CONDITION AND CPUE OF EUROPEAN GRAYLING (*Thymallus thymallus* L.) POPULATION IN THE CROATIAN KUPA RIVER

KONDICIJA I CPUE POPULACIJE EUROPSKOG LIPLJENA (THYMALLUS THYMALLUS L.) U HRVATSKOJ RIJECI KUPI

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Manuscript received: November 9, 2005; Reviewed: November 18, 2005; Accepted for publication: November 18, 2005

ABSTRACT

The study was carried out on the material of 98 European grayling (Thymallus thymallus L., 1758) from upper part Kupa river, in northwest Croatia. The research included angling by fly fishing tackle and collecting the data of fish species characteristics. Values of condition factor (CF) ranged from 0.615 to 2.239, but average value of this parameter is 1.094±0.27. The condition factor by dates of sampling indicated that all grayling caught before November, have had a negative condition factor. The quantity of fish present in the upper part of the Kupa river was evaluated using the catch per unit efforts (CPUE) parameter. The average value of CPUE parameter is 2.25±1.01.

KEY WORDS: European grayling; Thymallus; condition factor; CPUE; Croatia.

SAŽETAK

Istraživanje je provedeno na uzorku od 98 Europskih lipljena (Thymallus thymallus L., 1758) iz gornjeg toka rijeke Kupe, u sjeverozapadnoj Hrvatskoj. Istraživanje je obuhvatilo ribolov pomoću mušičarskog pribora i skupljanje podataka o ribljim karakteristikama. Vrijednost faktora kondicije (CF) kretala se od 0.615 do 2.239, a srednja vrijednost ovog parametra je 1.094±0.27. Faktor kondicije pokazuje da lipljeni ulovljeni prije studenog imaju negativni faktor kondicije. Kvantiteta riba prisutnih u gornjem toku rijeke Kupe procjenjena je parametrom ulova po jedinici napora (CPUE). Srednja vrijednost CPUE parametra iznosi 2.25±1.01.

KLJUČNE RIJEČI: Europski lipljen; Thymallus; faktor kondicije; CPUE; Hrvatska

DETALJAN SAŽETAK

Istraživanje je provedeno tijekom 2002. godine, od svibnja do studenog, na izvorskom dijelu rijeke Kupe u sjevernozapadnoj Hrvatskoj (45°30`N, 14°41`E). Sama lokacija nalazi se svega 200m nizvodno od izvora rijeke na 320m nadmorske visine. Taj dio rijeke Kupe još uvijek ima najvišu kvalitetu vode, i pruža optimalne uvjete za rast i razmnožavanje lipljena [2].

Ukupno je sportsko-ribolovnim alatom ulovljeno i obrađeno 98 lipljena (Thymallus thymallus L., 1758), a nakon uzimanja podataka sve su ribe neozljeđeno vraćene u rijeku. Vrijednost faktora kondicije (CF) kretala se u rasponu od 0,615 do 2,239, ali prosiječna vrijednost parametra bila je 1.094±0.27. Faktor kondicije pokazuje da sve ribe ulovljene prije studenog imaju negativan faktor kondicije, a slični podaci vrijede i za rijeku Unu [4]. Kvantiteta riba prisutnih u izvorskom toku rijeke Kupe procjenjena je parametrom ulova po jedinici napora (CPUE). Srednja vrijednost CPUE parametra iznosi 2.25±1.01. Ovaj parametar isti je kao što je u svom radu prikazao [4].

U periodu od 1991. do 1994. lipljen je bio dominantna riblja vrsta u ukupnom ulovu, i bio je zastupljen 41%-82%. Kasnijih godina taj je udio drastično pao, tako da je udio lipljena bio svega 48%-39% [14], a naš podatak pokazuje da se broj lipljena u ukupnom ulovu povečao 55%-77%.

INTRODUCTION

The European grayling (Thymallus thymallus L., 1758) is a gregarious fish spread through waters from northern England and southern Scandinavia to the Loire river in southern France in the west, and in the south it reaches the basin of the Po river, and is present in the Danube basin, while the eastern boundary of its natural area is the

Fig 1. The location of investigated river

Urals in Russia [6].

Over the last few decades the population of grayling have declined across Europe, and in many places their numbers have been decimated or entire populations have even disappeared. The causes have been degradation of the environment, watercourse regulation, habitat destruction, pollution, introduction of exotic fish species, the ravages of fish-eating birds and over fishing [19]. For this reason the grayling is now for the most part protected, and in the EU it is contained in the Habitats, Fauna and Flora Directive (92/43/EEC)- Annex V, and is also in the Berne Convention (1979)- Annex III [6].

Its morphology and growth were thoroughly analyzed in rivers of the former Yugoslavia [18, 17, 5, 1]. The grayling is one of the most popular fishes for anglers [8] and because of that it can be one of the most economically important Salmonids [9]. Information about fish species like the European grayling is scarce. Quantitative information on habitat requirements of the grayling is needed as an ecological basis for conservation and management work, such as habitat enhancements, fish stocking or flow regulation [11]. Actions for effective management cannot be planned without a good understanding of the species' habitat requirements throughout its life cycle [12].

The aim of this research was to study the present status of Croatian grayling population in the Kupa river. For that purpose we have compared length-weight relationship, condition factor (CF) and catch per unit efforts (CPUE) with the results of other research in Europe.

MATERIAL AND METHODS

The study was conducted from May to November 2002 in a 1500 m long section of the Kupa river (45°30`N, 14°41`E). The study area is located 200 m downstream from the spring, at approximately 320 m above sea level. The Kupa river flows through northwest Croatia and flows into the Sava river (Fig. 1).

The area of study contained a range of habitats from a deep pool section (maximum depth about 4.0 m), to rapids and riffles (mean depths 0.3-1.0 m) and a shallow pool section. At that part the river is 15 to 25 m wide. During the study time the water temperature varied between 7 and 11°C. The flow regime of the Kupa river is characterized by wide seasonal fluctuations, with minimum flows in winter and peak flows soon after snowmelt in March to April.

The upper part of Kupa river still has water of the highest quality class, and the grayling is common and abundant in the river. The low temperature, aquatic vegetation and water aeration by riffles and cascades give optimal conditions for breeding and growth of the grayling [2]. The graylings were caught in the upper section of the Kupa river by angling, using fly fishing tackle. The fish were measured for total length (L) in mm and weight (W) in g, after which fishes were gently released back into the water. Sex determination was based on two different methods; one is based on sexual dimorphism in dorsal and pectoral fin size [3] while the second is based on the disposition of black dots [13].

To establish a length-weight relationship, the commonly used $W = aL^b$ was applied [15] where W = weight in grams, L = total length in cm and a and b are constants.

The Condition factor (CF) was calculated as:

$CF = W \cdot L^{-3} \cdot 100$

The quantity of fishes present in the upper part of the Kupa river was evaluated with catch per unit efforts (CPUE) parameter. This parameter is in positive relation with the number and mass of fishes present in river. We monitored the study area over a period of time by following the catch result of one angler using the same fishing tackle under equivalent conditions. The catch per unit efforts is defined as the number of catch (expressed in pieces or kilograms) in one hour of angling (electrofishing) and it expresses average values for the fish species living in the

Table 1. Monthly condition factor (CF) and total length (L in cm) relationship parameters of grayling from Kupa river (CF = a-b L): number of specimens (n), constants (a, b), correlation factor (r), *p<0.05, **p<0,01

Parameter	May	Juny	July	Aug.	Sept.	Oct.	Nov.
n	11	11	12	7	13	20	24
a	2.193	1.985	1.851	1.483	1.899	1.261	0.557
b	-0.042	-0.032	-0.027	-0.013	-0.029	-0.005	0.016
r	0.662	0.386	0.721	0.439	0.214	0.016	0.074
p	0.002**	0.041*	0.000**	0.105	0.112	0.591	0.197

study area [10].

RESULTS AND DISCUSSION

Between May and November 2002 a total of 7 fishing campaigns were carried out. A total of 98 grayling were measured and weighted, and then carefully released in the same stretch. The specimens of grayling ranged from 17.0 to 41.0 cm in total length and from 40 to 700 g in weight.

Sex was determined only on 68 fish. At the Kupa river, sex determination was possible in grayling of total length (L) between 26.0 and 27.5 cm. There were slight differences in sex ratio with grayling from an expected 1:1 ratio [19]. Ratio between female and male grayling was 37:31 in favor of female.

The length-weight relationship (Fig 2) demonstrated a negative allometric growth with a b-value of 2.64 ($W = 0.035 \cdot L^{-2.64}$; $r = 0.891$, $p<0,01$). Values of condition factor (CF) ranged from 0.615 to 2.239, but average value of this parameter is 1.094±0.27. The regression between CF and total length is negative (Fig 3) because when the b-value is lower than 3, CF evolves to the opposite direction from that length onward ($b = -0.016$, $a = 1.554$, $r = 0.129$, $p = 0.00$). The monthly comparison between CF and total length is shown in Figure 4 and Table 1. The ratio of condition factor and total length (Fig. 4) by months of sampling indicates that all grayling caught before November, have had a negative condition factor. Similar results gave [4] in the Una river, where first positive condition factor was at the end of September. The average condition factor from the Turiec river [16] was estimated 1.55, from the Slana river [7] 1.70 which is much better than in our study, so living conditions in those two Slovak rivers are better than in the Kupa river. But lower average condition factor was estimated in the Pomerania river, 1.00 [20].

Results of catch per unit efforts (CPUE) did not markedly change between fishing campaigns apart from campaigns in October and November. The values of those two parameters in October (3.33) and November (4.00) are much higher compared to the other results, which are between 1.40 and 2.44. A higher result in October is caused by the much higher flow regime of the river. In

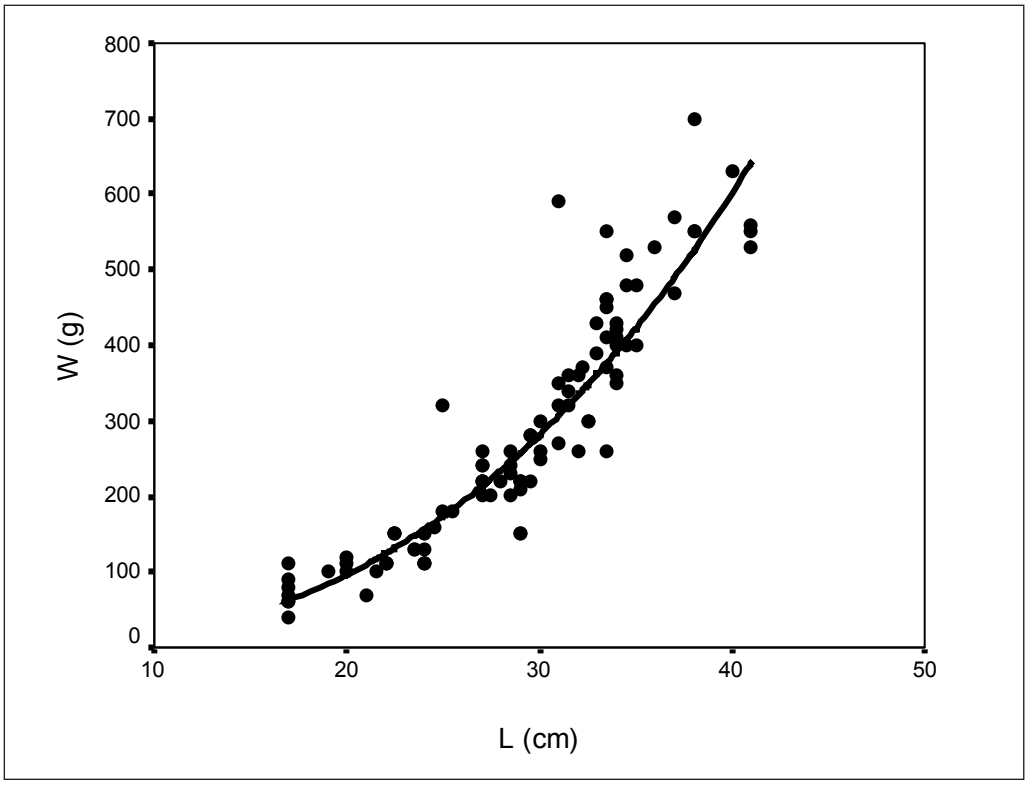

Fig 2. Total length (L in cm)-weight (W in g) relationship of grayling from Kupa river (W = 0.035 • L-2.64; r = 0.891, p<0,01)

those terms it was easier to catch grayling on artificial fly because more available food is present in the river and the grayling are consuming food in bigger amount. This is because they are preparing for the upcoming spawning season in March. The average value of CPUE parameter is 2.25±1.01. Beside our CPUE result of 2.25 fish per hour, only [4] in the Una river presents such data, where 11 fishermen caught 270 fish in 120 hours. From this data we have calculated CPUE for the Una river, and it was the same as ours: 2.25.

The result of total catch in period 1991-1994 years shows that grayling was the dominant species (41%-82%), while in later years total catch of grayling have declined (48%-39%) and catches of brown trout prevailed [14]. Data of our research 55%-77% show that grayling population slightly increases there share in total catch. High angling intensity, especially for grayling, has disordered the natural balance in the Kupa river ecosystem. The decrease of grayling population in the Una and Drina rivers is the result of exceeded fishing and poaching [4, 9]. Beside injuries from fish eating birds we noticed many mouth injuries, and this occurred from fishing pressure and bad fish handling.

Grayling co-occur with other fish species in the various stretches. Most of this fish species are not in competition with grayling, but certainly rainbow trout is [19]. By observing the behavior between these two species we can conclude that competition is at feeding and spawning sites. Because, we have caught only one species of rainbow trout, grayling population in this part of the Kupa river is not in threat from this kind of competition.

REFERENCES

[1] Aganović M., Study of minimal catch length of grayling in Bosna and Pliva rivers. Year book of biological institute, University of Sarajevo 1965, 18: 3-109 (in Croatian).

[2] Debeljak Lj., Habeković D., Pažur K., Basis of fishery management of fisheries society "Goran", Brod na Kupi. Zagreb, 2000 (in Croatian).

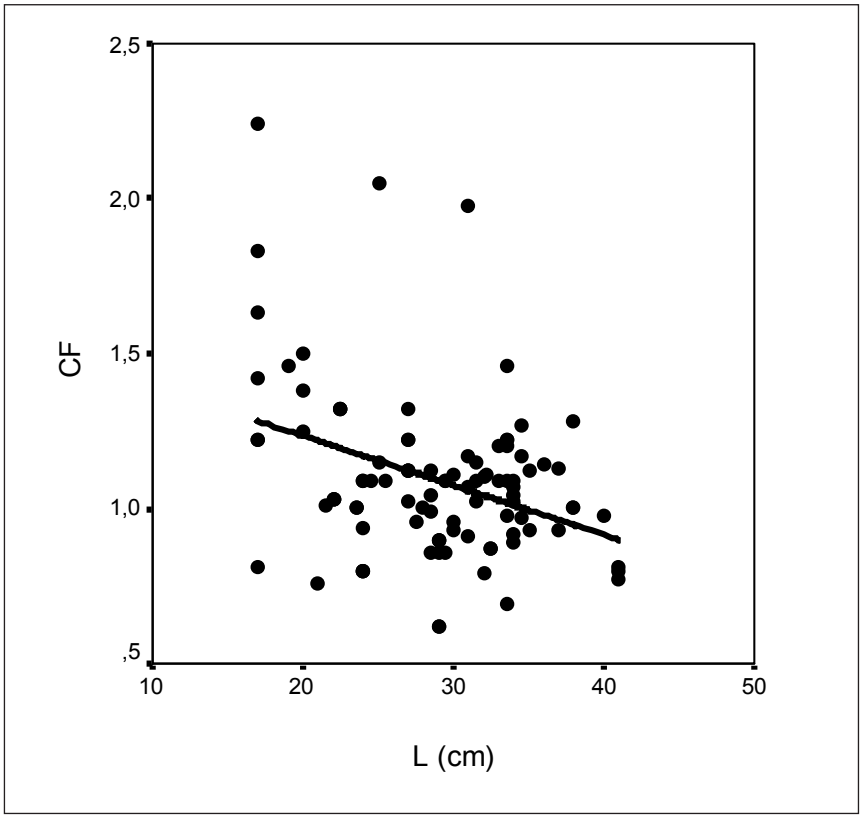

Fig 3. Condition factor (CF) – total length (L in cm) relationship of grayling from Kupa river (CF=1,554 -0,016 x L; r=0,129, p<0,01; n=98)

[3] Eloranta A., Grayling Thymallus thymallus L. in the lower part of the Rautalampi watercourse, Finnish Lake District. Verhandlungen der Internationalen Vereinigung für Limnologie, 1985, 22: 2555-2559.

[4] Horvat M., Growth of grayling in Una river. Ribarstvo Jugoslavije, 1964, 4: 103-111 (in Croatian).

[5] Janković, D., Grayling systematic and ecology in Yugoslavia. Biological institute, Society for improvement of freshwater fisheries. Beograd, 1960, 144 pp. (in Serbian).

[6] Jesenšek, D., Šumer, S., Adriatic grayling (Thymallus thymallus, Linnaeus, 1758) in the Soča river basin, Slovenia. Ribiška družina Tolmin in Ente Tutela Pesca del Friuli Venezia Giulia. (2004).

[7] Makara A., Stranai I., The age and growth of grayling Thymallus thymallus in the upper course of the Slana river. Polnohspodarstvo Agriculture, 1980, 26: 1007-1013.

[8] Mallet J.P., Lamouroux N., Sagnes P., Persat H., Habitat preferences of European grayling in a medium size stream, the Ain river, France. Journal of Fish Biology, 2000, 56: 1312-1326.

[9] Mikavica D., Sofradžija A., Škrijelj R., The spread and some idioecological characteristic of a grayling Thymallus thymallus L. from the Drina river. Ichthyologia, 1988, 20 (1): 27-36.

[10] Muzik V., Fish distribution of the middle part of Turiec river. Czech Journal of Animal Science, 1996, 41 (11): 491-499.

[11] Nykänen M., Huusko A., Size-related changes in habitat selection by larval grayling (Thymallus thymallus L.). Ecology of Freshwater Fish, 2003, 12: 127-133.

[12] Nykänen M., Huusko A. and Mäki-Petäys A., Seasonal changes in the habitat use and movements of adult European grayling in a large subarctic river. Journal of Fish Biology, 2000, 58: 506-519.

[13] Persat H., Photographic identification of individual grayling, Thymallus thymallus, based on the disposition of black dots and scales. Freshwater Biology, 1982, 12: 97-101.

[14] Povž M., Šumer S., Budihna N., Freshwater Fish and Crayfish of the Kolpa Catchement Area. Založba i2, Ljubljana, 1998, pp. 33-72.

[15] Ricker W.E., Computation and interpretation of biological statistics of fish populations. Bull. Fish. Board Can., 1975, 191: 382 pp.

[16] Stranai I., Age and growth of grayling (Thymallus thymallus) in lower part of Turiec river. Polnohspodarstvo Agriculture, 1992, 38, 497-502.

[17] Šenk O., Research of growth and sexual mature of grayling (Thymallus thymallus) from Drina, Bosna and Vrbas rivers. Veterinarija, Book of abstract of

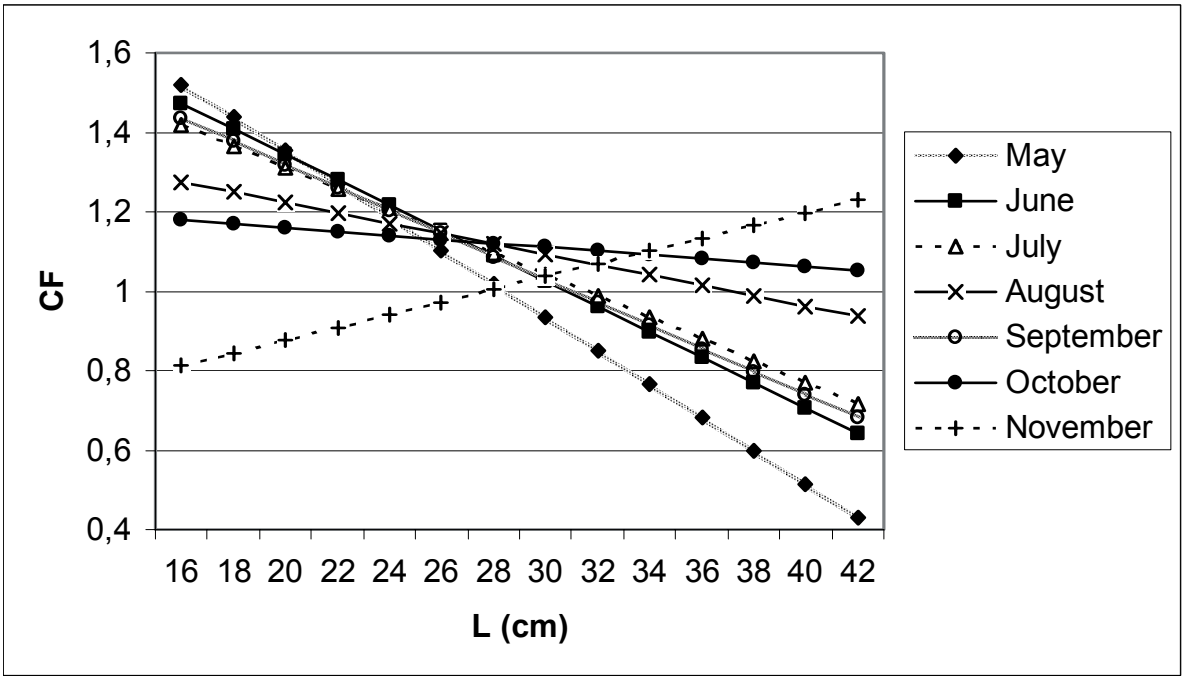

Fig 4. Monthly condition factor (CF) and total length (L in cm) relationship of grayling from Kupa river (2002)

animal production, Second year, 4. Sarajevo (1953) (in Serbian).

[18] Thaller Z., Grayling Thymallus thymallus, its habitat in Croatia and Balkan and its economic value. Priroda, Zagreb, 1944, 87 pp. (in Croatian).

[19] Uiblein F., Jagsch A., Honsig-Erlenburg W., Weiss S., Status, habitat use, and vulnerability of the European grayling in Austrian waters. Journal of Fish Biology, 2001, 59, 223-247.

[20] Witkowski A., Kowalewski M., Kokurewicz B., Grayling, PWRiL, Warszawa, (1984), pp. 1-214.