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REARING OF NASE (*CHONDROSTOMA NASUS*) FRY ON LIVE DIET AND PREPARED FEED

Robert Czerniawski, Józef Domagała, Łukasz Sługocki, Tomasz Krepski, Małgorzata Pilecka-Rapacz
Department of General Zoology, University of Szczecin, Szczecin, Poland

ABSTRACT

The aim of study was to evaluate the effects of the live diet and pellet diet on the survival and growth rates of the stocking material of nase fry. The rearing was performed in two variants: live-fed group (LFG) and pellet-fed group (PFG) – larvae fed on prepared food starter. The LFG were reared on similar food that occurred in a stream designed for the stocking in each week of the experiment (zooplankton, chironomids larvae and periphyton). In the beginning of rearing, the PFG were characterized by higher values of total length, mass than those from the LFG. After supplementation with periphyton for the LFG, the values of total length and mass of the LFG were higher than those of the PFG. Our results show that the rearing of the nase fry on natural food may lead to them obtaining satisfactory growth rates.

Key words: *Chondrostoma nasus*, Foraging skills, Fish restoration, Fish nutrition.

INTRODUCTION

Recently the abundance and biomass of potamodromous fish in Central Europe are more than ten times lower when compared to 70 and 80 years of the 20th century; the main reasons for this decline are pollution, and the regulation of river beds and river dams [1, 8, 11, 21, 25, 28]. Halting the decline in the abundance of rheophilic cyprinid species or restoring them can be achieved, among other measures, through intense stocking [14]. Therefore, in last decades, research has been focused on improving the techniques for rearing stocking material of potamodromous fish [6, 8, 11, 14]. Despite the stocking of the rivers of Central Europe with the hatchery-reared larvae and fry of rheophilic fish, the abundance of this species is still low [6, 7, 8, 11, 16, 27]. One of the species that requires artificial rearing prior to stocking is the nase (*Chondrostoma nasus*). Although in the Czech Republic the nase is characterized by relatively high abundance [9], in Poland this species has achieved a significant decline of abundance and biomass [3].

Intensification of fish production requires knowledge of the effects of high-energy diets on the growth rates and the time necessary to attain market-sized fish [19]. The main way of production of the stocking material of cyprinids is rearing them on brine shrimp larvae (*Artemia nauplii*) and then next on formulated dry diet [8, 11, 14, 24, 30, 31]. Attaining adequate survival rates of the rheophilic larvae of cyprinids in earthen ponds, or as stocking material prior to rearing them under controlled conditions, is impossible [14, 30]. This commercial method is relatively easy and cheep. However, the artificially prepared food given to larvae as stock does not develop the foraging skills needed for the capture of live food in the wild [18]. Earlier studies have shown that the use of live diet in the rearing of the stocking material of salmonids gave better results of survival for these fish in the wild [5]. Some authors reported that supplementation with live food or a supplement of the natural elements in rearing can positively affect the survival of fish released into the wild [4, 20, 32]. Thus, used in the rearing of nase as a stocking material, the live, natural food occurring in the wild could have a positive effect on its survival and growth.

The present study was undertaken to evaluate the effects of the live diet occurring in the wild, and that of a pellet diet, on the survival and growth rates of the reared nase fry designed for stocking.

MATERIAL AND METHODS

Before our experiment the fry were reared on brine shrimp nauplii and a pellet diet in the hatchery of the Polish Angling Association in Szczodre. The experiment of present study was performed in a closed recirculation system. Into the 300 L water tanks the 25-day old fish fry of the nase from the hatchery were introduced (mean initial total length (TL) – 19.12 mm; mean initial mass (W) – 0.055 g). In our experiment the introduced fry of the nase were reared for 9 weeks in 6 tanks (three replicates for each variant). In each tank 150 individuals of nase were introduced. The volume of water in the tanks was 300 L. The water temperature was kept between 14ºC (at the beginning of rearing) and 20ºC (at the end of rearing) by a cooling device (Aqua Medic, Titan 2000). The density of fish in each tank was 500 fish. The rearing was performed in two variants: live-fed group (LFG) and pellet-fed group (PFG) – larvae fed on prepared food starter (Skretting, Perla Larva 62% protein and 11% fat). Every week the temperature in the stream (designed for stocking) with good conditions for nase was checked and any changes in temperature change were then changed in the hatchery. The LFG were reared on similar food (zooplankton, chironomids larvae and periphyton) that occurred in a natural stream designed for the stocking. Every week in the stream we checked the occurrence of periphyton on stones that are the main food base for the fry of the nase in the wild [3, 22]. The abundance of periphyton in the wild is not constant during the whole year. However, in the sixth week from the beginning of rearing, the stones in the stream were the most densely overgrown with periphyton. Consequently, the stones with periphyton from this stream were placed into the tanks with the reared fry. From the first week, the fry from the LFG were fed on zooplankton (copepods and daphnids) and *Chironomidae* larvae; from the sixth week they were furthermore fed on periphyton. The live zooplankton and live chironomids was received from the culture. The food for the LFG and the PFG was given *ad libitum*, three times per day, from 7 o'clock to 17 o'clock. Every week, 50 individual fish were caught from each tank to measure and evaluate the average of total length and mass. They were anaesthetised in a MS 222 solution. Total length was recorded to the accuracy of 0.5 mm. Mass was recorded to the accuracy of 0.1 mg. Once the fish were roused they were placed back into the tanks.

The condition factor (K) was calculated by $K = 10^5 TL^{-3}$, where: W – mass; TL – total length. The specific growth rate was found from the formula: $SGR = (\ln M_F - \ln M_I\ 10^2)\ t^{-1}$, where: $\ln M_F$ – the natural logarithm of the final mass; $\ln M_I$ – the natural logarithm of the initial mass; t – time (days) between $\ln M_F$ and $\ln M_I$. The statistical significance of the differences in the rate of survival and total length, mass and condition factor of the reared and fish were tested by ANOVA and post-hoc Tuckey test ($P < 0.05$) with Statistica 10 software.

RESULTS

The survival rate of both reared groups was high – LFG 99% and PFG 98%. From the first week to the sixth week of rearing, the PFG were characterized by higher values of TL, W and condition factor than those from the LFG, and similar values of SGR (Fig. 1, Fig. 2). During this period the TL and W of the PFG was in some weeks significantly higher than those of the LFG ($P < 0.05$). By the sixth week of rearing, before and after periphyton inclusion, the SGR of the PFG (3.4% day^{-1}) was higher than that of the LFG (2.9% day^{-1}). In the seventh week, after supplementation with periphyton for the LFG, the similar values of TL, W and condition factor and insignificant differences between the LFG and the PFG were observed ($P > 0.05$). However, in this week there was a rapid increase of the SGR in the LFG. In the eighth and ninth weeks of rearing, the values of each parameter of the LFG were higher than those of the PFG (Fig. 1). Moreover, in the last two weeks of rearing the LFG achieved significantly higher W than the PFG, while the TL of the LFG was significantly higher than the PFG only in the last week of rearing. In the last three weeks of rearing, the LFG characterized were by a higher SGR than the PFG in each week (Fig. 2).

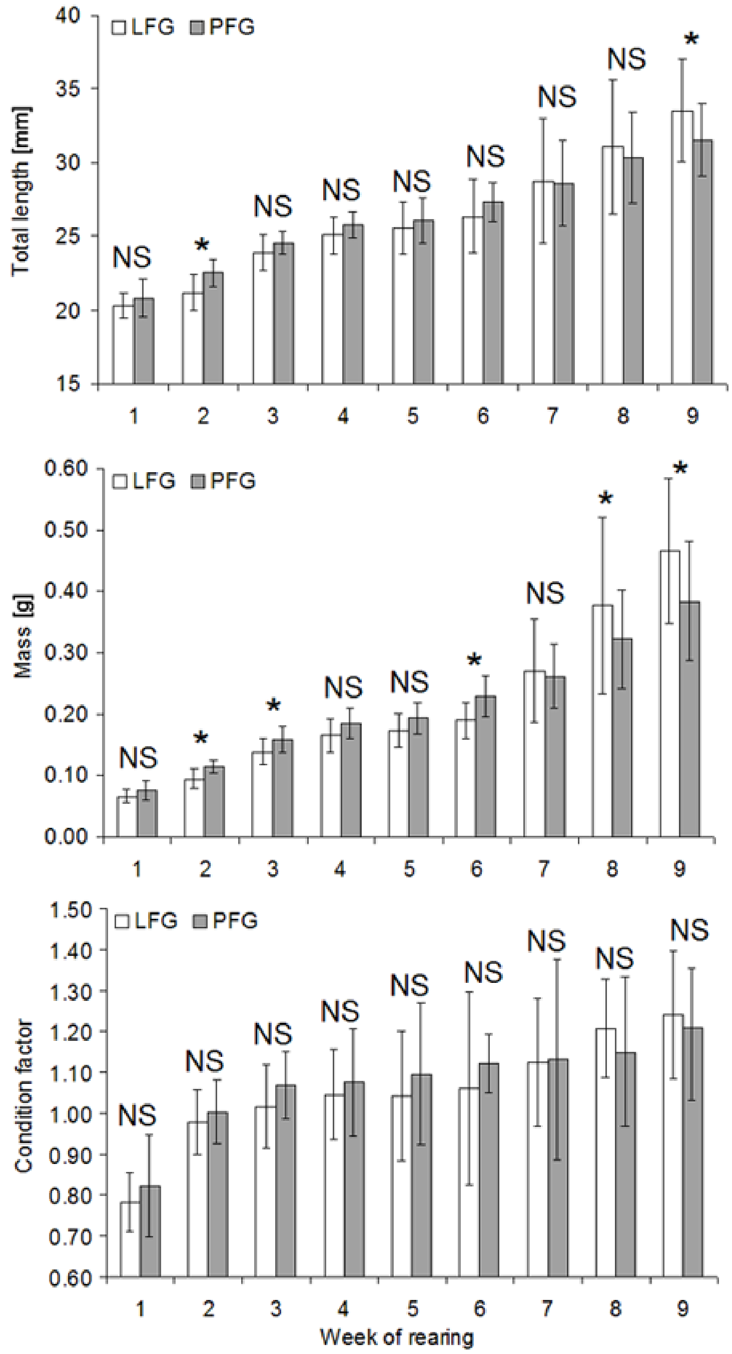

Fig. 1. The results of rearing of the nase larvae fed on zooplankton and live food (LFG) and on pellet diet (PFG). Data are presented as mean ± SD. Significant differences between groups are marked with astrerix: * P < 0.05; NS – not significant

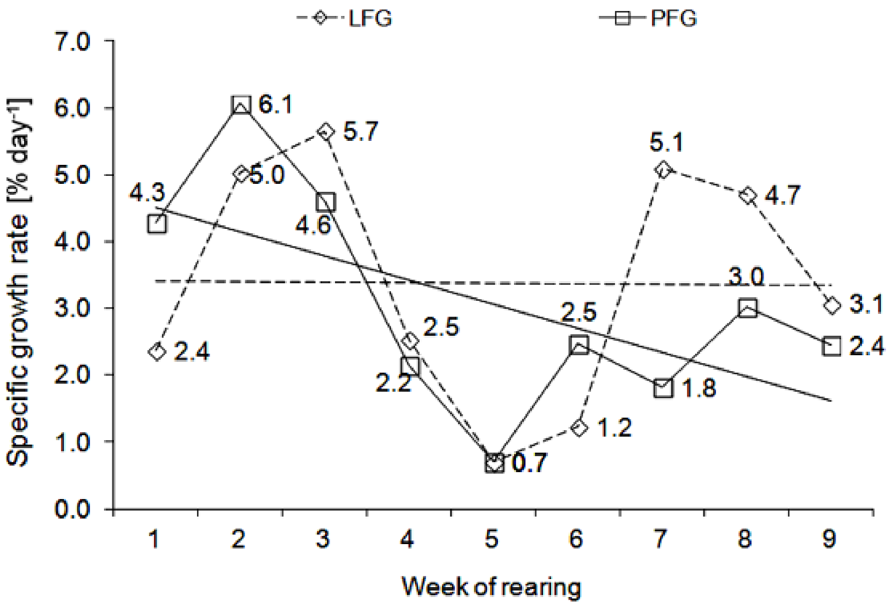

Fig. 2. Specific growth rate of two reared group of the nase in each week of rearing

DISCUSSION

Wolnicki [29] has reported that only two species among rheophilic cyprinids can be reared from the beginning of exogenous feeding of dry starter diet; these are the barbel (*Barbus barbus*) and the nase. However, they also obtain insignificantly slower larval growth and lower survival rates than larvae reared on live food [19, 29]. Hence, in the present study, in the first five week of rearing the differences between the LFG and the PFG were small; moreover, the PFG were characterized by faster growth than the LFG. The other larvae of rheophilic cyprinids (e.g. chub, asp, and vimba bream) reared on live zooplankton have a 50% higher survival rates and better growth rates than those which were fed only starters [8, 11, 28]. Contradictory results were obtained during the rearing of the larvae and fry of salmonids. Tymchuk and Devlin [26], Czerniawski et al. [5], Czerniawski et al. [6], reported that juvenile rainbow trout, brown trout and Atlantic salmon fed only live food achieved good rates of growth only in the first two week after exogenous feeding. Later these larvae were characterized by significantly slower growth rates in comparison to the larvae fed starters.

As shown, the results of the present study of the use of dry diet and live diet in the rearing of nase was enough to achieve good rates of survival and growth. However, significant differences in growth rates between the LFG and the PFG were observed and it seems that they were no strong. In contrast to the larvae, the diet had no strong effect on the cyprinid juvenile growth rates [30]. Thus, feeding juveniles with natural food does not accelerate growth [11]. Furthermore, it is not economically profitable, as the cost of commercial chironomid larvae used to produce 1 kg of juvenile fish biomass is several times higher than the cost of the dry diet [11]. Conversely, the highest differences in the growth rates between the LFG and the PFG after rearing on periphyton have shown that this kind of food can have an impact on the nase growth. Perhaps the use of natural and specific food for nase, which is a periphyton, is a key treatment in the production of stocking material. The nase is a phytophagous fish, feeding mainly on periphyton, but also insects [19]. Thus the rearing of nase larvae or juvenile on periphyton could affect the growth of this species under controlled conditions and could affect their survival and growth rates in the stocked stream.

The larvae of rheophilic cyprinids are fully able to accept both dry prepared food and live food, to grow intensively and to survive well [8, 11, 29]. From an economic-technical point of view, it seems to be the most suitable to rear larvae of cyprinids exclusively on a dry diet, that is, immediately after exogenous food to be taken. However from a biological point of view, it is more suitable to rear the larvae of the vimba bream (*Vimba vimba* L.) using live food up until the time of the final stages of the larval period of development [8]. The live food could shape the foraging skills of young fish [6].

The influence of the way of rearing on survival and growth rates of hatchery-reared salmonids in the wild were studied by Czerniawski et al. [5, 6]. The live food was used as the significant factor in shaping the foraging skills of these fish. The survival rates of hatchery-reared one-year old Atlantic salmon, brown trout and sea trout reared on live zooplankton were even over 50% higher than those reared on the pellet diet. The general conclusion of the studies was that the live food used during rearing had a positive effect on foraging skills, survival rates and the growth of juvenile salmonids in the wild. The pellet diet used in rearing had a worse impact on fish behaviour in the wild. The survival and growth rates of juvenile salmonids, noted by the other authors, who, prior to stocking into the wild, reared these fish only on dry prepared food, were also low [7]. Most authors studying the relationship between fish reared in artificial and natural or semi-natural conditions strongly suggested a rearing which is the most similar to the natural one. This is because natural conditions positively affect the survival, behaviour and physiology of fish [2, 10, 13, 17]. According to Paszkowski and Olla [20], Lazzaro [15] and Reiriz et al. [23], the process of learning to find and identify prey is of a key significance for the future survival of the fish in natural conditions. In regard to the results and statements of the cited authors, it can be concluded that the periphyton and natural food of the nase could shape its foraging skills that could affect the survival and growth rates in the wild. However, this statement is speculative cause in the present study any data on post-release survival rate of nase fry is given. Fish feed on periphyton might adopt a benthonic habit but in the present study any stomach were dissected for the diet study, so it is hard exactly to know what food was preferred by fish.

CONCLUSION

Recently, the nase as an endangered species is the important object of studies in Poland and other European countries [11, 12, 19]. The main aim of these studies has been the development of artificial spawning and the production of stocking material for restocking the natural conditions [11]. So, it is worth it to look for such ways of rearing that will produce the best stocking material of the nase. Our results show that the rearing of the nase fry on natural food may lead to them obtaining satisfactory growth rates. Moreover, according to other studies, it is very likely that natural and live food used in rearing will shape the foraging skills of this fish designed for stocking. In order to assure the presence of the main food items for the feeding of nase fry, our study could show the best period for stocking with the juvenile of nase. It seems that the stocking should be made in the period when, in rivers designed for stock, the stones are densely overgrown by periphyton. Despite their occurrence in river water, the zooplankton and chironomids that are also the natural food of the nase fry, the best growth and survival rates of the nase fry could be achieved thanks to eating the periphyton.

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Robert Czerniawski
Department of General Zoology, University of Szczecin, Szczecin, Poland
Z. Felczaka 3C
71-412 Szczecin
Poland
phone: +48 91 444 16 24
email: czerniawski@univ.szczecin.pl

Józef Domagała
Department of General Zoology, University of Szczecin, Szczecin, Poland
Z. Felczaka 3C
71-412 Szczecin
Poland
phone: +48 91 444 16 24
email: jozef.domagala@univ.szczecin.pl

Łukasz Sługocki
Department of General Zoology, University of Szczecin, Szczecin, Poland
Z. Felczaka 3C
71-412 Szczecin
Poland

Tomasz Krepski
Department of General Zoology, University of Szczecin, Szczecin, Poland
Z. Felczaka 3C
71-412 Szczecin
Poland

Małgorzata Pilecka-Rapacz
Department of General Zoology, University of Szczecin, Szczecin, Poland
Z. Felczaka 3C
71-412 Szczecin
Poland
phone: +48 91 444 16 24
