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THESES OF DOCTORAL (Ph.D) DISSERTATION

**EFFECT OF DIFFERENT SIZED PRUSSIAN CARP (*Carassius auratus gibelio* Bloch)
POPULATIONS ON THE PRODUCTION OF COMMON CARP (*Cyprinus carpio* L.)
YEARLINGS**

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I. INTRODUCTION

The share of aquaculture in the world fisheries are raising continuously. In the past decade while the quantity of fisheries (mostly the pelagic fisheries) have been stagnated, the aquaculture production was raising year to year. It's easy to recognize that the role of aquaculture has not reached that of the fisheries but the improvement is spectacular and consistent. These observations are valid in the European and Hungarian fish production, too.

There are several segments of the European aquaculture, which differ by the regions. In Hungary the most important sector - like in the nearby countries, too - is the pond fish culture. If in Hungary anybody mentioned the word "aquaculture" most of people think about the fishponds. It is not unusual, because 30 years before the 70% of the Hungarian fish production were made in fishponds (PÓCSI, 1974), and nowadays are more than 85% (HALTERMOSZ, 2004).

There are 27000 ha fishponds are in operation in Hungary (AKII, 2004), which is a very special area of the animal husbandry. Inland fisheries and aquaculture are both characterized by producing common carp, which is best shown by the following data: in 2004, more than 75% of the fish produced in Hungary was Common carp (AKII, 2004).

Hungary produces the fifth highest quantity of Common carp in Europe. The success of efficiency of the pond fish culture is primarily depending on the Common carp production, therefore the quality of the Common carp breeding is on of the most important question.

In Hungary, table-size Common carp is usually produced in a three-year production system. The largest disadvantage of this production is the long payback period, because of which the producers have to pay special attention to achieve safe production. The safety is of great importance, especially in the production of fingerlings. Although these are reared in approximately 10% of the total cultivation area, the success of it has a fundamental effect on the yields of the consecutive two years (SZÚCS, 2002).

On the Hungarian fishfarms during the three years long production period the safe production of the one year old Common carp is especially important, because fishes at this time are far less tolerant to the environmental factors (ware temperature, food base, predator fishes) as the older age groups. One of the most important environmental factors is the presence of wild fishes. There are several fish species of no economic importance in Europe – also in Hungary –, but only a few have effect on the profitability of the production.

The most important are the Prussian carp (*Carassius auratus gibelio* Bloch, 1782) the Brown bullhead (*Ictalurus nebulosus* LeSueur, 1819) and the Topmouth gudgeon (*Pseudorasbora parva* Schlegel, 1842). It can be said that the highest losses are caused by the Prussian carp (*Carassius auratus gibelio* Bloch, 1782) in the Hungarian fish farm production. A decade ago, the Prussian carp has caused problems only in fish farm at the western part of Hungary. Nowadays, it has become the most impedimental factor in each of the farms. In spite of that the Prussian carp is the fifth most produced fish on the world with 1,7 billion harvested tons, this fish is very harmful in the Hungarian waters.

The Prussian carp can enter the fish farm by two ways. First, fingerlings can get into the pond with the filling water. The fresh water is very important in Common carp fingerling cultures and that's the reason why the ponds are filled up 1-2 weeks before the stock. But this time is the same when the Prussian carp are spawned and lot of harmful Prussian carp fingerlings flow in the ponds with the water (HORVÁTH AND URBÁNYI, 2000). Of course, the Prussian carp can swim into ponds with two and three year old Common carps not only the fingerling ponds, but it is much more difficult to swim in, because the easier cleaning of the fish rails.

The second opportunity is that the disinfection following the harvesting was not perfect in each case. This means that some Prussian carps remain in the mudholes, where during the next spring and summer they spawn and thereby ensure yearlings continuously. This type of the competence also makes problems for the young fishes, because the older Common carps are able to oppress the Prussian carps.

The presence of the Prussian carp is also harmful in the logistic, because the work was delayed. The non-uniformed stocks were selected slower, which caused reduced survival rate, take more time for the fishing which means greater stress for the fishes.

The food conversation ratio of the Prussian carp is worse then the Common carp. Different calculations say that one kilogram of small size (50-100 gramm) Prussian carp consume the same quantity of food as five pieces one kilogram size Common carp (TÓTH and VÁRADI, 2002).

The worse food conversation ratio effects the profit of the production. Not only the food conversation ratio, but the price of the Prussian carp is lower too. That is the reason why the income is lower on those lakes where Prussian carp can be found.

II. AIMS OF THE RESEARCH

Nowadays the fish farmers are engaged in to rid ponds of the Prussian carp. In Hungary among the different trash fishes the Prussian carp is causing the most problem in the pond fish culture. That was the reason why I examined the effect of this fish on the production.

Although each agriculturist is familiar with the harmful effects of the presence of Prussian carps in the fish farm, nobody has quantified the negative effects of this phenomenon by real numbers, so far. Therefore, the main goal of our experiments was to prove the harm caused by Prussian carps in the Common carp yearling production of a fish farm. We have chosen this age group because the Common carp is the most sensible this time, and this is the key point of the economic production also.

The effect of the presence of Prussian carps on the yield of Common carp yearlings was surveyed during the experiment period and after the harvesting.

The following parameters were analyzed:

- the growth of Common carps and the Prussian carps
- individual weights at harvesting
- survival rate
- feed utilization
- yields/hectare and production value/ hectare
- profitability and direct costs

We tried to examine every factor which can be able to influence the production, to reveal how the Prussian carp is influencing the effectiveness of production of one year old Common carp.

III. MATERIALS AND METHODS

The three years long experiment were carried out in the Hajdúszoboszlói Bocskai Halászati Szövetkezet (Bocskai Fishing Cooperative, Hajdúszoboszló). These fishponds are very similar to those in the region, so the results could be disseminated, them too. The experiments were made in the years 2003, 2004, and 2005 from the beginning of July till the end of September. In every year the same experiment was installed.

The locations of the experiments every three years were the same experimental ponds of the Cooperative. There were five ponds in the experiment, one the control and the other four the treatment. The size of the ponds was 0,17 hectare. The preparation of the ponds was done by the conventional pond culture technology.

The fishes were hatched by us with the currently used technology in the same time. Fishes used in the experiments were the received Hajdúszoboszló mirror carp breed and Prussian carp. The fishes were pre-breeded till four weeks in different nursing ponds, and stocked in the experimental ponds in the middle of July.

The Hajdúszoboszló mirror carp and the Prussian carp fingerlings were stocked at the average weight of 0,3g and the stocking rate of 44 000 pieces/hectare (*Table 1.*). This stocking rate corresponds with a lot of similar experiments (SZUMIEC, 1993; ELEKES és SELMECZY, 1975; RUTTKAY, 1978; GORDA, 2002). In the control (T1) pond was stocked with Common carp monoculture, by the first treatment (T2) 50%, by the second treatment (T3) 100%, by the third treatment (T4) 150% and the fourth treatment 200% were Prussian carp proportion the correlate with the number of Common carp pieces.

Table 1.

Stocking rates

Ponds	Common carp		Prussian carp		Total	
	(piece)	(piece/ha)	(piece)	(piece/ha)	(piece)	(piece/ha)
(0,17 ha/pond)						
T1 (Control)	7 500	44 000	0	0	7 500	44 000
T2 (50%)	7 500	44 000	3750	22 000	11 250	66 000
T3 (100%)	7 500	44 000	7500	44 000	15 000	88 000
T4 (150%)	7 500	44 000	11250	66 000	18 750	110 000
T5 (200%)	7 500	44 000	15000	88 000	22 500	132 000

In practice we can use higher rates of Common carp (HORVÁTH and URBÁNYI, 2000), but in this case a lower stocking was chosen to not only do a simple overstocking. The other very important thing was the determination of the stocking rates. The first version was to change the rate of the Common carp and the Prussian carp within a fix number of total fish, or chose a fix number of Common carp, while the amount of Prussian carp was changing. Finally the second version was chosen, because in the reality the Prussian carp gets into a pond over the existing Common carp stock.

After the stocking we started to feed the fishes. In the first two weeks the fishes got pelleted carp food twice a day (NAGY, 1999). Then, during the breeding season the fishes were feed with milled maize and wheat in 50%-50%, once a day in the morning. The quantity of the feed was calculated from the biomass of the Common carps (ERŐSS, 1981). The feed ratio was 5% of the Common carp biomass (RUTTKAY, 1978).

On the breeding season, weekly test fishings were made, and then we measured the weights of 50-50 pieces fishes to examine the growth of the fishes. For the fishing we used different size nets.

In every year the experiment was kept 13 weeks and finished at the end of September. For the harvesting we used a 25 meter long, 2,5 meter deep and sized number 6 net. After harvesting the fishes were separated to Common carps and Prussian carps. Then we measured them on a scale Severin PW 7000 and Mettler PM 4600 because the different ranges.

We analyzed the growing of the fishes with SpGR index (BUSACKER et al., 1990; HOPKINS, 1992; LEE et al., 1999), which is one of the most popular and modern growing index for fishes.

The relationship between the average weight and the presence of the Prussian carps was analyzed with one way ANOVA test by the SPSS 11.0 for Windows program.

The relationships between average weights, yields and the presence of the Prussian carps were analyzed with polynomial trend function, which is very useful in practice. The survival rate of the fishes was calculated from the difference between the number of the stocked and harvested fishes. The relationships between the survival rate and the presence of the Prussian carps were analyzed with Chi² test and two samples Z test.

We analyzed the food conversation ratio with FCR index, which is one of the most frequent indices (STOREBAKKEN and AUSTRENG, 1987; RAD et al., 2003). We calculated the common food conversation ratio too, because it often used in the practice. The other index which the practice is using is the starch-value which was also calculated. For the calculating of the common food conversation ratio we examined the values by the total fishes and only by the Common carp, too. We made it because the cost of the feed was calculated for only the Common carp.

IV. RESULTS

The growing of the fishes

The average of the three years shows perfectly the negative effect of the presence of Prussian carp on the growing rate of the fishes. The results represent that the appearance of the Prussian carp is more important on the growing rate than the increasing number of the Prussian carp pieces.

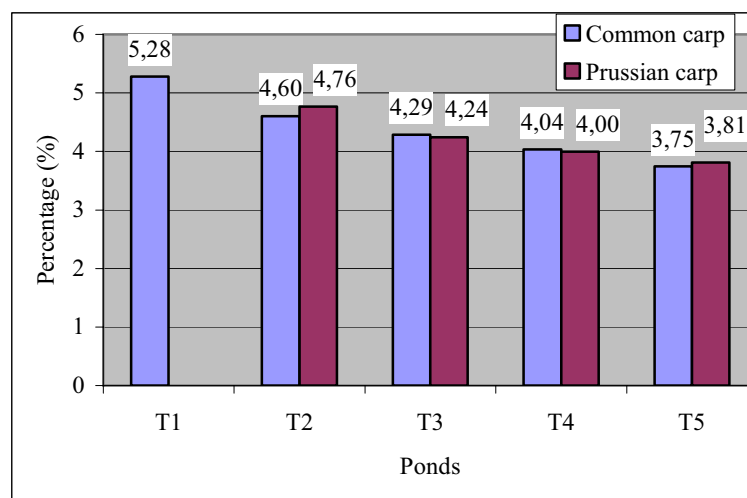


Figure 1.: The SpGR rates of the fishes in the average of the last three years (2003-2005)

Figure 1. shows for us that the difference between the growing rates of Common carps in T1 pond and T2 pond was 15%, while the difference between T2-T3, T3-T4 and T4-T5 was only 7%. When comparing the growing rates of Common carps and Prussian carps it can be determined that in ponds with both species there are not to much difference between them.

The final weight of the fishes

The harvesting average weight is very important factor because the weight is determining the yields, incomes, and the success of the wintering. Fishes which have not accumulated enough energy consumed all of their fats during winter and lot of them dropped off. The average causalities are about 5-10%, and it can grow up drastically, if the Common carp's weight can not reach minimal 20 g. If the average weight can not reach this, the losses can make the production uneconomical.

In each years only that Common carps reached the minimal weight (25 g) for the wintering, which there stocked in monoculture (control). In the average of three years the results of the experiment proved that the increasing number of Prussian carps reduced drastically the individual weights of the Common carp yearlings (*Figure 2.*).

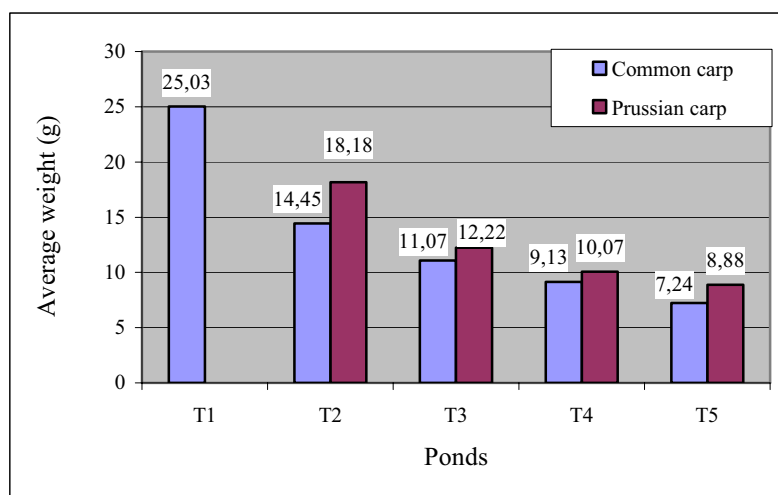


Figure 2.: The final weights of hte fishes in the average of the last three years (2003-2005)

There was 42% difference between the average live-weight of the Common carps in the control pond (T1) and that of the pond with the lowest rate of Prussian carps (T2), (25,0 g and 14,4 g, respectively). In case, the proportion of Prussian carps exceeding 50%, the weight of Common carps does not reach the minimum 20 g, that is necessary for successful wintering. In the other ponds the weight could not approach this value too, therefore number of fish died during the winter. The results show very well the aggressivity of the Prussian carp. In those ponds where the Prussian carp was appeared their average weights were each time larger then the Common carp weights.

The differences among the average weights were analyzed with ONE WAY ANOVA test to at 95% confidence level to determine the variances. To compare our results with the literature (AKIMOV, 1974; WORNIALIO, 1975; TREZBIATOWSKI, 1988) we concluded that the presence of Prussian carp was caused less Common carp average weight and the wintering would be worse.

For the easy utilization of the experimental results we made polynomial trend functions by the individual weights at harvesting in every year. These functions are helping in the estimation of the harvesting weights among the presence of Prussian carp 0-200%. Therefore, planning the stocking and the sale of the next year will be easier, as well.

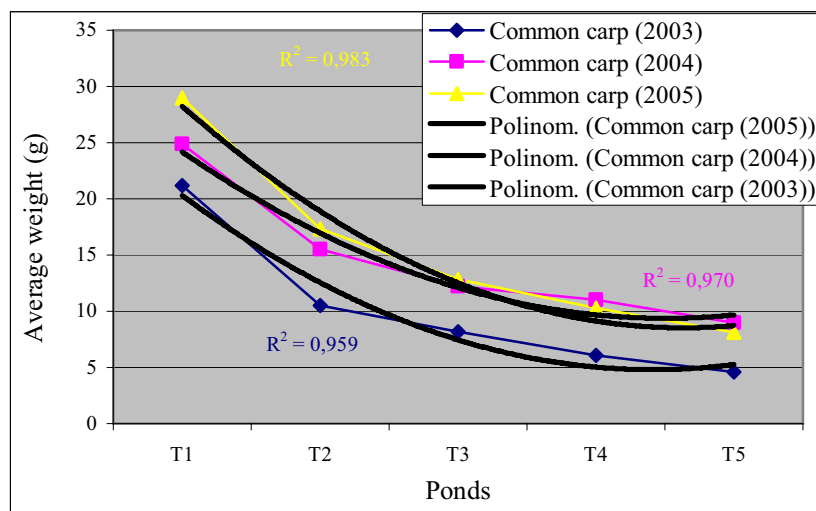


Figure 3.: Correlations between average weights and the presence of the Prussian carp

The correlations between the average weights of Common carps and the presence of the Prussian carp can be described with very close functions ($R^2=0,959, 0,970, 0,983$) (*Figure 3.*). The issues show that the more pieces of Prussian carp, the less harvesting weight of Common carp. The functions record uniform trends every year, so it would be easier to define the weight loss of Common carp.

The uniformity of the fish stocks

The uniformity of fish stocks affects a lot of different points of production. It influences the quantity of the feed, the harvesting time, planning of the stocking of the next year, and the health status of the fishes. The procedures are much easier and exact with uniform stocks. There is another great problem with the ununiform stocks. In these stocks there are a lot of little fish with poor health, and growing rate. The presence of these fishes is cause worse production. That is why we examined the effect of Prussian carp population on the uniformity of the Common carp yearlings.

Table 2.

The uniformity of the Common carp stocks (CV%)

Pond Year	T1	T2	T3	T4	T5
2003	11,93	15,39	16,08	19,33	23,32
2004	10,90	16,86	16,92	17,87	22,84
2005	7,00	17,92	22,20	22,69	29,62
Average	9,94	16,72	18,40	19,96	25,26

In every year we appointed that Common carp populations in the control pond (T1) was showing better uniformity (CV%) then the other ponds (*Table 2.*). In every year the uniformity of the T1 stocks were very good. The CV% was only 9,94, which is a very low value. Of the treatments in the T5 pond the stock had a huge variability (between 20-30%) and the others (T2, T3, T4) had a medium variability (between 10-20%). There were almost two times higher difference between the uniformity stocks of T1 and T2 pond.

The table shows squarely that the presence of Prussian carps reduce the uniformity of the Common carp populations, which is very unfavorable in the pond fish culture.

The survival rate of the Common carp

The survival rates of the fishes were calculated from the difference between the pieces of the stocked and harvested fishes. The examinations of the results show great differences among the fishes of ponds (*Table 3.*).

Table 3.

The survival rate of thre Common carp

Year Pond	Stocked (piece)			Harvested (piece)			Survival rate (%)		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
T1	7500	7500	7500	6000	6225	6000	80,0	83,0	80,0
T2	7500	7500	7500	5619	4645	5000	74,9	61,9	66,7
T3	7500	7500	7500	5366	4508	4850	71,5	60,1	64,7
T4	7500	7500	7500	5246	4260	4580	69,9	56,8	61,1
T5	7500	7500	7500	4772	3000	3550	63,6	40,0	47,3

The Common carp stock of the control (T1) pond had a very good survival rate (80-83%). With the appearance of the Prussian carp the survival rate started reducing and in the T2 pond, which was 15% lower on average the three years. The largest difference was detected between the T2 pond and the T5pond: 50% difference was appointed in 2004.

Huge differences could be found among the years, but if we examine the proportions we can find same rates. It is clear from the table, that there are differences among the ponds, but we use statistical methods to prove it. The relationships between the survival rates and the presence of the Prussian carps were analyzed with Chi² test and two samples Z test. The results show that there are negative correlation between the presence of the Prussian carp and the survival rate of the Common carp.

The food conversation ratio of the fishes

The cost of the feed is the largest cost element in the pond fish culture, so the food conversation ratio is one of the most important factors. Lot of professionals wrote about the importance of the feeding (WOYNAROVICH, 1968; TASNÁDI, 1983; HANCZ, 2000) and said that the best way to decrease the net cost is by the correct nutrition.

We analyzed the feed conversation ratio with FCR index, with the common feed conversation ratio and with the starch-value because it is often used in the practice. The examination of the FCR values on average of three years show that the growing density of stocks was causing worse feed conversation ratios.

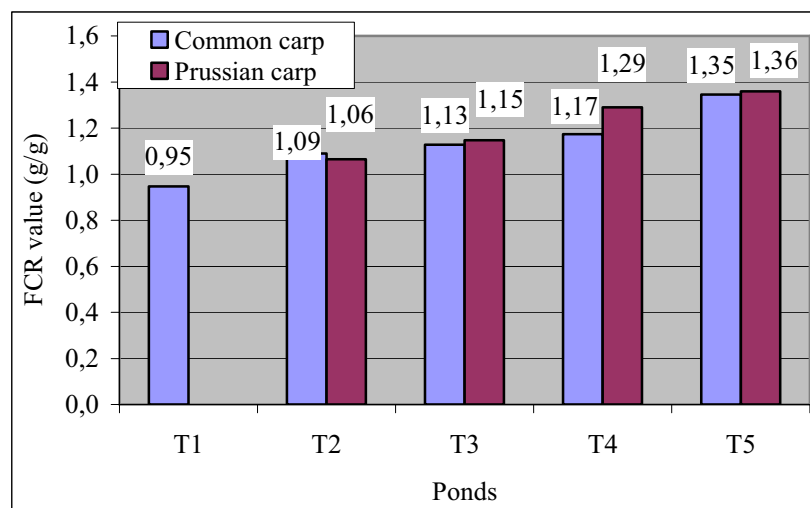


Figure 4.: The FCR values in the average of the last three years (2003-2005)

In every year the Common carp stock in the T1 pond had the best feed conversation ratio (*Figure 4.*). On average of the three years the Common carps in the control pond (T1) had better feed conversation ratio with 14% then the Common carps in the T2 pond, and better with 40% then the Common carps in the T5 pond.

Examination of the yields

The specialty of the fish culture is that the production is not depending on the maximal growing potential of the animals. The most important thing is to maximize the output of the production area. For this reason the farmers always have to control the growing rates of the fishes. The easiest way to do this is controlling the stocking rates. The more fish gets into the water the less will be their average weight.

The higher yields in the yearling Common carp production mean that you do not necessary to use more fishponds for the fingerling production so you are able to rear market size fish on a larger area. The yields of the ponds were calculated after the harvesting from the survival rates and the average weights. We examined the yield of the Prussian carp, the Common carp and the total yields, too. In every case the yield was extrapolated for one hectare. The *Table 4.* demonstrates the results of the three years. In every year the difference between the yields of the Common carp in the T1 pond and the T2 pond was more then two times, while the difference between the yields in the T1 pond and the T5 pond was almost six times. Of course, there were huge differences between the total yields too. It was determined that the appearance of the Prussian carp caused 30% lower Common carp yields in the T2 pond.

Table 4.

The yields of the ponds

Ponds	Common carp (kg/ha)			Prussian carp (kg/ha)			Yield (kg/ha)		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
T1 (Control)	748	912	1023	0	0	0	748	912	1023
T2 (50%)	347	424	510	124	235	153	471	659	663
T3 (100%)	259	324	366	159	341	205	418	665	571
T4 (150%)	188	288	277	229	365	241	417	653	518
T5 (200%)	124	159	169	265	471	241	389	630	410

The relationships between yields and the presence of Prussian carp were analysed with polynomial trend functions. The relationship was very close between the Common carp yields and the presence of the Prussian carp (in 2003 $R^2 = 0,9484$; in 2004 $R^2 = 0,9298$ and in 2005 $R^2 = 0,9643$) (*Figure 5.*). These results absolutely prove that if the Prussian carps get into the ponds, the yields will be drastically lower. The figures show different numbers in the different years but the functions are very similar.

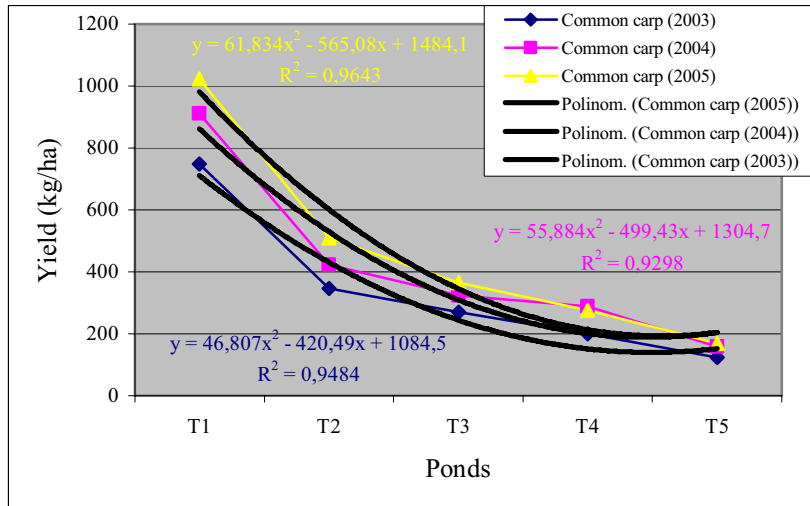


Figure 5.: Correlations between Common carp yields and the presence of Prussian carp

Examination of the production values

For the determination of the production values we calculated the values for one hectare too. It shows larger differences than the yields because of the prices of the Common carp and the Prussian carp. The Common carp is a valuable fish but the Prussian carp is an unworthy by-product. In case of the common carp we used the official prices of the Hungarian Fish Producers' Association every year. To set the price of the Prussian carp was more difficult, because this fish has not any official price. In every year we have used a 0,44 EUR price as if we sold the Prussian carp as a feed-fish.

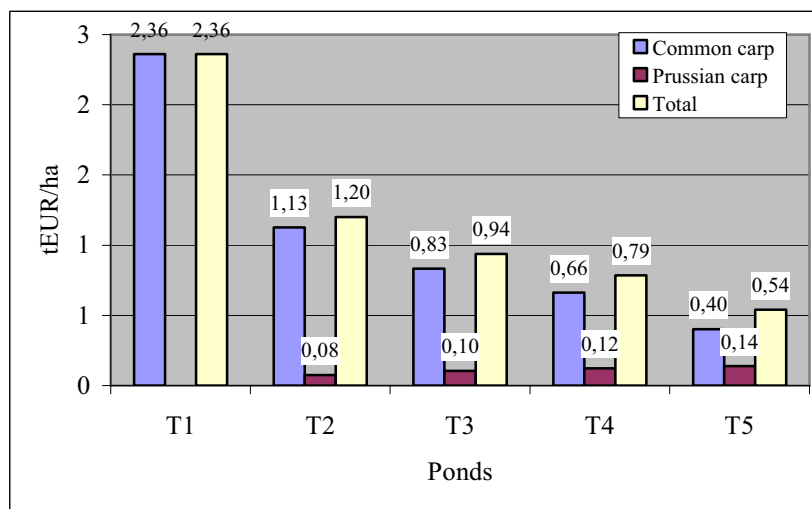


Figure 6.: The production values in the average of the last three years (2003-2005)

It is obvious from *Figure 6.* that the production values of Common carp is reducing in line with the growing of the Prussian carp populations. The growing of the Prussian carp population is also reducing the total production values but the values are a little bit higher because of the Prussian carp is present, and the rate of the decline is less. The production value of the Prussian carp is increasing with the bigger population but not at the same rate. The negative effect of the Prussian carp on the economy of production is demonstrated that while the difference between yields of T1 pond and T2 pond was only two times higher, the production values were over four times.

The average cost of the one year old Common carp

The final product of fingerling rearing is the Common carp yearling which will be in the stocking material for the next year. Because there are little amount of Common carp yearling is sold, the most important economic factor is the average cost of the production, it shows, that how much it cost to produce one kilogram Common carp. The *Table 5.* shows that the appearance of the Prussian carp increase the average cost of the Common carp production. The production was only economical when the number of the Prussian carp was less than 150%. There were huge differences among the profitable ponds, too. The difference between the average cost of the T1 and T2 pond was more then two times.

Table 5.

The average cost of the Common carp production in the last three years (2003-2005)

Pond Year	T1	T2	T3	T4	T5
2003	228,9	493,4	661,6	909,7	1326,2
2004	189,6	408,1	534,2	599,6	1088,2
2005	192,2	385,7	537,6	709,6	1163,0
Average	203,6	429,1	577,8	739,6	1192,5

The relationships between average cost and the presence of Prussian carp was analysed with polynomial trend function. The relationship was very close between the average cost of the Common carp and the presence of the Prussian carp (in 2003 $R^2=0,9898$, in 2004 $R^2=0,9332$ and in 2005 $R^2=0,9798$) (Figure 7.). In every the shape of the functions are very similar and we can determine that the growing the numbers of the Prussian carp cause a higher average cost in the Common carp production.

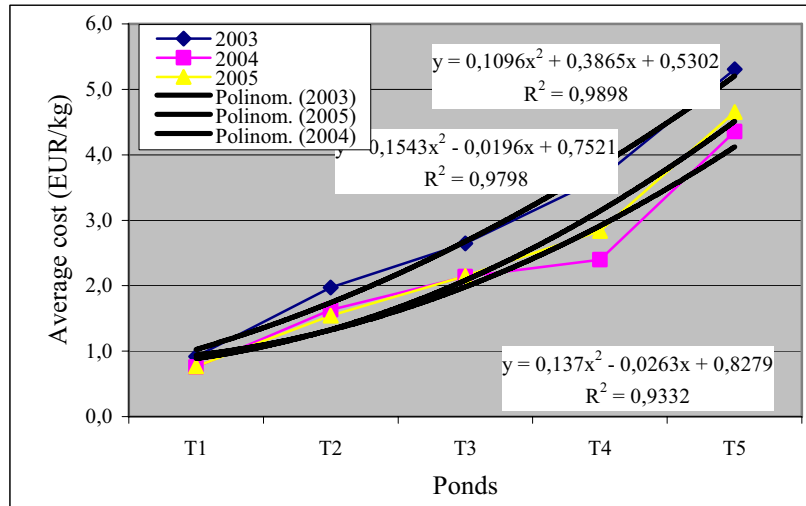


Figure 7.: Correlation between the average cost of the Common carp production and the presence of Prussian carp

The higher average costs debase the profitability of the two and three year old Common carp rearing. Therefore, the economical production of table size fish is in danger. The usefulness of using polynomial trend function in average cost is similar to that of the harvesting weights and the yields. The exact calculation of the average cost is a great help to control the production and reach the maximum profit. A cheaper nutrition, a higher manuring rate or the changes in the length of the breeding season could be chosen for the best result. With the application of the trend functions one can able to optimize the utilization of the resources for the economical fish production.

V. NEW SCIENTIFIC RESULTS

The effect of the Prussian carp presence on the yields of Common carp yearlings was surveyed in my research. The actuality of the experiments is provided by the fact that fish culturists have declared several times –since the Prussian carp had spawn in the Hungarian natural waters - that the presence of Prussian carps in the fish farms has harmful effects on fish production. Although everybody agrees with the above statement, no experiments have ever been performed to calculate the losses caused by the Prussian carp, so far.

Therefore, we undertook to survey the effect of the Prussian carp presence on the yields of Common carp yearlings in a three-years experiment. The following new scientific conclusions can be drawn from the results:

- The presence of the Prussian carp has an effect on the growth of Common carp yearlings. In ponds, where the Prussian carp appears, the growth of the Common carps begins to slow down. The Prussian carp, being present in fish ponds, reduces the growth rate of Common carps. 50% proportion of Prussian carps reduced the Common carp SpGR index with 13% in comparison to that of the control pond. 200% proportion of Prussian carps caused 29% reduction of the Common carp SpGR index.
- Results of the experiment proved that the increasing number of Prussian carps reduced the individual weights at harvesting of the Common carp yearlings. There was 42% difference between the average weight of the Common carp population in the control pond (T1) and that of the pond with the lowest rate of Prussian carps (T2), (25,0 g and 14,4 g respectively). In case the proportion of Prussian carps exceeds 50%, the weight of Common carps does not reach the minimum 20g necessary for successful wintering. Therefore, the number of animals died during the winter increases and this makes the stocking more difficult in the next year. We can get an accurate view of the possible losses even during the growing season by using the polynomial trend functions approximating the individual weights at harvesting. Therefore, planning the stocking and the sales of the next year will be easier, as well.

- The presence of Prussian carps reduces the uniformity of the Common carp populations, which makes the stocking, the organization of feeding and sales more complicated. 50% proportion of Prussian carps reduces the uniformity of the Common carp population with 60%, in comparison with the control population. The uniformity of the pond with the highest Prussian carp population was more than 2,5 times lower than that of the control pond.
- The presence of Prussian carps influences the survival rate of Common carps. After analyzing the results, we stated that 50% proportion of Prussian carps resulted in the reduction of Common carp survival rates by 16%, and 200% proportion of Prussian carps by 48%. Results were statistically significant. Lower survival rates decrease the yields.
- Feed utilization of Common carps was also negatively affected by the presence of Prussian carps. There was more than 14% difference in the FCR values of the T1 and T2 ponds, while the difference between the T1 and T5 ponds was 42%. Analyzing the feed conversion index values, we found that - in the case of the control pond- only 2,34 kg supplementary feed was necessary for the production of 1 kg Common carp. However, the feed conversion index was almost six times higher in the pond with the highest Prussian carp population (13,73 kg/1 kg carp). Since the Prussian carp is in fact valueless, the costs of the feed consumed by them fall entirely on the production of the Common carp, increasing the production values.
- Yields are drastically reduced in ponds where the Prussian carp is present. The Common carp yield of the control pond was 50% higher than that of the pond with the lowest proportion of Prussian carps (T2). Analyzing the total yield, it can be stated that the difference between the control pond and the T2 pond was 34%. In terms of production value, the difference was 49%. This increment is due to the difference between the market values of the two fish. The use of polynomial trend functions is not only a tool for determining individual weights at harvesting but can be used to predict yields, as well. More accurate yield estimations mean economic advantages for the producer.

- The presence of Prussian carps in ponds has a fundamental effect on the profitability of fish farms. Low feed conversion rates, reduced value of the Prussian carps and Common carp yield losses due to the presence of Prussian carps all contribute to the reduced profitability of Common carp production. The average cost of Common carp yearlings in the T2 pond was 210% higher than that of the control pond. This significant increment has a fundamental effect on the economic efficiency of production.

VI. PRACTICAL UTILITY OF THE RESULTS

Results of the experiment have clearly proved that the presence of Prussian carps in ponds has a negative effect on production parameters. Keeping in mind the result supported by exact numbers, producers and fish farmers have to pay special attention on the protection against Prussian carps.

Polynomial trend functions elaborated in the research project can help fish farmers in preparing more accurate production, harvesting and stocking plans. The knowledge of the Prussian carp population size enables the producers to estimate the reduction in individual weights at harvesting and in yields. These data makes it possible for the producer to draw an accurate picture of the successfulness or the unsuccessfulness of the production in a given year. More accurate estimations facilitate the planning of stocking and sales in the following year, offering financial advantages for those applying the polynomial trend functions.

VII: SCIENTIFIC PUBLICATION LIST

Reviewed scientific publications

- **Bársony P., Pócsi L., Szabó A.** 2004: A ponty (*Cyprinus carpio*) és az ezüstkárász (*Carassius auratus gibelio* Bloch) kölcsönhatásának vizsgálata. Acta Agraria Debreceniensis, pp: 16-19
- **Bársony P., Pócsi L., Szabó A.** 2005: Az ezüstkárász (*Carassius auratus gibelio* Bloch) jelenlétének hatása az egynyaras ponty termelésére Acta Agraria Debreceniensis, pp: 9-12
- **Bársony P., Vinginder Cs.** 2005: Correlations between Prussian carp and the yields of common carp fingerlings. Sustainable agricultural across borders in Europe, Debrecen 2005.05.06. pp: 109-113
- **Bársony P.**, 2006: Különböző méretű ezüstkárászpulációk hatása az egynyaras ponty növekedésére. Állattenyésztés és Takarmányozás, 55.1. pp: 57-63
- **Bársony P., Szűcs I.** 2006: Az ezüstkárász fertőzöttség gazdasági hatásai a tógazdasági haltermelésben. Gazdálkodás, in press,
- **Bársony P.** 2006: A fitoplankton hatása a halak növekedésre, különböző nagyságú halpopulációknál. Állattenyésztés és Takarmányozás, in press

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- **Bársony P.** 2004: Az ezüstkárászfertőzöttség hatásai a tógazdasági haltermelésben. IX. Nemzetközi Agrárökonómiai Tudományos Napok, Gyöngyös
- **Bársony P., Szabó A., Pócsi L.** 2004: Az ezüstkárász jelenlétének hatása a tógazdasági ökoszisztémákra. XLVI. Hidrobiológus napok. Tihany
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- **Bársony P., Vinginder Cs.** 2004: Az ezüstkárász jelenlétének hatása az egynyaras ponty termelésére. XXVIII. Halászati tudományos Tanácskozás, Szarvas, pp: 69-74
- **Bársony P.**, 2004: Az ezüstkárász és az egynyaras ponty kölcsönhatásának vizsgálata Nemzetközi Halgazdálkodási Tanácskozás. Debrecen, 2004.08.18.-19. pp:116-120

- **Bársony P.**, *Vinginder Cs.* 2005: Az ezüstkárász, mint pontyhozamot csökkentő tényező. XI. Ifjúsági Tudományos Fórum, Keszthely 2005.03.24
- *Vinginder Cs.*, **Bársony P.** 2005: A törpeharcsa (*Ictalurus nebulosus*) növekedése intenzív tartástechnológiai körülmények között XI. Ifjúsági Tudományos Fórum, Keszthely 2005.03.24
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- **Bársony P.**, *Vinginder Cs.* 2005: A fitoplankton mennyiségének változása és a ponty növekedése közti kapcsolat vizsgálata. XXIX. Halászati Tudományos Tanácskozás. Szarvas, 2005. május 4-5.
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- **Bársony P.** 2005: A vadhalak jelenlétének hatása a haltermelés gazdaságosságára. DAB konferencia, Debrecen, 2005.11.18.

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- **Bársony P.** 2004: The affect of the Prussian carp (*Carassius auratus gibelio* Bloch) in pond fish culture Natural Resources and Sustainable Development. 2nd International Scientific Symposium of the Faculty of Environmental Protection University of Oradea and University of Debrecen Faculty of Agricultural sciences. April 23-24, 2004, Oradea.
- **Bársony P.**, *Stündl L.*:2004: The effect of the Prussian carp (*Carassius auratus gibelio* Bloch) in carp fingerling production. International Carp Conference, Bautzen, Germany, 2004.09.23.-25
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- **Bársony P.**, Pócsi L., Szabó A. 2004: Az ezüstkárász (*Carassius auratus gibelio* Bloch) hatása a ponty (*Cyprinus carpio*) takarmányértékesítésére. Szent István Egyetem Állatorvos-tudományi Kar Akadémiai beszámoló. 2004.01.26.-29.
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