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# COMPARISON OF THE EFFECTS OF REARING STURGEON FRY USING VARIOUS STARTERS

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A B S T R A C T. A study was done to compare usefulness of various starters in various phases of sturgeon fry rearing. Following starters were used: „ASTA-AC" - experimental feed for sturgeon larvae, and two trout starters - „Kristall" produced by ALLER MØLLE and Fb 50/14 SP made by Kraft. Highest survival (over 50%) at the initial stage of rearing was obtained using starter „ASTA-AC". In further rearing highest growth rate (up to 14% of stock mass per day) was attained by the fry fed with „Kristall" feed.

Key words: INTENSE FISH REARING, ACIPENSERIDAE, FRY REARING, ARTIFICIAL FEEDS

## INTRODUCTION

Formulas used in the intense fish rearing, besides balanced content of basic nutrients, should be appropriate in terms of smell and taste. It is related to specific mode of food localization and uptake by *Acipenseridae*, using unlike most other fish, mostly chemoreception (Pavlov et al., 1970; Piatkina 1976, 1991; Pavlov, Kasumian 1990). It was observed that olfactory organs in *Acipenseridae* develop already at embryonic stage, and ability of taste reception is attained at the moment of shift to exogenous feeding (Devitsina, Kazhalev 1992; Kasumian, Kazhalev 1993). During larval period behavioral mechanisms of food localization and uptake are developed. Thus, it is assumed that using feeds of inappropriate smell and taste may adversely affect food intake, which causes size differentiation and leads to canibalism, or even to starvation and mass mortality of fish (Kolman 1993).

Laboratory studies (Kasumian et al. 1992) revealed that Caspian sturgeon fry (*Acipenser stellatus*) is attracted by the smell and taste of yeast in feed, and repelled by fish meal as a source of protein used in most of commercial trout starters. Thus, such feeds should not be used during pre-rearing of *Acipenseridae* larvae, immediately after shift to exogenous feeding. However, trout starters are appropriate in further rearing, which means that their composition well meets nutritional requirements of *Acipense-*

*ridae* (Hung, Lutes 1987; Gamygin et al. 1989; Ronay 1992; Muller 1992; Kolman, Szczepkowski 1995).

The aim of present study was an assessment of usefulness as pre-starter for *Acipenseridae* of „ASTA-AC", a feed formulated in Z.I.i.G.R PAS taking into consideration smell and taste preferences of *Acipenseridae* fry.

## MATERIAL AND METHODS

Rearing of the larvae was carried out in water recirculation system in D.O.Z. „Dgał", during three consecutive rearing seasons.

During first season larvae of triploid hybrid of (*Huso huso* L. x *Acipenser ruthenus* L.) bester and Siberian sturgeon were reared, and in second and third season Siberian sturgeon larvae. Fertilized eggs were brought from Russia and incubated in the hatchery of D.O.Z. „Dgał". Rearing of the larvae was done in two phases:

- pre-rearing;
- intense rearing until average body mass over 10 g/ind.

During pre-rearing mainly „ASTA-AC" starter was used, and only in first season „Kristall" was applied to compare the effects of rearing (group 1). Initial daily dose applied beginning from 10 day of rearing was equal to 30% of stock mass and was gradually reduced according to the growth rate of larvae, basing on feeding diagram (Fig. 1). Feed was supplied continuously during 24 h using conveyor feeders.

During pre-rearing of the larvae, initial stock densities differed in various seasons: in first season fish were stocked in density of 2000 ind./$m^2$ of tank bottom, in second - 2190 ind./$m^2$, and in third - 1445 ind./$m^2$.

During intense rearing phase in first season two feeds were applied: „Kristall" (group 1) and „ASTA-AC" (group 2). In second season three feeds were used: „Kristall", „ASTA-AC" and Fb 50/13 SP. In third season only „Kristall" was applied. Daily feed doses were determined basing on average fish mass, according to feeding diagram (Fig. 2). During all seasons two replicates of each group were tested. Stock densities were equal to 750 ind./$m^2$.

Fish mortality was estimated twice a day and expressed as percent of present fish number. Survival was calculated according to the formula:

$$S\% = \frac{N_i - M_n}{N_i \cdot 100}$$

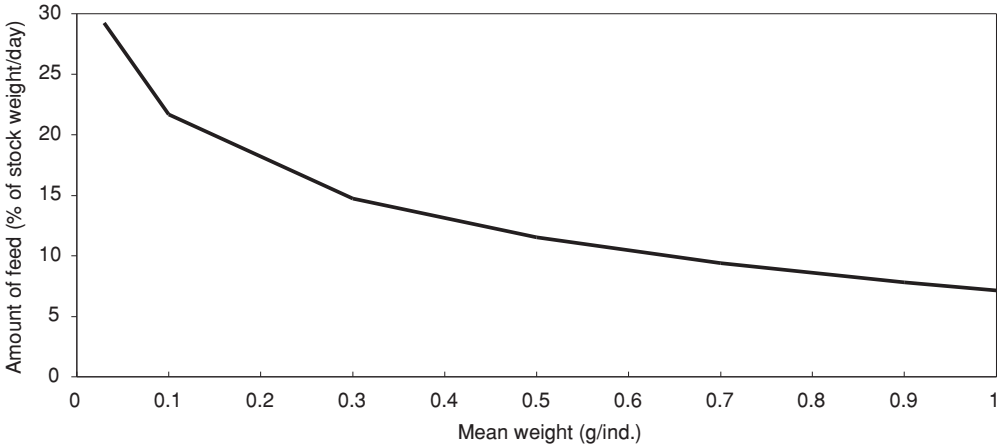


Fig. 1. Feeding diagram for sturgeon larvae.

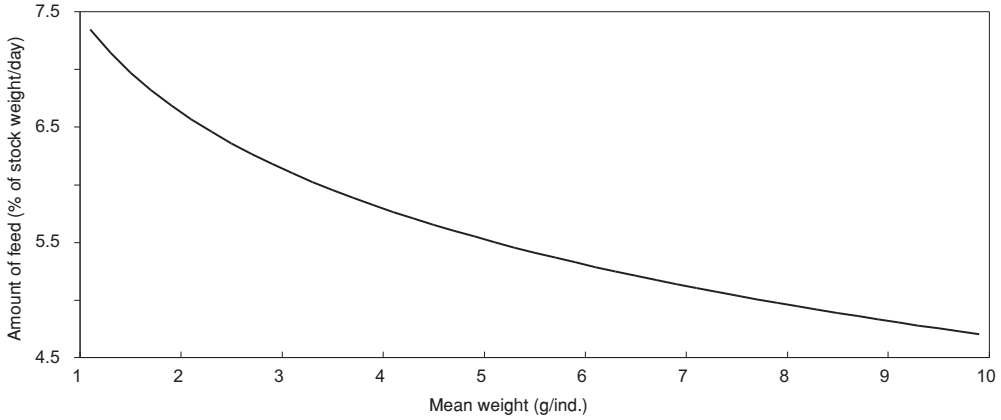


Fig. 2. Feeding diagram for sturgeon fry.

where: S% - survival of fish on day „N" [%],

Ni - initial number of fish [ind.],

Mn - mortality on day „n" [ind.].

During rearing fish were weighed twice a week. Larvae were weighed in samples of 150 ind. each, and average body mass was calculated. Fry was weighed in samples of 30 ind. Growth rate of fry, as increase of average mass in percent per day was calculated according to the formula:

$$\Delta W\% = \frac{\frac{W_i - W_f}{W_i}}{n \cdot 100}$$

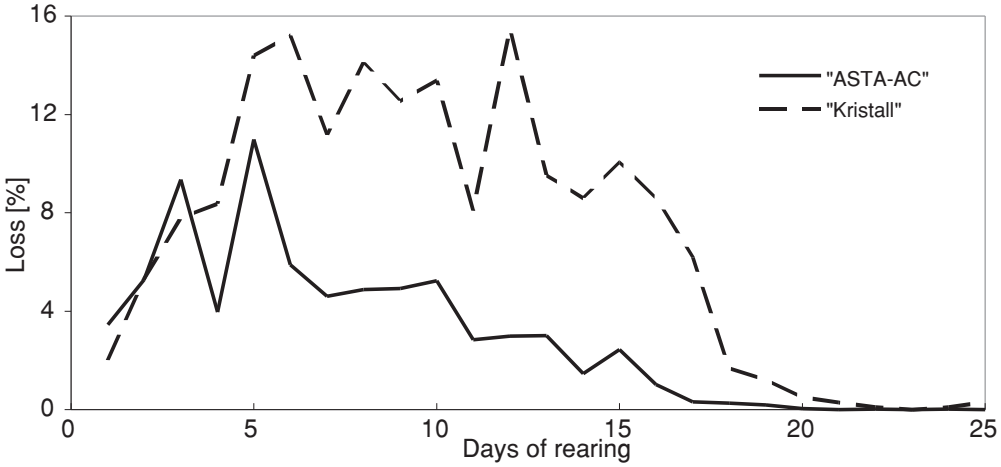


Fig. 3. Comparison of fish losses of hybrid during pre-rearing using two starters.

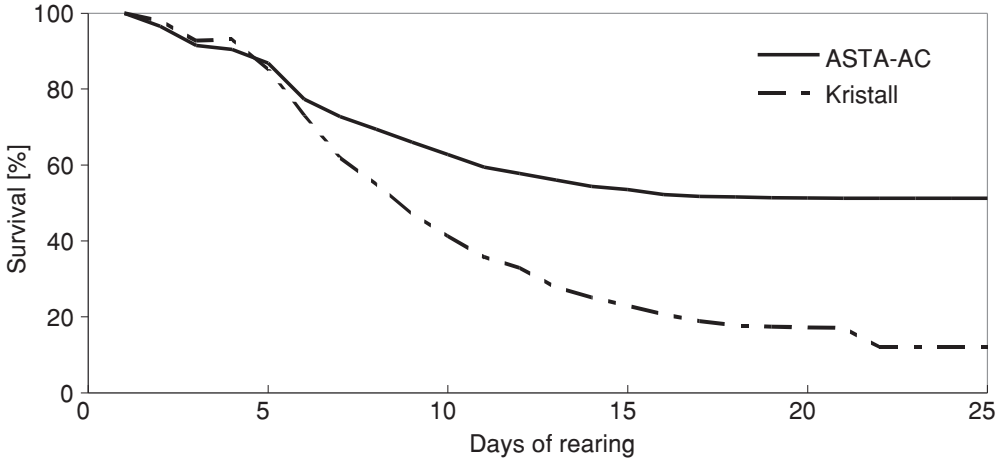


Fig. 4. Differences in survival of hybrid during pre-rearing using two starters.

where: ΔW% - daily incease of average body mass [%],
Wi - initial average body mass [g],
Wf - final average body mass [g],
n - number of rearing days.

During pre-rearing phase water temperature was 17°C, and during intense rearing 20-21°C. Dissolved oxygen concentration measured at the outflow was over 6 mg/dm$^3$. Concentrations of ammonia and nitrites were below treshold for Salmonid larvae (Kolman 1992).

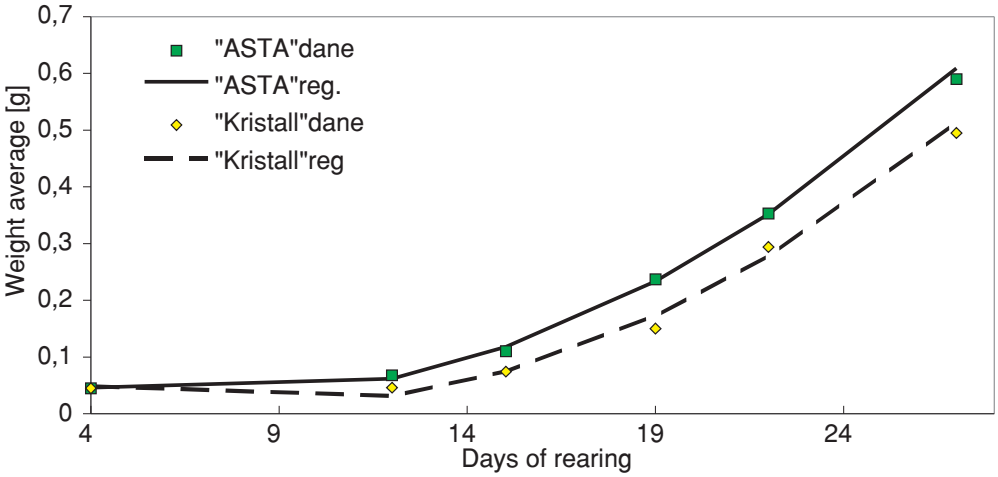


Fig. 5. Comparison of growth rate of hybrid larvae during pre-rearing using two starters.

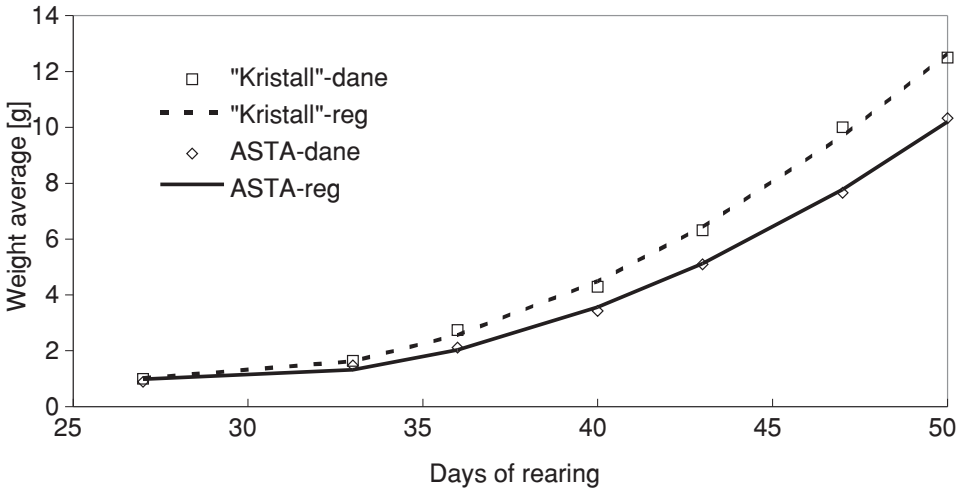


Fig. 6. Comparison of growth rate of hybrid fry during intense rearing using two starters.

# RESULTS

## FIRST SEASON

Highest fish loss was observed on days five and six of rearing, and in groups 1 and 2 it was equal to 15% and 11%, respectively (Fig. 3). In group 1 high mortality occured, with few exceptions, until day 15, and in group 2 it decreased, and after 15 da-

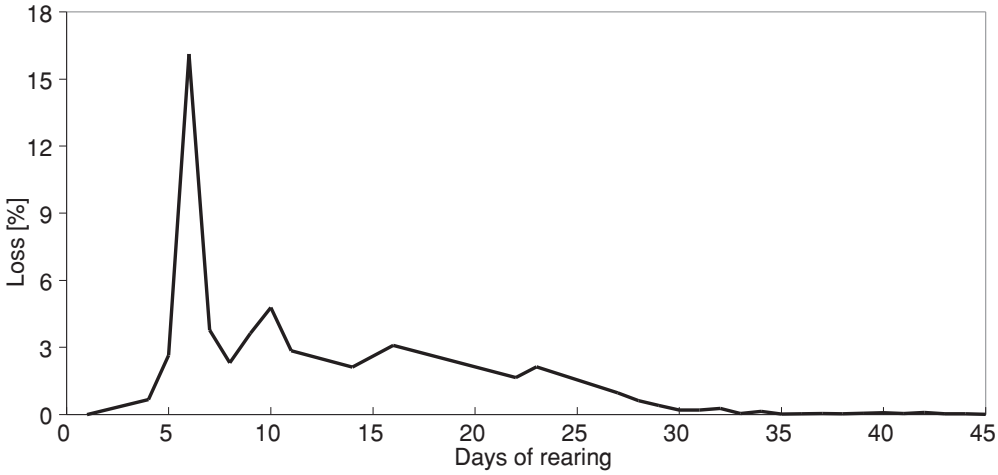


Fig. 7. Changes in mortality of Siberian sturgeon (*Acipenser baeri*) larvae during pre-rearing in second season.

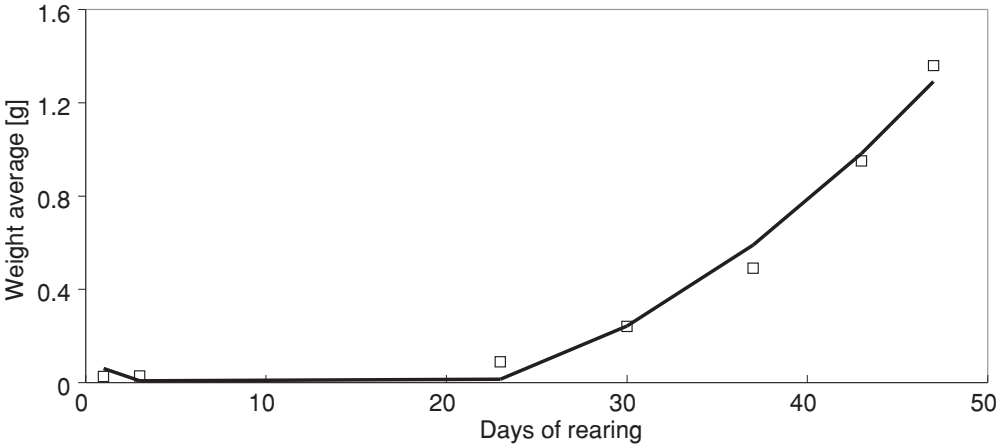


Fig. 8. Growth rate of Siberian sturgeon (*Acipenser baeri*) larvae during pre-rearing in second season.

ys did not exceed 2%. Survival at the end of rearing in both groups was 12.1% and 51.3%, respectively (Fig. 4). Growth rate of the larvae was higher in group 2 (Fig. 5).

For the next phase of rearing fish of average body mass 0.8 g were selected. Two weeks of rearing resulted in fish body mass over 10 g. Higher growth rate was noted in fish fed with „Kristall" starter (Fig. 6, group 1). This group of fish showed also better food utilization - average feed conversion coefficients were 0.54 and 0.57, respectively. Fish losses were negligible and equal to 17 individuals in group 1, and 2 individuals in group 2.

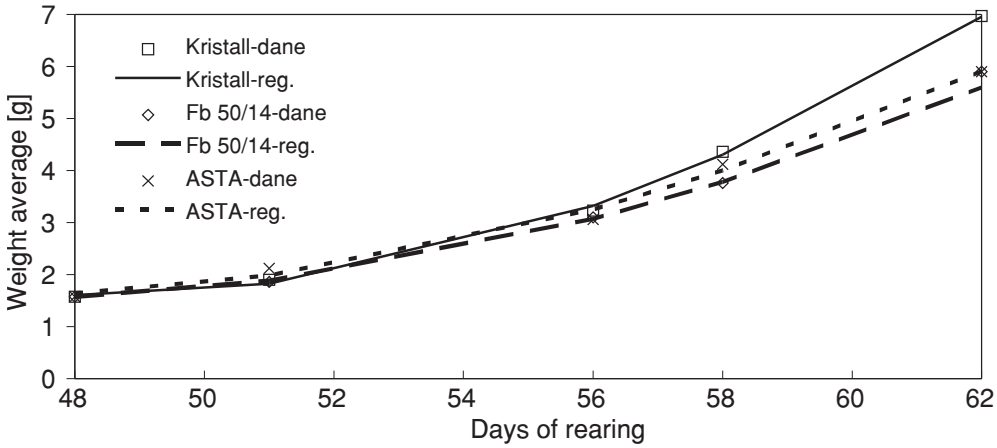


Fig. 9. Comparison of growth rate of Siberian sturgeon (*Acipenser baeri*) fry during pre-rearing using various starters, in second season.

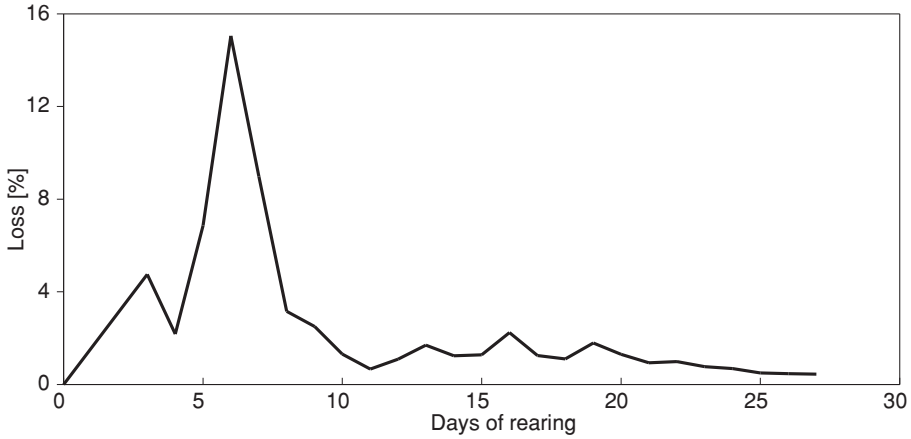


Fig. 10. Changes of mortality of Siberian sturgeon (*Acipenser baeri*) larvae during pre-rearing in third season.

**SECOND SEASON**

During pre-rearing fish were fed exclusively an experimental starter „ASTA-AC". Feed was supplied in small quantities, starting from day 4 of rearing.

As in the previous season, highest fish losses were observed on day 6 (Fig. 7), later on mortality sharply decreased. Summarized fish losses were lesser than in the previous season of rearing (in group 2) and equal to 40.2% of initial fish stock. Growth rate was lesser too - after 47 days average fish body mass was 1.36 g (Fig. 8).

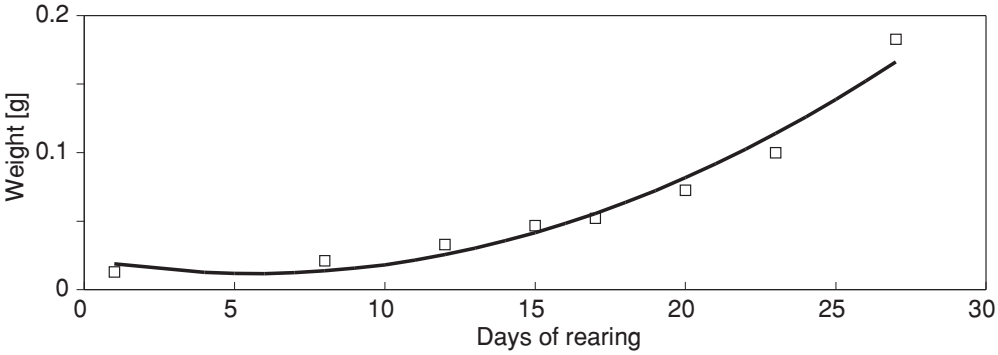


Fig. 11. Growth rate of Siberian sturgeon (*Acipenser baeri*) during pre-rearing in third season.

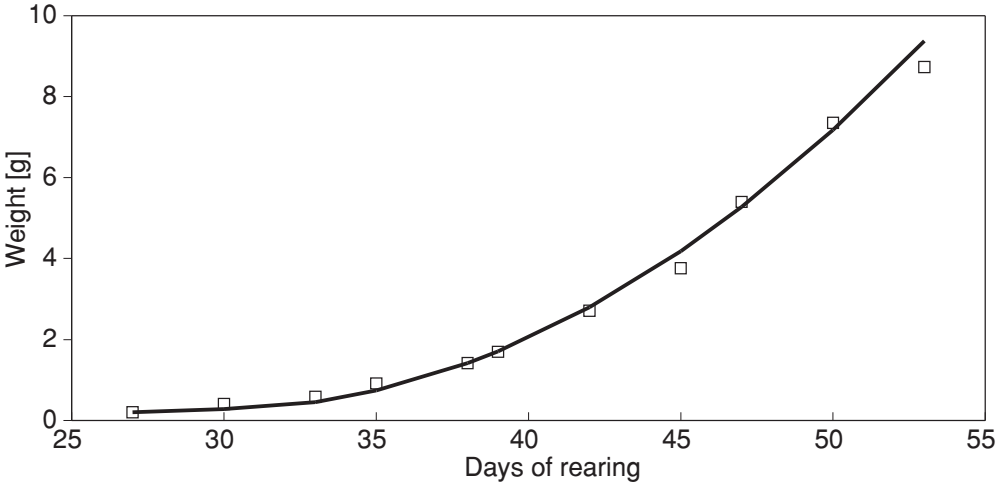


Fig. 12. Growth rate of Siberian sturgeon (*Acipenser baeri*) fry during intense rearing in third season.

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In further intense rearing of pre-reared Siberian sturgeon fry three feeds were applied: „Kristall" - group 1, trout starter made by Kraft - group 2, and „ASTA-AC" - group 3.

Survival was high in all three groups - 100% of initial stock. However, differences in growth rate were observed (Fig. 9), and different values of feed conversion coefficient. Highest body mass was attained by the fish of group 1 (6.98 g), and lowest in group 2 (5.62 g). Average feed conversion coefficients for entire intense rearing period were 0.5, 0.52 and 0.65, in groups 1, 2 and 3, respectively.

**THIRD SEASON**

As in second season, feed was supplied in small quantities beginning from day 4. Highest fish mortality occured on day 6 (Fig. 10). However, it did not exceed 16% of stock number per day, and summarized loss was equal to 44.7% of initial number of fish. Pre-rearing (feeding with „ASTA-AC") was reduced to 27 days. Final average body mass of fish was 0.18 g (Fig. 11).

Further rearing lasted until day 53 and „Kristall" starter was used. Fish losses during that period were negligible and did not exceed 1%. Growth rate of fry was high - average daily increase of body mass was equal to 14.5%. At the end of rearing period fish mass was 9 g (Fig. 12).

## DISCUSSION

Comparing of the results of first season pre-rearing shows that „ASTA-AC" starter fully meets nutritional requirements of earliest larval stages of *Acipenseridae.* Survival over 50% is satisfactory and similar to that obtained by other authors (Dąbrowski et al. 1985, Lutes et al. 1990, Giovannini et al. 1991). Low survival in group 2 suggests that trout starter „Kristall" was inappropriate for sturgeon larvae in the initial period of active feeding. Usefulness of the feeds was also determined by fish behavior, different in both groups. Larvae fed with „ASTA-AC" from the beginning of feeding were attracted by the feed and gathered places spots where starter accumulated, intensely feeding. In group 2 situation was different: fish avoided places of feed concentration. Many fish did not take feed and tended to chase other individuals. Starving fish were also observed. Such situation, together with cannibalism, resulted in poor survival between day 8 and 18 (Fig. 3).

Comparison of the growth rate of larvae and fry in all three seasons indicates that „ASTA-AC" starter should be used only in the initial phase of rearing, until body mass about 0.2 - 0.4 g is attained by the fish. Further feeding with this starter causes reduction of growth rate. This is most evident from the comparison of the effects of rearing in second and third season (Figs. 8, 9 and 10, 12). Extension of pre-rearing on „ASTA-AC" until fish attained average body mass 1.37 g caused retardation of further growth until 7 g by 12 days (Figs. 9 and 12).

The results of growth rate of sturgeon fry (Figs 6, 9 and 12) reveal that in this phase of rearing trout starter „Kristall" was more efficient. Higher protein content (Tab.

**TABLE 1**

Content of protein, fat and carbohydrates in tested starters.

| Name of starter | Content of protein (%) | Content of fat (%) | Content of carbohydrates (%) |
|---|---|---|---|
| ASTA-AC | 38 | 8 | 30 |
| Aller Kristall | 53 | 14 | 12 |
| Kraft Fb 50/13 | 50 | 13 | 17 |

1) in this feed better meets nutritional requirements of fast growing fish (average increase of body mass over 14%).

## CONCLUSIONS

1. Smell of feed is an important factor during initial phase of sturgeon rearing when fish shift to exogenous feeding, and determines the results of rearing (survival and growth rate).
2. „ASTA-AC" starter was most appropriate feed in pre-rearing of sturgeon larvae (until 0.2 - 0.4 g of individual body mass), resulting in best survival over 50%.
3. During the phase of intense rearing of sturgeon fry highest growth rate (over 14% of body mass per day) was attained by the fish fed with trout starter „Kristall"of highest protein content.

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## STRESZCZENIE

PORÓWNANIE EFEKTÓW PODCHOWU WYLĘGU JESIOTRÓW Z ZASTOSOWANIEM RÓŻNYCH PASZ TYPU STARTER

Przeprowadzono badania porównawcze, których celem było określenie przydatności na różnych etapach podchowu wylęgu jesiotrowatych następujących starterów: "ASTA-AC"- eksperymentalny starter dla wylęgu jesiotrowatych i dwa startery pstrągowe "Kristall" (firmy- ALLER MLLE) i Fb 50/14 SP (firmy-Kraft), różniących się przede wszystkim zawartością i pochodzeniem białka. Badania prowadzono w ciągu trzech sezonów, w których wyróżniano dwa etapy: wstępny podchów wylęgu i intensywny podchów narybku. Na podstawie uzyskanych wyników stwierdzono, że na etapie podchowu wstępnego (do średniej masy 0.2 - 0.4 g) najwyższą przeżywalność (powyżej 50%) gwarantował starter "ASTA-AC". Natomiast na etapie intensywnego chowu najwyższe tempo wzrostu narybku (do 14% masy obsady/dobę) uzyskiwano na starterze "Kristall".

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