</sup>, so that the nets ranged in rows and one above the other get all sufficient moisture. The sprinklers were connected with a rubber hose to a water tap. For the arrangement to work there must be a pressure of at least half an atmosphere in the pipes. If the pressure should be less, it can be increased with a low-powered compressor.

The water consumption of this spray provided with a triple, very fine sprinkler head, did not exceed 20–40 l an hour. This is such a small quantity that no difficulties were encountered in warming it to the optimum of 20 C°.

We can summarise the course of ripening and hatching out the eggs as follows. Every second day we brought in nests covered with eggs from the *Lucioperca* spawning grounds in Lake Balaton. After their arrival we examined them, to establish the degree of development of the embryos. This examination takes about half a minute per nest. Grouping the nests according to degree of development we established how long it would presumably take for the eggs to hatch with the temperature given. We also carefully observed whether there were damaged or mildewed eggs among them. The nests where *Lucioperca* eggs were mixed with those of roach (*Leuciscus rutilus* L.) were treated separately, for during shipment, the larger roach eggs were very often badly injured and became extremely mouldy during the ripening.

The examined nests (Figure 1), arranged in groups as above, were hung on hooks beside and above one another, on a framework in the spraying chamber (Figure 2). On our scaffolds we could place 120–150 nests at a time.

The spraying was only interrupted for treatment and control three times daily, in each case for about 10–15 minutes. It could be seen that if the spraying was turned off every quarter of an hour no harm was done to the eggs.

When the eggs had about reached hatching time — previously established — we ascertained from a few samples that they were ripe. The nests were put into water for hatching. This could be accelerated by two means: 1) by exposing the eggs to the heat of the sun for 2–4 minutes; 2) by putting them for half an hour into water at 20–27° C after which they reached their destination in the nursery basin at a temperature of about 20° C. In this case 90–95% of the eggs hatched



inside 15—20 minutes. Drying in the sun produced no after effects on the young.\*)

In the spraying chamber with an average temperature of 15.5—16° C (measurements 12 times a day, max 21° C, min. 11.5° C\*\*), the eggs always ripened three days sooner than the control material kept in an aquarium with running Balaton water, though when they were brought in they could have been at most 48 hours in the Balaton and most of them were at an entirely initial grade of development, which is when the germinal disc grows entirely or about 3/4ths around the yolk.

A certain definite amount of heat is necessary for fish eggs to ripen. This amount is a certain number of days multiplied by their average temperature (in° C). According to UNGER (1939 p. 735) in the case of *Lucioperca* this is 95—120° C (German „Tagesgrad“). This we controlled by aquarium hatching experiments of our own. But in the sprayed eggs the time of ripening is considerably shorter, compared with the control hatched in an aquarium. According to our estimations the acceleration amounts to 40—50%. We consider the cause of the speedier development to be the greater oxygen provision and the effect of direct sunlight. This is supported by the fact that the eggs at the bottom of the nest, to which no sunlight penetrated and which were also less favourably supplied with oxygen, remained appreciably behind in development. But further experiments are necessary to establish the correctness of this supposition.

The effect of direct sunlight also manifested itself in other ways. In the eggs exposed to light, the eye of the embryo is pigmented black and glistening; guanine crystals also appear, whereas in individuals hatched in water the coloration of the eyes begins only after about 12 hours after hatching.

Hatching of the eggs kept in the sprinkling chamber can be delayed for 3—4 hours. If we do not put the eggs ripe for hatching into the water, in 6—12 hours the larvae begin to emerge in the spraying chamber. They drop down in the drops of water which gather on the fibers of the nest. These larvae are also viable. Experience shows that it is nonetheless better if the eggs ripe for hatching are put into water in time.

We controlled the eggs several times daily, as to whether there were dead or mildewed ones among them. In nests in which the eggs were not injured during shipment (the small *Lucioperca* eggs are very resistant and are injured by only very rough treatment), we never observed mortality and mildew.

If an egg perished it could easily be observed by the empty shell remaining behind.

\* By drying nearly ripened eggs for 5—10 minutes in the heat of the sun a premature hatching can be brought about. The prematurely hatched larvae are incapable of swimming vertically as the normal ones do immediately after emergence; instead they wriggle on the bottom amidst uncoordinated tail-flappings. The individuals which hatched less than half a day less than the normal time, grow into normal larvae without any greater degree of mortality (according to our 1948 observations).

\*\* The temperature varied thus, because the hatching, for lack of other, more suitable place, was carried out in a greenhouse, where it was warm by day and cool at night. The framework needs only to be protected by a roof.



Extensive mildew was usually seen in those nests where there were roaches, which are easily injured in transport, among the *Lucioperca* eggs. The overpowering mildew on the injured roach eggs — which developed abundantly under spraying — spread over the healthy *Lucioperca* eggs too.

The hatched *Lucioperca* larvae were put into an aquarium with standing water aerated with compressed air. In each 40 l aquarium we put 20—30 thousand larvae and in a 100 l aquarium 40—60 thousand. We calculated the number of larvae by carefully stirring the water in the aquarium, then counting the larvae in samples of known content.

If no trouble occurred in the aerating system there was very little mortality among the larvae, scarcely to be expressed in %. The dead larvae are white and are soon betrayed by their immobility.

At the age of 5—7 days we put the larvae into the lake. At this age their yolk-sacs are to a great degree absorbed. They are vigorous, swim like fish and are able to protect themselves. There is now hope for the survival of a greater percentage of them.

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## ОПЫТЫ ИСКУССТВЕННОЙ ИНКУБАЦИИ LUCIOPERCA SANDRA CUV. ET VAL

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#### РЕЗЮМЕ

Мы выработали новый метод высживания, прородного для яиц *Lucioperca sandra* Cuv. et Val. в большом количестве, и подходящего для целей рыболовства. Сущность метода следующая: мы держим повешенные в рамках яйцевые „гнезда“ на воздухе до момента созревания, действуя на них тонкой водяной пылью, температурой в 20° С. Процесс инкубации может быть ускорен выставлением зрелых яиц на солнце в течение 2—4 минут и держа их полчаса в воде, темп. в 20—27° С. прежде чем класть их в сажалку. Молодь там выращивается в течении 5—7 дней и потом выпускаются в свободную воду. Во время выращивания количество их никогда не должно превышать 600—800 на литр, даже в хорошо проветриванном аквариуме.





Fig. 1. Nest with the spawn of *Lucioperca sandra*.

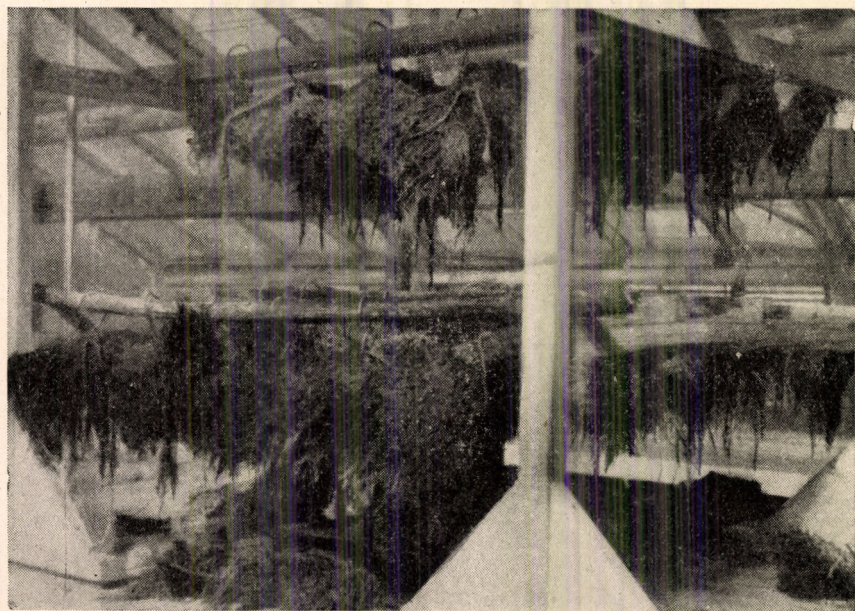


Fig. 2. Nests, hanging on the framework, where the ripening of the eggs takes place under a continuous spray.