GROWTH OF PIKE (*Esox lucius* L.) IN CROATIAN RESERVOIR KRUŠČICA

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Summary

This paper presents the data of pike (*Esox lusius* L. 1758) growth in the reservoir Kruščica. The reservoir is situated in the mountainous part of Croatia, where the winters are longer and chillier than in other parts of the country. Other fish species that inhabit this reservoir are roach (*Rutilus rutilus*), chub (*Leuciscus cephalus*), dace (*Leuciscus leuciscus*), bleak (*Alburnus alburnus*), tench (*Tinca tinca*), common carp (*Cyprinus carpio*), grasscarp (*Ctenopharingodon idella*), silver carp (*Hypophthalmichthys molitrix*), wells (*Silurus glanis*), ruffe (*Gymnocephalus (Acerina) cernua*) and pumpkinseed (*Lepomis gibbosus*). Based on total length, Von Bertalanffy's growth curve of pike in Kruščica appears to be:

$$L_t = 142 \; (1 - e^{-0.14 \; (t-0.5)})$$

Compared to the growth pike attains in some other stagnant waters, the growth of pike in this reservoir appears to be fair, but in principle, it is higher than in many a river. Comparative growth index during the first ten life years of pike was 86.6% if compared to the standard growth curve published for the British isles.

The overall growth performance (phi–prime) is: $\phi' = 7.95$. This value is almost the same as the one obtained from the British data ($\phi' = 7.90$).

Key words: Growth, Esox, Croatia, Von Bertalanffy, growth curve

INTRODUCTION

Pike (*Esox lucius* L. 1758) is a widely spread fish species. It inhabits most of Europe and some parts of Asia (L a d i g e s and V o g t, 1979). Being extremely

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carnivorous species it holds the top position of the trophic pyramide. By its growth it reflects complex conditions of the habitat (Vuković and Ivanović, 1971; Habeković and Pažur 1998). Thus, among others, it is a very useful species when comparing different habitats, or the same biotopes over the period of time (Hickley, Sutton, 1984).

Many data on pike growth in different habitats were published over the years. The purpose of this paper is to present the data on pike growth in Croatian reservoir Kruščica and to compare them to those elsewhere.

MATERIALS AND METHODS

Kruščica reservoir is situatied in the Croatian mountainous region of Lika. It was built around 1970 and covers an average area of 320 ha. The water level varies between 516 m and 554 m above the sea level. The maximum water depth is 71 m, the average one being 40 m. The shores are mostly steep. Before flooding, the area was covered by wood and somewhere pastures.

The pike (22 specimens) was sampled in September 1987, when all the water was released from the reservoir (Habeković et al. 1989). During the 1986 and 1987 the sampling of other fish species in the reservoir as well as water quality analyses were performed several times. The oxygen content of the surface water area during the investigation was between 8.8 mg l^{-1} and 12.3 mg l^{-1}. The water transparency varied between 2.5 m and 3.0 m and so did pH (between 7.5 and 8.4). The other fish species caught in the lake were roach (*Rutilus rutilus*), chub (*Leuciscus cephalus*), dace (*Leuciscus leuciscus*), bleak (*Alburnus alburnus*), tench (*Tinca tinca*), common carp (*Cyprinus carpio*), grasscarp (*Ctenopharingodon idella*), silver carp (*Hypophthalmichthys molitrix*), wells (*Silurus glanis*), ruffe (*Gymnocephalus (Acerina) cernua*) and pumpkinseed (*Lepomis gibbosus*).

The age was determined by the number of year rings formed on the scales. Total lengths were used in calculating growth curves. The von Bertalanffy growth curves and phi–primes were calculated according to Sparre and Venema (1992).

The data of Ladišić (1988) and Opačak et al. (1998) that resulted in unreasonably high values of L∞ could not fit von Bertalanffy growth model. These data put into figure were presented by their original values. In order to make possible the comparison with the standard growth curve of British Isles, standard lengths were used. That being the case, the following equation was used:

TL=0.95 + 1.10 SL

where TL=total length, SL=standard length and correlation coefficient being: r=0.9999 (p<0.01)

RESULTS AND DISCUSSION

The obtained parameters of standard von Bertalanffy growth curve for the pike in Kruščica reservoir appeared to be: $L_\infty=142$; $K=0.14$; $t_0=0.5$. Therefore the curve can be expressed as:

$$L_t=142 \ (1-e^{-0.14 \ (t-0.5)})$$

According to Hickley and Dexter (1979) comparative growth index can be obtained, comparing the growth of pike from Kruščica to the standard growth curve of pike published for the British isles (Hickley and Sutton, 1984). During the first ten life years of pike, this index for Kruščica reservoir appeared to be 86.6% as the result of slower growth during the first years of life, whereas in the eight year the lengths of both populations become similar (Fig. 1).
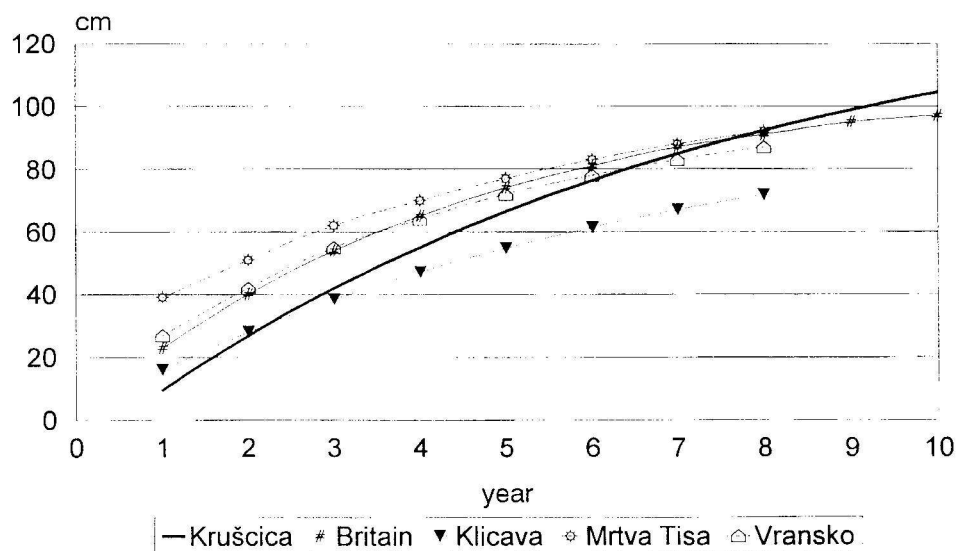

Fig. 1 Von Bertalanffy's growth curves for pike from the Kruščica reservoir, standard curve for British Isles and curves for some stagnant waters (authors named in the text).

Sl. 1. Von Bertalanffyjeve krivulje rasta za štuku iz akumulacije Kruščica, standardna krivulja za Britansko otočje, te krivulje za neke stajačice (autori imenovani u tekstu).

Compared to some other stagnant waters (Fig. 1) the growth of pike in this reservoir seems to be slower (Ristić 1963; Ocvirk 1985; Švatora and Pivnička 1992). The reasons are probably quite cold water temperatures most of the year that can be attributed to the mountainous region where

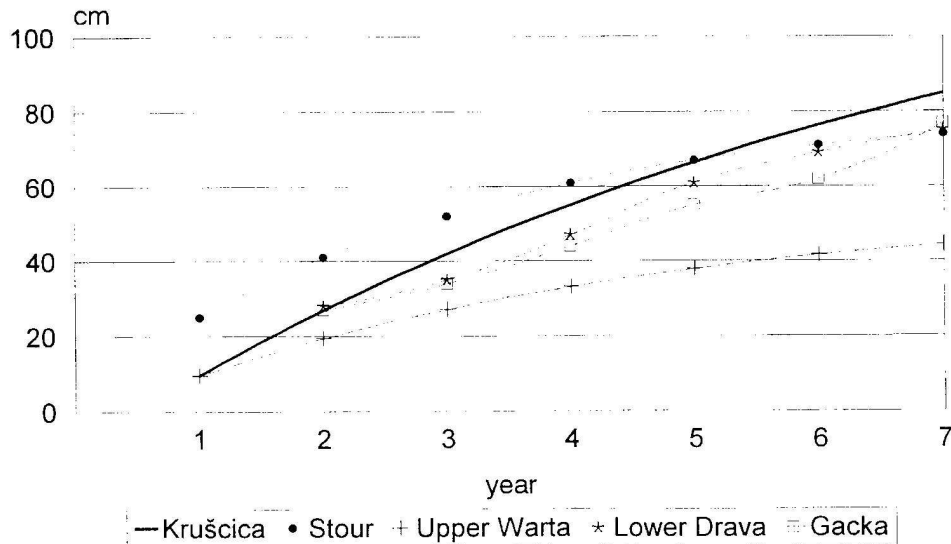the reservoir is placed. During our investigations the water temperatures varied between 7 °C and 23 °C.

Fig. 2 Von Bertalanffy's growth curves for pike from the Kruščica reservoir, the rivers Stour and upper Warta and the curves based on absolute data for the lower Drava and Gacka rivers (authors named in the text).

Sl. 2 Von Bertalanffyjeve krivulje rasta za štuku iz akumulacije Kruščica, rijeka Stour i gornja Warta, te krivulje bazirane na apsolutnim podacima za rijeke donju Dravu i Gacku (autori imenovani u tekstu).

However, compared to the growth of pike in the rivers (Fig. 2) the one in Kruščica appears to be fair (Mann 1975; Ladišić 1988; Przybylski 1996; Opačak et al. 1998). Consequently, the pike's way of life agrees better with stagnant waters regime than with that of the rivers. Similar differences were obtained for other fish species as for perch (Perca fluviatilis). (Simonović and Simović, 1997).

The phi–prime of pike in Kruščica is $\phi'=7.95$. This value is almost the same as the one obtained from the British data ($\phi'=7.90$), (Hickley and Sutton, 1984). These data confirm the reliability of pike growth curve, as the overall growth performance (ϕ') has minimum variance within the same species (Moreau et al. 1986). The phi–primes at other locations were also very close to these two and varied from 7.35 to 7.78 (Table 1). Only the upper Warta value was different ($\phi'=6.72$). Due to the harsh weather conditions the growth of fish in this section of the river was also extremely slow (Przybylski 1996).

Table 1 Comparative data on pike growth at different locations
Tablica 1. Usporedni podaci rasta štuke na različitim lokacijama

Location	Source	L∞	k	t_0	φ'
Kruščica	this paper	142	0.14	0.5	7.95
Britain	Hickley & Sutton 1984	111	0.22	–0.5	7.90
Kličava	Švatora & Pivnička 1992	102	0.15	–0.15	7.35
Mrtva Tisa	Ristić 1963	111	0.19	–1.28	7.76
Vransko	Ocvirk 1985	102	0.23	–0.33	7.78
Stour	Mann 1975	83	0.32	–0.12	7.70
Upper Warta	Przybylski 1996	54.3	0.25	0.23	6.72

Sažetak

RAST ŠTUKE (*Esox lucius* L.) U LIČKOJ HIDROAKUMULACIJI KRUŠČICA

Štuka je široko rasprostranjena riblja vrsta u gotovo cijeloj Europi i u dijelu Azije. Budući da je u prehrani izraziti karnivor i stoji na samome vrhu hranidbene piramide, u svojem rastu dobro odražava stanje ihtiofaune u pojedinoj vodi. Stoga je vrlo pogodna za usporedbu rasta u različitim staništima.

Rast štuke u hidroakumulaciji Kruščica, prema von Bertalanffyju, iznosi:

$$L_t = 142\ (1-e^{-0.14\ (t-0.5)})$$

To znači da teoretska najveća dužina štuka (L∞) iz ove akumulacije iznosi 142 cm. Brzina kojom je dostižu (K) relativno je mala i iznosi 0,14, slično kao u Mrtvoj Tisi, a znatno je manja od npr. one u britanskoj rijeci Stour gdje je 0,32. Točka gdje krivulja presjeca apscisu (t_0) iznosi 0,5.

Indeks rasta u odnosu na standardnu krivulju rasta štuka u Velikoj Britaniji iznosi 86.6%.

Ukupna performanca rasta štuke iz ove akumulacije iznosi φ'=7.95. Ova vrijednost odgovara vrijednosti izračunatoj za britanske otoke (φ'=7.90) i potvrđuje valjanost ovih podataka, jer je performanca rasta za svaku vrstu ribe vrlo malo varijabilna, bez obzira na različiti tempo rasta.

Ključne riječi: rast, štuka, Hrvatska, Von Bertalanffy, krivulja rasta

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