

MONITORING OF ALIEN FISH SPECIES PRUSSIAN CARP (*Carassius gibelio*) IN CROATIAN PART OF THE SAVA RIVER AREA FROM 2004 TO 2017

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Abstract

The alien fish species Prussian or gibel carp (*Carassius gibelio*) was introduced to Croatia from Asia several decades ago. The analysis was performed by the official monitoring data from the Final Report for the Ministry of Agriculture of the Republic of Croatia by the Faculty of Agriculture, University of Zagreb during the last eight years (2010-2017) in combination with the statistical analysis of the fisheries data of the Krapina-Zagorje County and Sisak-Moslavina County in the period from 2004 to 2015. The proportion of Prussian carp catches (in kg) increased at Sisak-Moslavina County from 26.45% to 41.84% from 2004 to 2015, leading to a significant decrease of catches of common carp from 25.59% to 8.70%, respectively ($r^2 = 0,936$; $p < 0,01$). The catch per unit effort (CPUE) of Prussian carp, defined as annual catch by an average angler, significantly increased, from 6 kg at the beginning of this period to 14 kg at its end. These data show that Prussian carp still enlarges its populations along the Sava River.

Key words: gibel carp, common carp, CPUE, invasive species, competition.

INTRODUCTION

The alien fish species Prussian or gibel carp (*Carassius gibelio*) spreads very rapidly and is considered to be one of the causes of the decline of other fish populations, especially due to the possibility of gynogenesis, a process that gives rise to new females. Females spawn with several other species, for example *Cyprinus carpio* (Figure 3) and *Carassius carassius*, but the eggs just develop without being actually fertilized resulting in an only female population.

The milt of male fish is needed to initiate development of the eggs, but when the embryos form, the chromosomes from the males are excluded. The offspring produced are thus copies of the female. This is especially problem with common carp because after spawning stay only Prussian carp females.

In Europe, gibel populations are considered as triploid and only females (Kottelat et al., 2007.). Because of that they have a bad influence on the share of some species in the catch.

The increasing number of Prussian carp individuals over the years can influence the share of common carp (*Cyprinus carpio*) (Gaygusuz et al., 2015). Therefore the aim of

this paper is to check such changes analyzing the fisheries information from the Sava river, obtained from three sources (Jakopinac, 2016; Augustin, 2017; Treer et al., 2017).

MATERIALS AND METHODS

Data which were processed are the official monitoring data from the Final Report for the Ministry of Agriculture of the Republic of Croatia by the Faculty of Agriculture, University of Zagreb (2010-2017) (Treer et al., 2017) in combination with the statistical analysis of the fisheries data of the Krapina-Zagorje County (Jakopinac, 2016) and Sisak-Moslavina County (Augustin, 2017) in the period from 2004 to 2015. The scientific sampling by electric gear at several locations along the whole section of the Sava River in Croatia were made in different seasons. The data are interpreted for the period of time from 2004 to 2017. Catch per unit effort (CPUE) is defined as annual catch (kg) by an average angler.

RESULTS AND DISCUSSIONS

The proportion of Prussian carp catches (in kg) increased at Sisak-Moslavina County from

26.45% to 41.84% from 2004 to 2015, leading to a significant decrease of catches of common carp from 25.59% to 8.70% (Figure 1).

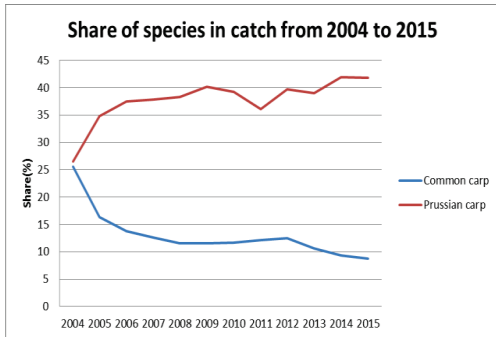


Figure 1. Movement of share of species in total catch in Sisak-Moslavina county from 2004 to 2015

This points to a very pronounced competition between common carp and Prussian carp in this area, which is statistically significant ($r^2=0,936$; $p<0,01$), (Figure 2).

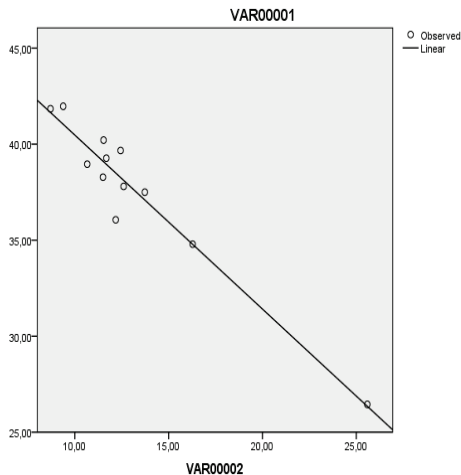


Figure 2. Correlation between the amounts of catches of common carp and Prussian carp through the years ($r^2=0.936$, $p<0.01$) in Sisak-Moslavina County from 2004 to 2015

CPUE of Prussian carp significantly increased, from 6 kg at the beginning of this period to 14 kg at its end. In 2012 it even tripled to nearly 19 kg (Figure 4).

This is also confirmed by the CPUE of common carp, which is in observed period halved. While the average fisherman in 2004 caught nearly 6 kg of carp each year, as in 2012, in 2015 it fell to below 3 kg (Figure 5).

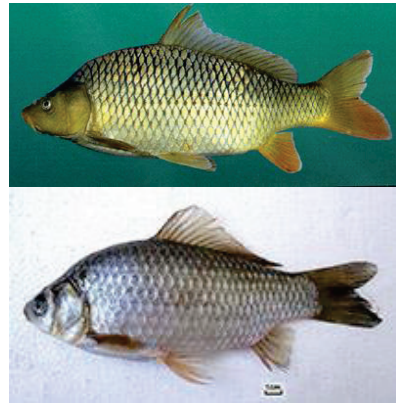


Figure 3. The phenotype difference between common carp (up) and Prussian carp (down)

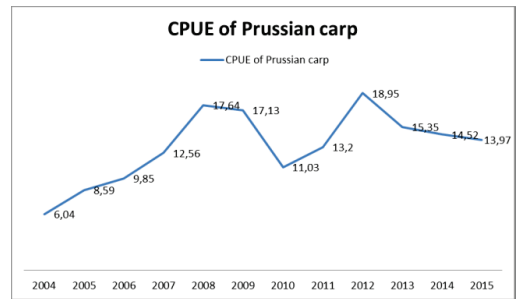


Figure 4. Movement of catch per unit effort of Prussian carp in Sisak-Moslavina County from 2004 to 2015

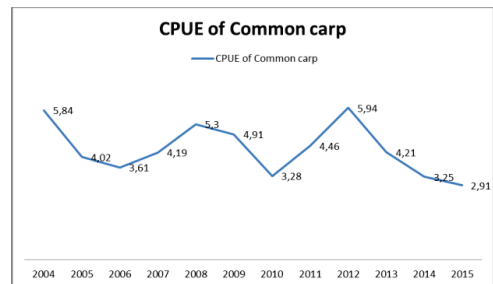


Figure 5. Changes of catch per unit effort of common carp in Sisak-Moslavina County from 2004 to 2015

The significant increase in the number of this species caught has been confirmed by scientific sampling by electric gear at several locations along the whole section of the Sava River in Croatia over several years.

These data show that Prussian carp still enlarges its populations along the Sava River. In the first sampling in 2004 there was only found 4 Prussian carps and in the last sampling in 2017 there was found even 52 Prussian

carps. Research was done on the same locations. Over the years number of Prussian carp in the Sava River area increased and this fish species occupies a share in the total catch of 37.73% (Figure 6).

Average weight of Prussian carp also increased in this part of Sava River area.

Such results in Sisak-Moslavina County are more visible than in Krapina - Zagorje County, but there is also increase of average weight (Figures 7 and 8). These results correspond with the ones find by Gaygusuz et al. (2015).

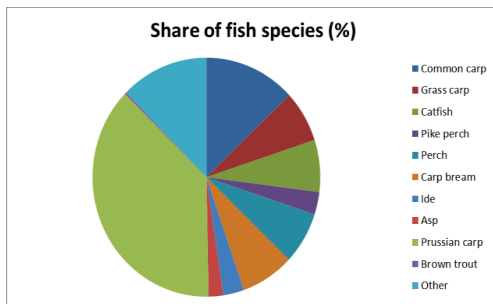


Figure 6. Average mass fraction of species in total catch in Sisak-Moslavina County from 2004 to 2015

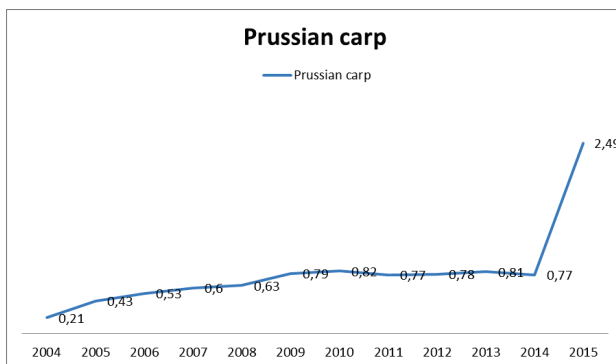


Figure 7. Annual dynamics of the average weight change of Prussian carp in Sisak-Moslavina County from 2004 to 2015

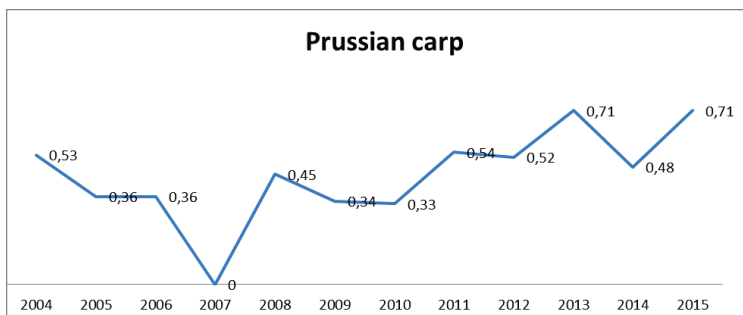


Figure 8. Annual dynamics of the average weight change of Prussian carp in Krapina-Zagorje county from 2004 to 2015

CONCLUSIONS

The proportion of Prussian carp catches (in kg) increased at Sisak-Moslavina County from 26.45% to 41.84% from 2004 to 2015, leading to a significant decrease of catches of common carp from 25.59% to 8.70%.

In the first sampling in 2004 there was only found 4 Prussian carps and in the last sampling by electric gear in 2017 there was found even

52 Prussian carps. The increase in the number of Prussian carp could in the future be endangered the existence of domestic species. Therefore, this phenomenon should be closely monitored next years. In addition, it is very important to share the catch data to those who are realized in open waters than those realized in closed ecosystems. Therefore, the continuous monitoring of its possible impact on domestic species is important.

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