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Short communication

PRELIMINARY STUDIES OF INTENSIVE WELS CATFISH (*SILURUS GLANIS* L.) AND STURGEON (*ACIPENSER* SP.) POND CULTIVATION

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ABSTRACT. Studies were conducted on intensive monoculture and polyculture of wels catfish and sturgeon in ponds. The initial average body weight of the fish in monoculture and polyculture was similar (wels catfish – approximately 100 g; sturgeon - approximately 720 g), and the biomass was equal in each pond (approximately 30.7 kg). The fish were fed trout granulate for two months. The final survival rate was the same in both the monoculture and polyculture (wels catfish - 99.5%; sturgeon - 100%). Statistically significant differences ($p < 0.05$) were observed between the fish growth in monoculture and polyculture. Wels catfish grew faster in polyculture, with an average body weight of 349.1 g and a specific growth rate (SGR) of 2.0 % day^{-1}. In monoculture these figures were 276.1 g and 1.6 % day^{-1}, respectively. Sturgeon grew faster in monoculture, with an average body weight of 1229.2 g, and an SGR of 0.86 % day^{-1}, while in polyculture these values were 854.2 g and 0.28 % day^{-1}, respectively. The intensive cultivation of wels catfish with sturgeon in pond polyculture influenced their growth, but not survival rates.

Key words: MONOCULTURE, POLYCULTURE, WELS CATFISH (*SILURUS GLANIS*), STURGEON (*ACIPENSER* SP.)

The cultivation of Wels catfish (*Silurus glanis* L.) and sturgeon (Acipenseridae) in ponds (Wiśniewolski 1989, Mareš et al. 1995, Kolman 1998), pens (Müller and Varadi 1980, Filipiak et al. 1997) and recirculating systems (Pruszyński and Pistelok 1999, Linhart et al. 2002, Szczepkowski and Kolman 2002b) is becoming increasingly common. These fish have fast growth rates and effectively utilize granulated feed (Heymann 1990, Kolman 1998). Both wels catfish and sturgeon are recommended as additional fish in pond polyculture with carp (*Cyprinus carpio*) and tench (*Tinca tinca*) or herbivorous fish (Harsanyi 1987, Wiśniewolski 1989, Duda 1994), as well as with fish which are fed with supplemental artificial feed (Kolman 1998). The possibility of using granulated feed in wels catfish and sturgeon cultivation means that these two species are suited for intensive pond polyculture. However, the impact of the polyculture of these two species on growth, survival rate and potential food competition is still unknown.

The aim of the studies was to determine the impact of pond polyculture of wels catfish and sturgeon on their growth and survival rates.

The material for studies consisted of three-month-old wels catfish specimens and age group 1+ specimens of sturgeon SR.S – reciprocal back cross hybrids of Siberian sturgeon and Russian sturgeon (*Acipenser baeri* × *Acipenser gueldenstaedti*) × *Acipenser baeri* - obtained from controlled reproduction and rearing in recirculating systems (Szczepkowski and Kolman 2002a). The experiment was carried out between 18 June and 20 August 2002 in six concrete ponds with an area of 200 m^2 each. The fish stocks were qualitatively diverse, and there were three variants - the experimental groups of wels catfish (202 individuals in each pond) and sturgeon (15 individuals in each pond), polyculture, and two single-species control groups (310 wels catfish and 42 sturgeon specimens per pond). The stock biomass in all the ponds was the same, 30.7 kg (Table 1).

The fish were fed daily after 20:00 with trout granulate (46% protein, 14% fat, 21.5% carbohydrate, digestive energy - 17 MJ kg^{-1}, 4 mm - granule diameter). The feed

TABLE 1

Initial data for the experimental groups (each group repeated twice)

Group	Stock (individuals)		Stock biomass (kg)			Average body weight (g)	
	Wels catfish	Sturgeon	Wels catfish	Sturgeon	Total	Wels catfish	Sturgeon
Wels catfish-control	310	0	30.7	-	30.7	98.7	-
Sturgeon-control	0	42	-	30.7	30.7	-	722.5
Polyculture	202	15	20.3	10.4	30.7	100.2	717.9

was distributed manually to cover the largest possible pond surface area. The daily feed ration was identical at 500 g per pond during the first month of cultivation. During the second month, the feed ration was doubled and was distributed at twelve hour intervals. The total amount of feed used was the same for each pond. The water temperature and oxygen content were measured every two to three days. The average water temperature during the experiment was 22.7 ± 1.7°C, and the oxygen content was 6.3-11.7 mg O_2 dm^{-3}. The experiment was completed after 62 days. The entire stock of each fish species was caught, weighed and counted. The average fish body weight was determined by dividing the fish biomass by the number of fish of each species. The feed conversion ratio (FCR) and the specific growth rate (SGR) coefficients were calculated using the following formulae:

$$FCR = P\ (W_F - W_0)^{-1} \quad (1)$$

$$SGR = 100\%\ (ln\ W_F - ln\ W_0)\ t^{-1} \quad (2)$$

where:

P – weight of feed distributed (kg);

W_F – final stock biomass (kg);

W_0 – initial stock biomass (kg);

t – duration of cultivation in days.

In order to identify differences between the groups, ANOVA variance analysis ($p \leq 0.05$) was conducted with Statistica software.

A very high, stable fish survival rate was obtained in all the experimental ponds during the study; this indicates that polyculture does not have a significant impact on wels catfish and sturgeon survival.

Statistically significant ($p < 0.05$) differences were confirmed for average body weight, biomass increments, and FCR and SGR coefficients between the wels catfish and sturgeon in the experimental and control groups (Table 2, Fig. 1). The wels catfish exhibited a much higher growth rate in polyculture than in monoculture. The opposite was true of sturgeon. The higher wels catfish growth rate in polyculture resulted from the fact that, as the dominant species, it consumed more of the feed provided, including the portion intended for sturgeon. The equal final biomass values for the wels catfish control group and the experimental group of wels catfish and sturgeon polyculture indicate that differences in growth might have resulted from food competition between the species. In order to prevent one species from dominating, it is necessary to determine what the wels catfish to sturgeon ratio should be in polyculture. This issue should be the subject of a separate study.

TABLE 2

Final results of wels catfish and sturgeon in pond monoculture and polyculture

Group	Stock biomass (kg)			Average body weight (g)		FCR	Survival rate (%)	
	Wels catfish	Sturgeon	Together	Wels catfish	Sturgeon		Wels catfish	Sturgeon
Wels catfish-control	82.8	-	82.8[a]	276.4[b]	-	0.86[b]	99.5	-
Sturgeon-control	-	52.2	52.2[b]	-	1229.2[a]	2.09[a]	-	100
Polyculture	70.4	12.3	82.7[a]	349.1[a]	851.2[b]	0.87[b]	99.5	100

The averages in columns with different letter indexes differ significantly statistically ($p < 0.05$)

The values of the FCR coefficients indicate that the feed ration in the sturgeon monoculture was too high. The initial daily feed ration of 1.6% of the stock biomass is recommended for sturgeon specimens of this size cultivated in ponds (Kolman 1998);

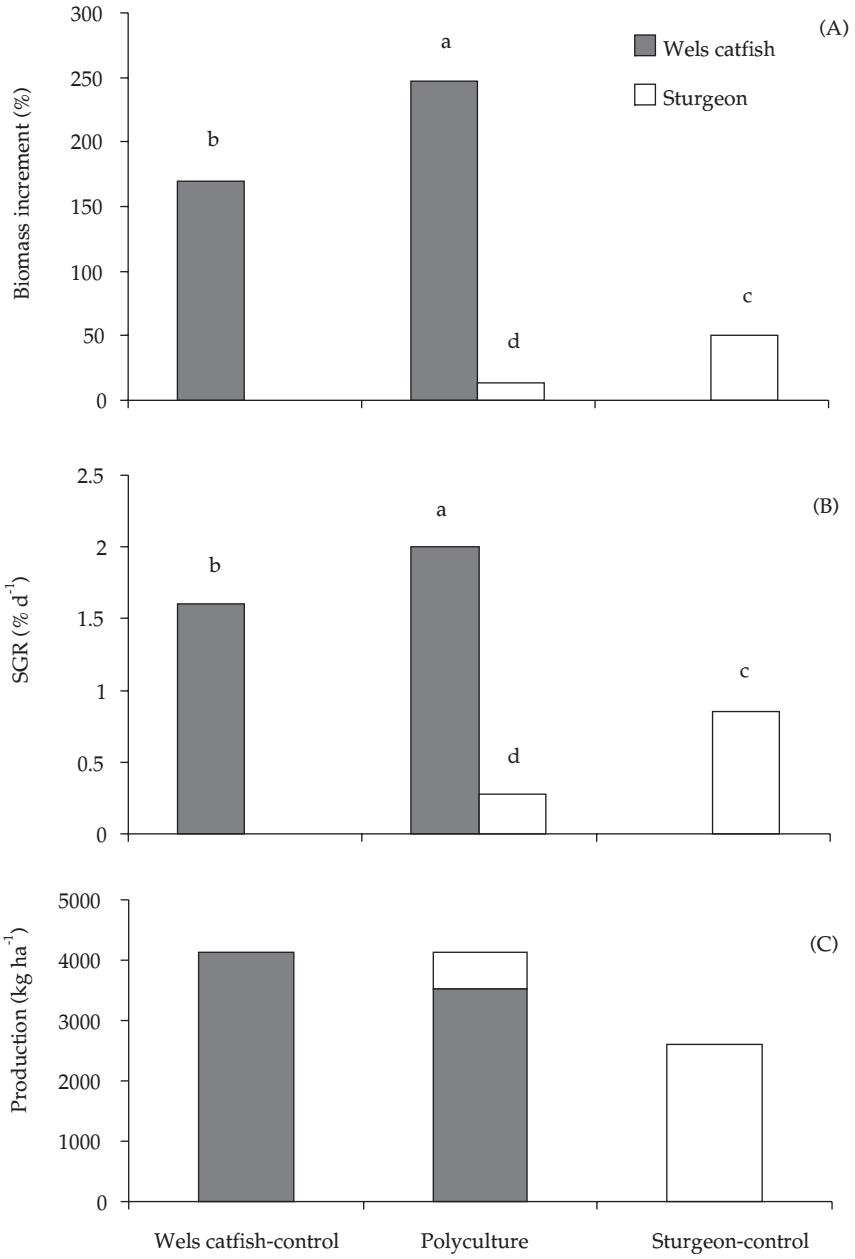

Fig. 1. Average stock biomass increment (A), values of the daily percentage biomass growth coefficient SGR (B) and final production of wels catfish and sturgeon (C) during intensive, two-month-long pond monoculture and polyculture. The columns with different letter indexes differ significantly statistically ($p < 0.05$).

however, it appears to be too high for the sturgeon SR.S hybrid which was used in this study. Similar results were obtained by Szczepkowski and Kolman (2002b) with bester, a Beluga sturgeon and Sterlet sturgeon hybrid (*Huso huso* × *Acipenser ruthenus*); they determined that the highest daily feed ration (for fish weighing between 550-950 g) should not exceed 1.25% of the stock biomass.

The daily feed ration for the wels catfish in polyculture with sturgeon might have been too low, especially in the second half of the first month of culture. The feed ration applied in this study during the first month of culture fell from 1.6 to 0.8% of the biomass as the fish gained weight. During the second month of rearing the feed ration was doubled, and its value fell from 1.7 to 1.2% of the stock biomass by the end of the experiment. The recommended feed ration for wels catfish pen cultivation for specimens weighing from 70-400 g is about 1.5% of the metabolic fish weight ($W^{0.8}$) at a water temperature of 18-23°C and 2% at a water temperature of 24-27°C (Filipiak et al. 1997). The daily feed ration should also be increased more frequently, i.e., weekly with wels catfish which weigh from 100 to 400 g, and bi-weekly with sturgeon weighing from 700 to 1200 g. The results of the present study indicate that the proper feed ration for wels catfish and sturgeon in ponds should be investigated further.

REFERENCES

Duda P. 1994 – Rearing of shitfish (*Silurus glanis*) fry in polyculture with tench (*Tinca tinca*) and common carp (*Cyprinus carpio*) – Bul. VURH Vodnany 1: 21-26.

Filipiak J., Sadowski J., Trzebiatowski R. 1997 – Comparative analysis of using different food rations in juvenile wels (*Silurus glanis*) culture – Acta Ichth. Piscat. 27(1): 41-51.

Harsanyi A. 1987 – Welszucht in Teichen – Fisch. Teichwirt. 38(5): 133-138.

Heymann A. 1990 – Intensivzucht des Welses (*Silurus glanis*) in Warmwasser mit Trockenfutter – Z. Binnenfisch. 37(12): 382-384.

Kolman R. 1998 – Sturgeon rearing – IRS Olsztyn, No 177: 16 pp. (in Polish).

Linhart O., Stech L., Svarc J., Andebert J.P., Rodina M., Audebert J.P., Grecu J., Billard R. 2002 – The culture of the European catfish, *Silurus glanis*, in the Czech Republic and in France – Aquat. Living Resour. 15(2): 139-144.

Mareš J., Jirasek J., Ondra R. 1995 – Survival and growth of intensively reared European catfish (*Silurus glanis* L.) in culture ponds – In: International Conf.: New fish species in aquaculture. (Ed.) R. Trzebiatowski, Agric. Univ. Szczecin: 44-48.

Müller F., Varadi L. 1980 – The results of cage fish culture in Hungary – Aquaculture Hungarica 2: 154-167.

Pruszyński T., Pistelok F. 1999 – Biological and economical evaluation of African and European catfish rearing in water recirculating systems – Arch. Pol. Fish. 7(2): 343-352.

Szczepkowski M., Kolman R. 2002a – Development and behaviour of two reciprocal back cross hybrids of Siberian sturgeon (*Acipenser baeri* Brandt) and Russian sturgeon (*Acipenser gueldenstaedti* Brandt) during early ontogenesis sturgeon – Czech J. Anim. Sci. 47(7): 289-236.

Szczepkowski M., Kolman R. 2002b – The impact of feed ration on the rearing indexes of bester F (*Huso huso* L. × *Acipenser rutenus* L.) fry – Komun. Ryb. 5: 1-4 (in Polish).

Wiśniewolski W. 1989 – Zuchtmoeglichkeiten des Welses in Teichen in Polen – Rocz. Nauk Rol. H-102(1): 138-166.

STRESZCZENIE

INTENSYWNY CHÓW SUMA EUROPEJSKIEGO (*SILURUS GLANIS*) I JESIOTRÓW (*ACIPENSER* SP.) NA PASZY GRANULOWANEJ W STAWACH

Przeprowadzono doświadczenie z intensywnym chowem na paszy granulowanej w stawach suma europejskiego i jesiotrów. Obsady ryb były jakościowo zróżnicowane (tab. 1) i obejmowały trzy warianty: grupę doświadczalną z obsadą polikulturową sumów i jesiotrów oraz dwie grupy kontrolne – składające się z obsad jednogatunkowych tych ryb. Biomasy obsad we wszystkich stawach były jednakowe (po 30,7 kg na każdy staw). Badania prowadzono przez dwa miesiące w dwóch powtórzeniach dla każdego wariantu. Końcowa przeżywalność ryb w mono- i polikulturze była jednakowa (sumy 99,5%, jesiotry 100%). Wyższe średnie masy ciała i wartości SGR (odpowiednio 349,1 g i 2,0 % dzień$^{-1}$) uzyskały sumy w grupie doświadczalnej niż w kontrolnej (267,4 g i 1,6 % dzień$^{-1}$). Odwrotnie było z jesiotrami, które uzyskały większe średnie masy ciała i wartości SGR w grupie kontrolnej (odpowiednio 1229,2 g i 0,86 % dzień$^{-1}$) niż w doświadczalnej (851,2 g i 0,28 % dzień$^{-1}$). Końcowe średnie biomasy obsad i wartości współczynników pokarmowych FCR (tab. 2) w grupie doświadczalnej oraz w kontrolnej sumów były porównywalne (odpowiednio 82,7 kg i FCR 0,87 oraz 82,8 kg i FCR 0,86). W grupie kontrolnej jesiotrów uzyskana średnia biomasa obsad była niższa (52,2 kg), a współczynniki pokarmowe paszy wyższe (FCR 2,09). Stwierdzone różnice w wartościach średnich: przyrostów biomasy obsad, masy ciała ryb, współczynników SGR oraz FCR między grupą doświadczalną a kontrolnymi sumów i jesiotrów były statystycznie istotne ($p < 0,05$). Intensywny chów w stawach w polikulturze suma europejskiego z jesiotrami nie wpływał na ich przeżywalność, ale na ich wzrost. W przypadku chowu suma w polikulturze z jesiotrem wykazuje on szybszy wzrost niż w monokulturze. Odwrotnie jest z jesiotrem, który szybciej rośnie w monokulturze niż w polikulturze z sumem. Stwierdzono ponadto występowanie konkurencji pokarmowej między obu gatunkami, w przypadku dominacji w obsadzie suma.

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