

STANDARD GROWTH CURVE FOR CHUB (*Leuciscus cephalus* L. 1758) IN CROATIA

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Summary

Chub (*Leuciscus cephalus*) is widely spread fish species and it inhabits most of Europe and some parts of Asia. It is also the dweller of different sections of rivers and stagnant waters and it eats both — animal and plant organisms. Thus, it is a very useful species when different habitats, or same biotopes over the period of time are being compared.

Based on a number of published data on different habitats, the standard growth curve for chub in Croatia was calculated. Based on total length, Von Bertalanffy's growth curve appears to be:

$$L_t = 31,8 (1 - e^{-0,28(t-0,04)})$$

A comparative growth index for the first eight years of chub life was the lowest in the upper Kupa river (89,8 %) and the best in the upper part of the Lonja river (112,2 %).

The overall growth performance (ϕ') is $\phi' = 5,69 \pm 0,14$.

These data are discussed and compared with literature.

Key words: Growth, *Leuciscus*, Croatia, Von Bertalanffy

INTRODUCTION

Chub (*Leuciscus cephalus*) is widely spread fish species and it inhabits most of Europe and some parts of Asia (Ladiges, Vogt, 1979). It is also the dweller of different sections of rivers and stagnant waters and it eats both — animal and plant organisms (Vuković, Ivanović, 1971). Thus, it is a very useful species when different habitats, or same biotopes over the period of time are being compared.

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Through years, the amount of data on the growth of chub has been accumulated in Croatia. Such amount necessarily called for quantification and standardization as it was done for example for the British Isles (Hickley, Dexter, 1979; Hickley, Sutton, 1984) for chub, bream (*Abramis brama*), roach (*Rutilus rutilus*), dace (*Leuciscus leuciscus*) and pike (*Esox lucius*).

MATERIALS AND METHODS

Data on club growth in Croatia was collected from twelve locations. As at one location the data was given two times in more than ten years' time span there are thirteen data sets (Habeković et al. 1979, 1980, 1983, 1988a, 1988b, 1988c, 1989, 1993; Homen et al. 1979; Mišetić et al. 1984). The habitats cover most of Croatia, from the Drava river in the north to the Zrmanja river in the south. As some plots resulted in unreasonably high values of L_{∞} , not all published data could fit von Bertalanffy growth model. Finally, five locations were used in the standard growth curve estimation: the Bednja river, the Lika river, middle section of the Dobra river and the upper sections of the Lonja and Kupa rivers.

In every source of the data the age was determined on the number of year rings formed on the scales and the length was presented as the mean sizes in different age-groups. According to the statement that fish in moderate European climate practically do not increase in length from October to May (e. g. Biro 1977; Geri et al. 1995) the time of sampling was also taken into account and so was the age.

Total lengths were used in calculating growth curves. In order to make the comparison with the standard growth curve of British Isles possible fork lengths were used. In that case the following equation was used:

$$FL = -0,015 + 0,931 TL$$

were FL=fork length, TL=total length and $r=0,999$ ($p<0.01$).

The von Bertalanffy growth curves and phi-primes were calculated according to Sparre and Venema (1992).

RESULTS AND DISCUSSION

The obtained parameters of standard von Bertalanffy growth curve for the chub in Croatia appeared to be: $L_{\infty}=31,8$; $K=0,28$; $t_0=0,04$. Therefore the curve can be expressed as:

$$L_t = 31,8 (1 - e^{-0,28(t-0,04)})$$

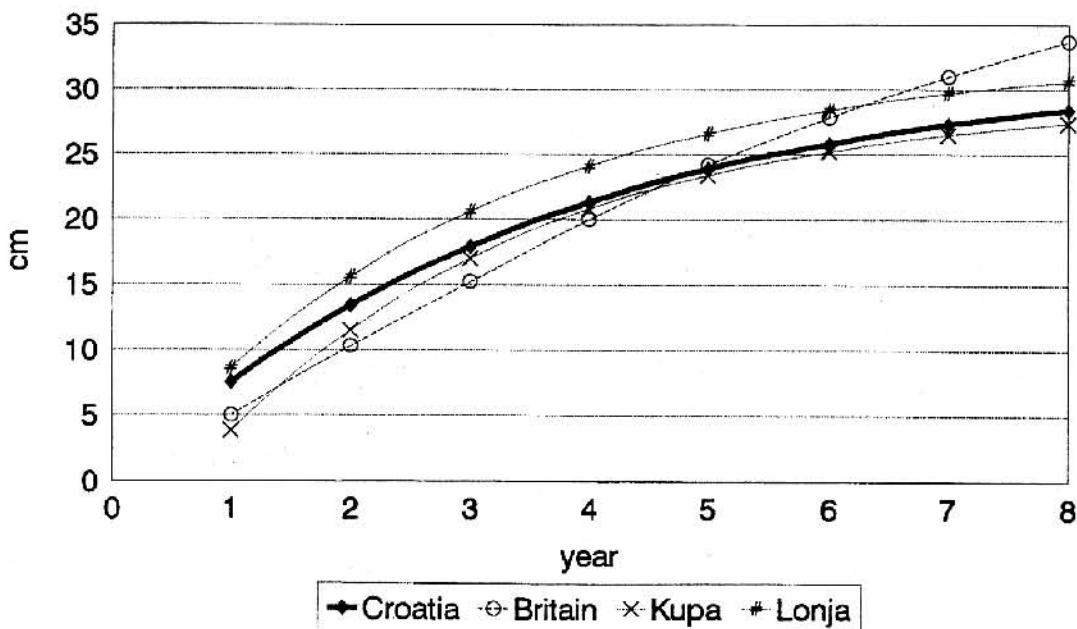


Fig. 1. Von Bertalanffy's growth curves for chub from the Kupa and Lonja rivers and standard ones for Croatia and British Isles

Sl. 1. Von Bertalanffyjeve krivulje rasta za klena iz Kupe i Lonje, kao i standardne krivulje za Hrvatsku i Britansko otočje

A comparative growth index, according to Hickley and Dexter (1979), for the first eight years of chub life was the lowest in the upper Kupa river (89,8%) and the Lika river (96, 0%). Both rivers are situated in the mountainous part of Croatia where climate is less than moderate and vegetation period is shorter. The water is clean and the amount of nutrients is low. Nevertheless, this growth can still be considered fairly good in comparison to some other habitats, for example the stream originated from the springs of Pinarbasi in Turkey (Geldiay, Balik, 1973).

The middle part of the Dobra river expressed growth index of 100,5%, which is almost the same as the standard one. Although the growth index was somewhat higher (102,4%), the growth curve of the Bednja river paralleled the standard one the most.

Finally, the best growth was expressed in the upper part of the Lonja river (112,2%). This river is situated in the Croatian portion of Pannonian valley, where the climate is warmer, vegetation period longer and the water is richer in nutrients (Fig. 1).

In comparison to the standard growth curve of the British Isles chub (Hickley, Dexter, 1979), the Croatian chub grows better. The growth index of British chub is 95,7% in comparison to the standard growth curve in Croatia. It corresponds to the index of the mountainous river Lika and can

be attributed to the northern geographical position of the British Isles. It is also visible that British chub grows slower during the first years of its life and alters its growth later on.

The phi-prime of Croatian chub is $\phi' = 5,69 \pm 0,14$. This value is similar to the one calculated from the British data ($\phi' = 5,90$) whose ϕ' is the same as the one from the upper Lonja river. These data confirm the reliability of chub growth curves, as the overall growth performance (ϕ') has minimum variance within the same species (Moreau et al. 1986).

CONCLUSION

Based on a number of published data on different habitats, the standard growth curve for chub in Croatia was calculated. based on total length, Van Bertalanffy's growth curve, appears to be:

$$L_t = 31,8 (1 - e^{-0,28(t-0,04)})$$

The overall growth performance (phi-prime) is $\phi' = 5,69 \pm 0,14$. these data are discussed and compared with literature.

Sažetak

STANDARDNA KRIVULJA RASTA KLENA (*Leuciscus cephalus* L. 1758.) U HRVATSKOJ

Klen je široko rasprostranjena riblja vrsta u gotovo cijeloj Europi i u dijelu Azije. Naseljava različite vodene biotope i u prehrani je omnivor. Stoga je vrlo pogodan za usporedbu rasta u različitim staništima.

Na osnovi dostupnih podataka, poglavito iz gospodarskih osnova, određeno je trinaest tablica njegova rasta. One su poslužile kao osnova za izračunavanje standardne krivulje dužinskog rasta ove vrste u Hrvatskoj. Ona, prema von Bertalanffyju, iznosi:

$$L_t = 31,8 (1 - e^{-0,28(t-0,04)})$$

To znači da $L_\infty = 31,8$; $K = 0,28$; $t_0 = 0,04$.

Indeks rasta kreće se u rasponu od 89,8% u gornjoj Kupi do 112,2% u gornjoj Lonji. Indeks je rasta britanskih klenova 95, 7%, što odgovara rijeci Lici.

Performanca rasta za klenove u Hrvatskoj iznosi $\phi' = 5,69 \pm 0,14$. Ova vrijednost odgovara vrijednosti izračunanoj za britanske otoke ($\phi' = 5,90$), koja je istovjetna indeksu phi-prime u gornjoj Lonji. To potvrđuje valjanost ovih

podataka jer je performanca rasta za svaku vrstu riba vrlo malo varijabilna, bez obzira na različiti tempo rasta.

Ključne riječi: rast, *Leuciscus*, Hrvatska, von Bertalanffy

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