Observations of the Crucian carp (Carassius carassius) pond culture

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GAJENJE KARAŠA (*CARASSIUS CARASSIUS*) U RIBNJACIMA

Abstrakt

Uzgoj juvenilnih jedinki karaša (C. carassius) analiziran je u pet ribnjačkih objekata veličine 100 m^2. Karaš je gajen u monokulturi u dva, dok je sa linjakom gajen u bikulturi u tri ribnjačka jezera. Stopa preživljavanja karaša u monokulturi iznosila je 21.15±6.86 %, a u bikulturi 47.07±16.86%. Kod linjaka je zabeležena veća stopa preživljavanja (69.33±16.76) i brži rast u odnosu na karaša. Iako je prema dobijenim rezultatima teško proceniti razlike između uzgoja u monokulturi i bikulturi, može se zaključiti da linjak nije značajan kompetitor karašu.

***Ključne reči**: Carassius carassius, karaš, uzgoj u ribnjacima*

INTRODUCTION

Due to water regulation in XVIII.-XIX. centuries, population of crucian carp (*Carassius carassius*) considerably decreased, however, once they were found in large numbers in Hungary. Increase of non-native prucian carp (*Carassius gibelio*) had a negative effect on remaining populations of crucian carp. Recently, it is on the IUCN Red List and population is going to decrease further according to several surveys. In Austria, Croatia and Slovakia, it is under protection of fishing; in Serbia and Romania, it is under specific prohibition and size restriction. Introduction of national protection was emphasized by nearly all ichthyologists. However, beyond protection rehabilitation of habitats and continuous stocking are needed to maintain reproductive populations. Furthermore, chances of survival would be improved if its rearing is economically feasible in pond aquaculture. The increase of production effectiveness required the analysis of one year old juvenile rearing in monoculture and biculture with tench (*Tinca tinca*). Less information is available on the pond culture of *C. carassius* in Hungary. The aim of our study was to investigate the possibilities of the crucian carp production in monoculture and biculture with tench.

MATERIALS AND METHODS

Propagation and larvae nursing: *Tinca tinca* broodstock originated from a commercial fish farm called Aranyponty Ltd (Sáregres-Rétimajor, Hungary) and *C. carassius* broodstock were caught from Vörösmocsár (Kecel, Hungary). Broodstocks intended for laboratory breeding were acclimatized for one month. Spawning of females of *T. tinca* and *C. carassius* was induced by gradual increase of temperature in the tanks and by hormonal treatment (6 mg carp pituitary per body weight kg). Males of both species were injected with a single dose of 3 mg per kg of body weight of dry carp pituitary extract 24 hours before milt stripping. Fertilisation and egg incubation were conducted according to carp propagation technique between 30 May and 2 June. Juveniles of the two genotypes were reared in laboratory separately (200 l tanks), but in the same conditions. Larvae were fed by *Artemia salina* and tubifex in the first two weeks then a mix (tubifex and artificial foods - Perla Larva Proactive 6.0, Nutra Pro 4.0; Skrettings©) were given for one month. Larval body weight was 0.05±0.02 g in *C. carassius* and 0.07±0.04 g in *T. tinca* at the introductions.

Preparation of ponds, rearing, harvesting, measurement: Rearing experiments were conducted at TEHAG Ltd. (Százhalombatta, Hungary) in five 100 m^2 size ponds. Muddy bottom and rich vegetation, first of all reed-grass were characteristics of these ponds. Before introductions, ponds were dried and treated by chlorine-lime, then water was filled up and the juveniles were stocked on 1st August, 2008. Water was filled into ponds through a mosquito net in order to avoid passage of other fish in the the ponds. Stocking density was 1000 individuals / pond: 2×1000 *C. carassius* juveniles in two ponds as „monoculture”. In mixed groups 500 individuals of *C. carassius* and 500 individual fish of *T. tinca* were put together to each ponds. “Biculture” was set up in triplicates in three ponds. During rearing fish were given artificial food (DANA FEED 0.4) around 2% of the fish total biomass as supplement and revised every 2 weeks based on results of samplings. Water parameters were measured every two weeks such as pH, nitrite, nitrate, ammonium, ammonia.

Fish were harvested in the first week of November. Standard body length (1 mm accuracy) and body weight (0.1 g accuracy) of all *C. carassius* and *T. tinca* fish in each group were recorded. In other fish species, standard body length and body weight of the first 40 fish were measured then total weight of the group was measured and all of them were counted individually.

RESULTS

Summarised harvesting results are shown in Table 1. and water parameters in Table 2. The survival rate of *C. carassius* in „monoculture” and „biculture” were 21.15±6.86 and 47.07±16.86 %, respectively. Results of survival rate of *T. tinca* were better 69.33±16.76 %.

Table 1. Summarised data of harvesting (*includes other caught fish species as well).

	Ponds	II	V	I	III	IV
	culture	„monoculture”		„biculture”		
Carassius carassius	Σ ind.	163	260	283	285	138
	Σ g (means±S.D.)	118.55 (0.7±0.2)	343.15 (1.3±0.6)	847.5 (3±1)	729.7 (2.6±0.5)	237,4 (1,7±0,5)
	Survival rate (%)	**16.3**	**26**	**56.6**	**57**	**27,6**
	Biomass in ind. (%)*	19.2	25.6	36.8	17	11,5
	Biomass in weight (%)*	2.5	13.9	31.5	22.3	22,5
	Carassius-Tinca rate in ind.			1:1.4	1:1.4	1:1.8
	Carassius-Tinca rate in weight			1:1.8	1:2.2	1:3
Tinca tinca	Σ db			391	399	250
	Σ g (means±S.D.)			1511.4 (3.9±2.7)	1607.6 (4±2.4)	700.34 (2.8±1.5)
	Survival rate (%)			**78.2**	**79.8**	**50**
	Biomass in ind. (%)*			50.8	31.3	33.8
	Biomass in weight (%)*			56.2	37.4	40.8

Table 2. Water quality parameters in the rearing ponds (mean±SD).

culture	**ponds**	**pH**	**Nitrite (mg/l)**	**Nitrate (mg/l)**	**Ammonium (mg/l)**	**Ammonia (mg/l)**
monoculture	II.	9.03±0.66	0.03±0.012	0.94±0.35	1.34±0.507	0.26±0.141
	V.	8.07±0.61	0.02±0.004	0.88±0.349	0.825±0.701	0.08±0.142
biculture	I.	7.47±0.34	0.02±0.006	0.78±0.36	1.3±0.35	0.01±0.003
	III.	8.72±0.52	0.03±0.005	0.88±0.3	1.31±0.72	0.19±0.1
	IV.	8.44±0.63	0.03±0.009	0.59±0.45	1.29±0.67	0.26±0.3

There was a strong correlation between the survival rate and final body weight (Figure 1.). The summarised pond production is shown in Figure 2. Fish production varied between 2.1-4.7 kg/100m^2 but a significant part of it consisted of invasive fish species such as *Pseudorasbora parva*, *C. gibelio* despite of prevention. These fish successfully reproduced as. *P. parva* and *C. gibelio* could be found in every age classes in all ponds.

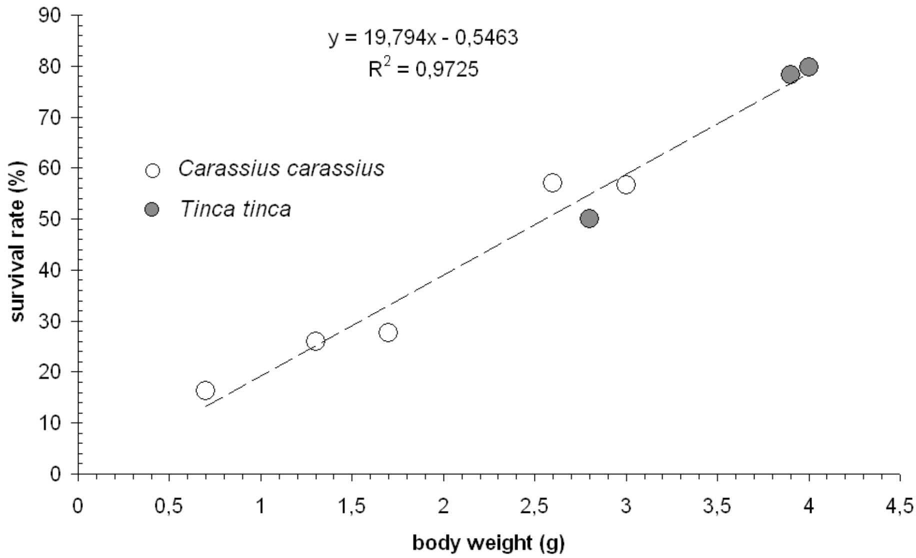

Figure 1. Relationship between survival rates and average final body weights of the two species.

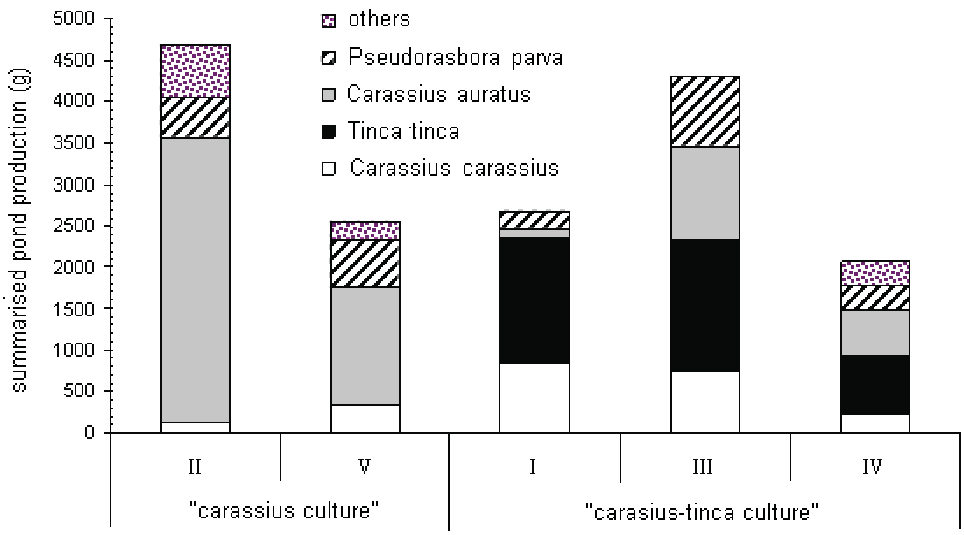

Figure 2. Summarised production of ponds.

DISCUSSION

Little information is available on the growth of *Carassius carassius* in Hungary. According to P i n t é r (2002) the estimated growth rate in the first year is 2-3 cm and at the end of second year is 10 cm. L a u r i l a et al. (1987) investigated the juvenile growth rate in laboratory conditions in 50-64 day period. The fastest growth this time, 0.32 mm /day, was reached at 28.5ºC. The average growth rate was 0.1-0.2 mm/day between 15-20°C, but none at 10ºC. Growth rate of natural populations in 0+ age group varied between 2.5-10.5 cm (mean 6.3 cm; 4.9 g) depending on density at the end of September. Crucian carp in suitable conditions can achieve 9-22 g in the first year 80-160 g in second year in monoculture (personal communication by Péter Lévai, Aranyponty Ltd, Hungary).

Based on our own observations, *C. carassius* juveniles reached only 26.63 mm average standard length in the poorest performing pond (Pond II.) and 45 mm in the best pond (Pond I.). It means 0.11 mm/day and 0.27 mm/day growth rate for 120 days (1st August - 1st November). These results are close to natural growth *C. carassius* in large density L a u r i l a et al., (1987). It would be important to indicate that larger growth rate could be reached if artificial propagation was earlier. M ü l l e r et al. (2007) was able to propagate *C. carassius* out-of-season (March-April).

Given results show some changes of water quality parameters. Water quality was poorest at the weakest monoculture (II.) and biculture (IV.) ponds. Formation of results depended especially on amount of invasive fish species (quality of embankments and construction works was not adequate unfortunately). Survival and growth of *C. carassius* in monoculture ponds was the worst, but the number of invasive species was the highest here. There was less invasive fish species in biculture ponds, and survival and growth showed better rates (survival in monoculture: 21.15±6.86 %, in biculture 47.07±16.86 %; average weight in monoculture: 1±0.4 g, biculture: 2.4±0.7 g). However, it is clear that species composition and amount of fish affect production. *Pseudorasbora parva* adults and juveniles were common in every pond, however, from the point of view of production this was indifferent, because the highest amount of *P. parva* appeared in the III. pond which also showed the highest and best production. Here, the survival rate and growth of tench and crucian carp was better as well. The same cannot be told about *C. gibelio*, which was harvested in the highest amount from a pond where survival rate and growth of *C. carassius* was the lowest. These were monoculture ponds (II. and V), and a significant amount of wild *C. gibelio* juveniles were found in these ponds (197 individuals in II. pond, 458 individuals in V. pond), while in the case of biculture (I., III., IV.pond) no *C. gibelio* juveniles were found. Although, according to the observed results it is difficult to estimate differences between monoculture and biculture rearing, it is still clear that <u>*T. tinca* is not a significant competitor for *C. carassius*</u> and *P. parva* has not affected our experiment significantly. However, the <u>quantity of *C. gibelio*, especially juveniles considerably influenced survival and growth</u> of other species. It can be concluded that while feeding behaviour and food sources are the same for *C. gibelio* and *C. carassius*, *T. tinca* is different from them and is not a feeding competitor of *C. carassius*.

Table 3. shows the comparison of our results and other companies' production results (TEHAG 2008), and results of experiments from earlier studies are compared. Data of BH Plc are given only as supplementary information, as it shows production

results of 1+ fish originating from Iskolaföldi ponds (2007) which were reared in polyculture (survival rate 21.6%). It is obvious that mono- and biculture rearing results varied between wide margins in yield (12 kg/ha – 895 kg/ha). Maximum yield in biculture was 240 kg/ha, which is still a medium result, however, the number of fish shows the second highest rate here. This means that with earlier stocking and less invasive species yields would be much higher.

Table 3. Comparison of given results and results of other companies, and early research data.

Pond of department MÜLLER et al. (2007)	kg/ha	1140	Harvesting in August (4,5 months rearing time) 10 million juveniles/ha
	ind./ha	2 000 000	
	mean (g)	0,57	
Anyponty Plc (2008)	kg/ha	750	Rearing in large pond (200 kg/ha broodstock), +80 kg/ha one-year old grass carp
	ind./ha	46 875	
	mean (g)	16	
TEHAG (2008)	**kg/ha**	**12-85 (240)***	**Many invasive fish, Monoculture-Biculture 100 thousand ind/ha stocking**
	ind/ha	**16 300-28 300 (67 400)***	
	mean (g)	**0,7-3**	
Iskolaföldi ponds (Szarvas) (2007)	kg/ha	74	Many *P. parva* 500 thousand ind/ha stocking
	ind./ha	9 250	
	mean (g)	8	
BH Plc (2008)	kg/ha	2,3	2 year old, mature fishes, spawned at the age of 1 year, polyculture 300 ind/ha stocking
	ind./ha	66,7	
	mean (g)	35	

In case of carp: 1000 kg/ha, mean weight 35-50 g, cc 23 thousand db/ha
*with tench

Our results support the assumption that optimal conditions are given in biculture for both species. However, more experiments are needed for statistical analysis and use in production.

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