

## Effects of producing stocking material of vendace *Coregonus albula* (L.), using spawners reared in captivity – initial studies

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**Abstract.** The aim of the studies was to conduct vendace, *Coregonus albula* (L.), spawning with spawners reared under controlled conditions. The initial work of rearing spawners was begun in spring 2006, and in the fall 2007 the brood stock numbered 26 females and 20 males. Overall, 155 g of spawn, which was about 71,500 eggs, was obtained. The mean effective fecundity was determined as 83,954 eggs kg<sup>-1</sup> of female body weight. The eggs obtained were incubated, and the hatchlings were reared for 7 weeks. In the third week, the mean larval body weight was 32 ± 9 mg, while in the fifth week the mean weight and length of the larvae was 50 ± 20 mg and 19.9 ± 3.27 mm, respectively. After 7 weeks of rearing, 14,162 juveniles of a mean weight of 109.3 ± 33.0 mg and mean length of 26.1 ± 3.15 mm were obtained. The cumulative mortality from fertilization to the fry stage was approximately 80.3%.

**Keywords:** *Coregonus albula*, stocking material, spawning, rearing

Deteriorating environmental conditions resulting from progressing eutrophication mean that the number of lakes inhabited by vendace, *Coregonus albula* (L.), is decreasing systematically, and the species is under threat. Currently, the spawn incubated in hatcheries comes exclusively from spawners caught in the wild (Szczerbowski 2008). This is highly disadvantageous since decreasing population numbers of vendace in Poland significantly decrease the quantities of spawn obtained for the production of stocking material. This, in turn, means the magnitude of stocking programs is also decreasing. This is why developing technologies for rearing spawners is as important a task for fisheries as it is for saving this species of Polish ichthyofauna.

Attempts to rear vendace spawners have been made only rarely, and these were usually focused on ripus, *Coregonus albula* m. *vimba* (L.) (Terlecki 1953, Grabda and Hesse 1991), while in Poland this type of work has not been undertaken, or, if it has, it was unsuccessful since there are no references to be found in the available literature. The primary aim of the current study was to determine under which artificial conditions it is possible to conduct a full vendace production cycle.

The initial work on rearing vendace spawners was begun in spring 2006. From 5000 fish of a mean weight of 0.28 g, 755 vendace selects of a mean weight of 13.4 g were obtained by spring 2007

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(Kozłowski et al. 2007). The fish were divided into two groups: one (190 individuals) was kept in the in two tanks with a bottom surface area of 0.75 m<sup>2</sup> and a volume of 600 dm<sup>3</sup> (Department of Biology and Fish Culture, University of Warmia and Mazury in Olsztyn). The second group was held at a fish farm in Komorowo (northern Poland approximately 30 km from Olsztyn) in concrete ponds with a bottom area of 6 m<sup>2</sup> and a volume of 4.8 m<sup>3</sup>, and supplied with lake water.

During rearing, the fish were fed commercial trout feed Nutra HP T. 1.1 (54% protein, 18% fat, digestible energy 20 MJ kg<sup>-1</sup>) three times daily ad libidum (Kozłowski et al. 2007). Feeding was limited at the fish farm during periods of high temperature. In fall 2007, the brood stock numbered 26 females and 20 males. Prior to spawning, the females and males were held together at the fish farm in Komorowo. After the water had cooled to 4°C, the fish were inspected twice a week using the methods applied by Terlecki (1953) for the artificial spawning of ripus, *Coregonus albula* infrasp. *lagodensis* (Berg 1948). All manipulations of the fish were performed after they had been anesthetized in a solution of Etomidat at a concentration of 120 mg dm<sup>-3</sup>. When sexual maturity was confirmed in females (when eggs flowed freely under slight pressure on the abdomen), eggs were collected and fertilized with the milt of several males. The fertilized eggs were incubated in Weiss jars (Szczerbowski 2008) that were supplied with water with a natural thermal regime. The 26 ripe females were stripped of 155 g of eggs, which was approximately 71,500 oocytes (mean weight of 2.17mg, range from 1.89 to 2.61 mg). The mean weight of the eggs expressed as the percentage of body weight was 18.4%, while the mean effective fecundity was determined to be 83,954 oocytes per kg of female body weight (Table 1).

The egg incubation was concluded in spring 2008, and the larvae produced were reared further. Larvae aged from 3-5 days of a weight of approximately 3 mg were stocked into aquaria with a volume of 200 dm<sup>3</sup> at a density of about 40 indiv. dm<sup>-3</sup>. Each aquarium was equipped with an external

**Table 1**

Selected parameters describing the effectiveness of artificial vendace reproduction

	Mean	Range	
Female weight (g)	42.8	28.0	79.0
Weight of eggs (% of female BW)	18.73	12.41	24.30
Working fecundity (eggs)	7085	1373	9650
Relative effective fecundity (eggs kg <sup>-1</sup> )	83954	43683	99927

cannister filter Unimax 250 (Aquael, Poland) with a filtration capacity of 8 dm<sup>3</sup> and a maximum capacity of 650 dm<sup>3</sup> h<sup>-1</sup>, but during the first week of rearing the water flow rate was limited to about 300 dm<sup>3</sup> h<sup>-1</sup>. The aquaria were also aerated, and half of the water volume was exchanged every second day. During rearing, it was attempted to maintain the oxygen saturation rate above 95%, while the amount of undissociated ammonia was kept below 0.05 mg dm<sup>-3</sup>.

The larvae were fed with brine shrimp *Artemia* sp., nauplii and commercial feed: Gemma micro 150 µm and 300 µm (55% protein, 14% fat) and Perla Larva Protective 3.0 (62% protein, 14% fat) ad libidum. For the first three weeks, the fish were fed mixed feed six times daily: three times with live food and three with commercial feed in single portions delivered in about 30 min. In the third week of rearing, the share of brine shrimp was reduced gradually and by the fourth week they were fed only commercial feed. The water temperature during rearing ranged from 13 to 15°C.

Following the three-week rearing period, the first measurements were taken (n = 50, TL ± 0.1 mm, BW ± 1 mg). Subsequent measurements were taken at two-week intervals. At the third week of rearing, the mean body weight of the fish was 32 mg while total length was 17.2 mm, in the fifth week these values were 50 mg and 19.9 mm (Fig. 1). After seven weeks of rearing, 14,162 juvenile specimens were obtained at a mean weight of 109.3 mg and a mean

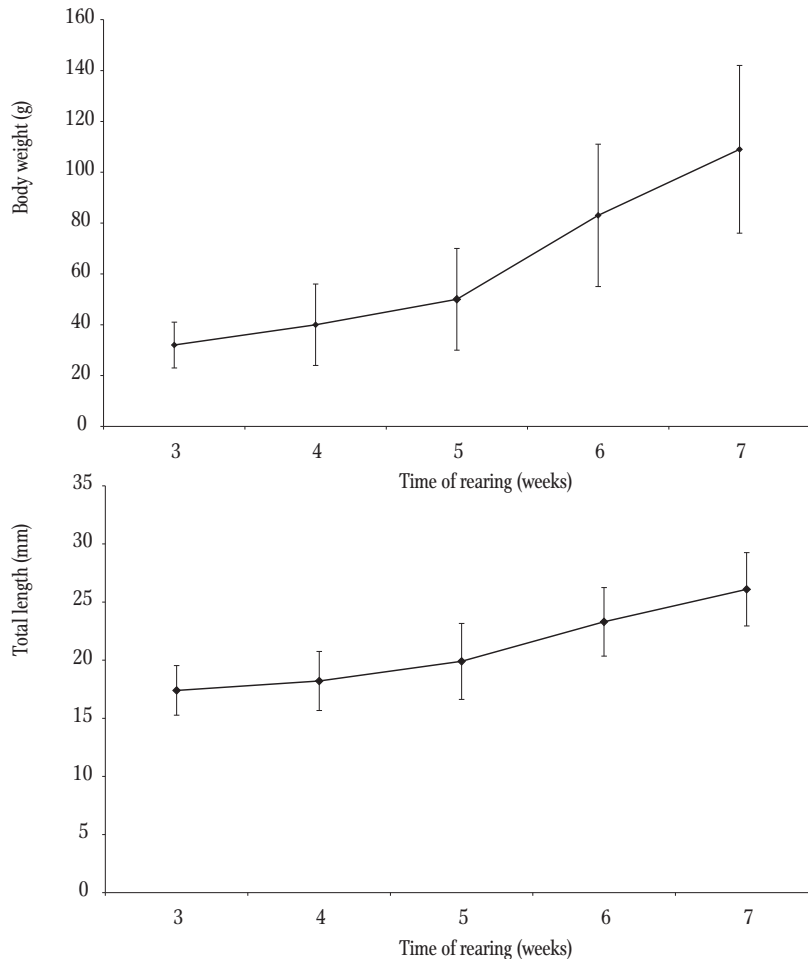


Figure 1. Temporal changes of (mean  $\pm$  SD) body weight (a) and total length (b) of 0+ vendace during rearing. Initial larvae mean body weight was 3 mg.

total length of 26.1 mm. The cumulative mortality from fertilization to the juvenile stage was 80.3%.

These initial studies indicated that rearing vendace spawners and obtaining sexual products from them is an alternative method for the production of stocking material, which currently relies on the capture of ripe spawners from natural waters. Even during the initial stages of study, the quantity of juveniles produced was three-fold larger than the initial size of the stock in 2006. Although the brood stock was small (total of 56 fish), the weight of all of the females used in breeding was just over 1 kg. In comparison to the effective fecundity of spawners caught in lakes (Szczerbowski 2008), the economic fecundity of the cultured vendace was approximately 30% higher. The significantly higher economic fecundity was likely due to

the fact that the females did not expel spawn during manipulations, as happens during catches of spawners from lakes. Removing fish from net gear, transport, and other manipulations cause some fish to lose eggs, which probably contributes to the lowered actual effective fecundity of the vendace.

The growth rates of the larvae were similar to those obtained by Mamcarz et al. (1995) and Kozłowski (2004). This indicates that rearing spawners under artificial conditions does not have a negative impact on the progeny obtained. The results recorded to date indicate that techniques for rearing spawners requires further development, especially those for increasing stock density and improving lighting conditions during rearing to minimize stress and limit the mortality noted

among selects during the second year of rearing. Stress might be the cause of non-specific bacterial infections that occur due to decreased fish resistance (Prost 1980). In earthen ponds it was confirmed that filamentous algae have a significant impact on the condition and mortality of the fish, as was observed by Szypuła (1970), who compared the vendace in earthen ponds and lakes, and by Bernatowicz et al. (1975), who conducted studies of rearing vendace fry in earthen ponds. Thus, reproduction under artificial conditions does not pose a problem for the rearing of this species.

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## Streszczenie

### Efekty produkcji materiału zarybieniowego sielawy *Coregonus albula* (L.) w oparciu o tarlaki wyhodowane w niewoli – badania wstępne

Wstępne prace nad hodowlą tarlaków sielawy podjęto wiosną 2006 roku. Jesienią 2007 roku uzyskano stado tarlaków liczące 26 samic i 20 samców. Łącznie pozyskano od nich 155 g ikry, czyli około 71500 ziaren. Przeciętna płodność gospodarcza została określono na 83954 ziaren ikry na kg masy ciała samic. Uzyskaną ikrę inkubowano, a larwy podchowowano przez 7 tygodni. W trzecim tygodniu średnia masa larw

wynosiła 32 mg (SD = 9 mg), zaś w piątym odpowiednio: 50 mg (SD = 20 mg) i 19,9 mm (SD = 3,27 mm). Po siedmiu tygodniach uzyskano łącznie 14162 osobników juwenalnych o średniej masie 109,3 mg (SD = 33,0 mg) i długości 26,1 mm (SD = 3,15 mm). Skumulowana śmiertelność od momentu zapłodnienia ikry do czasu uzyskania osobników juwenalnych wyniosła około 80,3%.