

## CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, *Salmo letnica* (Karaman)

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The investigations of the spawning of the Lake Ohrid trout, comprised from several subpopulations (forms) within the same lake ecosystem, during the past already seven decades has been always one of the main subject in the lymnological investigations of Lake Ohrid.

Unlike the usual population fluctuations within the dynamics of the ecosystem which were recorded during the first 5,5 decades (since 1934/35 year), in the last 1,5 decade and mainly in the last five years very significant and unfamiliar changes were recorded for the process of the natural spawning of this trout.

Namely, changes were registered as in the composition of the spawning population as well in the abundance of present spawning nests in all of the up to date natural spawning sites and grounds.

Due to this changes - which are mainly provoked by human activities like fishing, disruption of the spawning grounds, over fishing, pollution etc. - the population recruitment was drastically affected by reducing the reproductive capacity.

**Key words:** Lake Ohrid trout, spawning, recruitment, reproductive capacity

### Introduction

The Lake Ohrid fish fauna is represented with 17 autochthonous species from four families: Salmonidae (2), Cyprinidae (12), Cobitidae (2) and Anguillidae (1). Among them the most important, as from scientific point of view as well in whole, are the two, up to know, distinguished endemic and relic trout: *Salmo letnica* (Karaman) and *Acantholingua ohridana* (Steind.) According some authors (Karaman 1924; Stankovic 1960; Berg 1932) these species had inhabited the lake soon after its formation.

The so-called Ohrid trout, *Salmo letnica*, from various authors (Stefanovic 1948; Stankovic 1960; Dimovski, Grupce and Spirkovski 1992; Spirkovski

1991, 1992) has been considered like polymorph species regarding the taxonomical and ecological features. According the forth-mentioned authors four forms of Ohrid trout can be distinguished with different place, time and substrate for spawning (Tab. 1). This species, in the conditions that are present in the lake, reaches weight of 1 kg in the seventh year of its life with an average total body length of 420-460 mm, while the maturity among males occurs in the 4th year and 5th for the females.

As it can be seen from the table this four forms (or according different authors, subspecies or even species Kottelat 1997) differ mostly in their spawning ecology. But, as the Lake Ohrid trout is also the most important fishing object, in order to maintain the nat-

**Tab. 1.** Spawning periods, substrate and regions of Lake Ohrid trout forms

**Tab. 1.** Периоди на мрестење, субстрати и региони на формите од охридската пастрмка

Forms	Spawning period	Spawning substrate and region
<i>Salmo letnica typicus</i>	January - March	Between stones, gravel and sand / littoral and sublittoral (east and west coast)
<i>Salmo letnica balcanicus</i>	December - January	Fine sand / littoral (north and south coast and formerly in River Crni Drim)
<i>Salmo letnica lumi</i>	November - January	Sheltered parts of the tributaries
<i>Salmo letnica aestivalis</i>	July - August	Rocky bottom / sublittoral around sublacustrine spings with temp. of 10,5 °C (Gradiste - Veljapes) East coast

ural population in the lake in optimal abundance, and to allow fishing in the same time, in 1935 was established the process of artificial spawning. Namely, during the natural spawning period ripped parents were fished and the striped eggs were fertilized and further on incubated in the hatchery in the Hydrobiological Institute in Ohrid, from where afterwards, depending on the region of collecting the eggs, the offspring was released into the lake. This was mainly done on the East coast of the lake and mainly with the form *S.l.typicus*. Later on, this became practice also with the *S.l.aestivalis* form. In the early sixties of the last century, another hatchery was established on the north part of the lake in order to perform the artificial spawning of another form *S.l.balcanicus*. At the beginning of this process parental individuals were mainly collected from the River Crni Drim the outlet of Lake Ohrid. This process was never applied to *S.l.lumi* which was entering the small tributaries for spawning, but usually in the fish catch it could be found in the lake.

But due to different factors affecting the trout population as a whole in the lake, during the last two or three decades, during the spawning season in the lake could be distinguished for sure just two forms - *S.l.typicus* and *S.l.aestivalis* due to their totally different time of spawning; in winter and in summer respectively. *S.l.lumi* hasn't been reported in the catch for years ago and for *S.l.balcanicus* evidences are showing that this form has been absent also. It is worth to mention here that, again, due to different factors, the population of the so called "summer form" *S.l.aestivalis* is diminishing. Having noticed these changes in 1997 special notice was paid to this problem, which this paper more or less is dealing with.

### Materials and methods

For the purpose of this survey, the spawning grounds in the East region of Lake Ohrid (Fig. 1) during the fishing period of the natural spawning of *S.l.typicus*, which takes part from 21st January till 20th March each year, were monitored. During this period the whole fish caught from the commercial fishery were counted with respect to their sex. The collected data were grouped per existing landing sites: Ohrid, Pestani

and Trpejca in the direction North-South respectively. For calculating the fishing effort data it was always taken into account the same number of fisherman and same number of equal fishing gear - gillnets with mesh size 45 and 50 mm from knot to knot for



Fig. 1: Part of the East coast of Lake Ohrid (Photo: P.Boev)

Сл. 1: Дел од источното крајбрежје на Охридското Езеро (Фото: П.Боев)

the period 1997, 2001-2003 year.

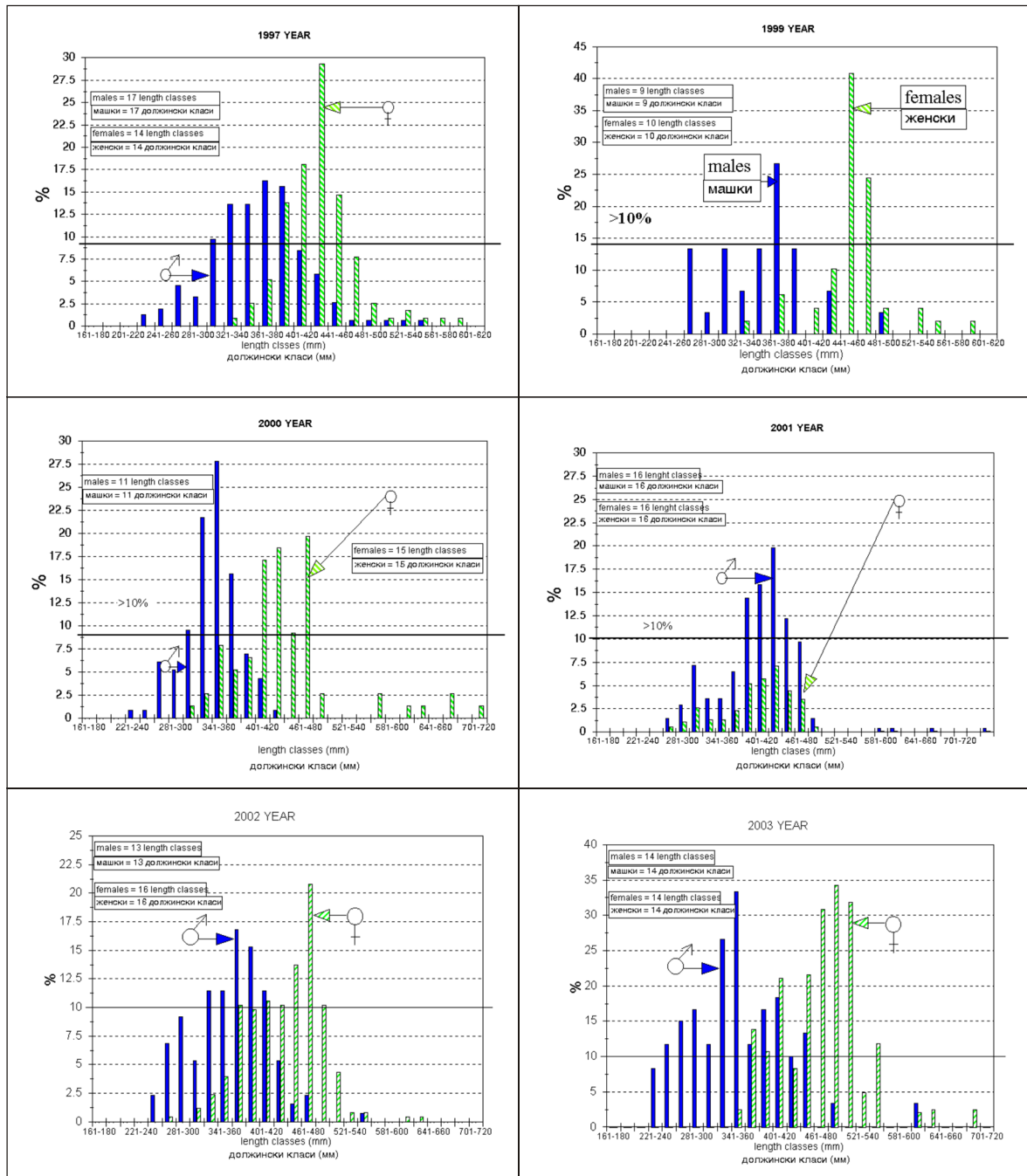
From other hand during the period 1997-2003, biometric measurements (length, weight, sex and fish scales for determining age) were performed on representative and statistically significant fish samples. For the purpose of this paper weight and age were not considered.

Also, the collected eggs during the spawning period per year were counted by volumetric method and in

Tab. 2. Fishing effort during the spawning period of Lake Ohrid trout per landing site and total

Таб. 2. Риболовни напрегања во текот на мрестителниот период на охридската пастрмка

Year	1997			2001			2002			2003		
	N of fish	N of fishing days	Fish/day (Effort)	N of fish	N of fishing days	Fish/day (Effort)	N of fish	N of fishing days	Fish/day (Effort)	N of fish	N of fishing days	Fish/day (Effort)
Ohrid	3131	10	313	3878	19	204	4487	20	224	1101	12	92
Pestani	6805	22	309	3669	18	203	5011	23	217	1369	18	76
Trpejca	2750	26	105	1995	16	124	2141	24	99	528	18	29
TOTAL	12686	48		9542	53		11639	67		2998	48	
AVG ( $\bar{x}$ )			242			177			180			66



**Fig. 2:** Changes of the relative length and sex composition of the spawning population of Lake Ohrid trout in the professional catches for the period 1997 - 2003. In 1998 fishing during spawning period was banned.

**Сл. 2:** Промени во релтивниот должински и полов состав на мрестителната популација на охридската пастрмка во професионалните ловини за периодот 1997-2003. Во 1998 година риболовот за време на мрестот не беше дозволен.

this paper are presented only per year using longer time scale period (1984/2003).

### Results and discussion

When referring the data in Tab. 1, quite evident is the decrease of number of the matured fish, present on the spawning grounds as well the huge decrement of the fish caught per day at the same sites

with the same gears and their same number. The most significant is the comparison between the data from 1997 and 2003, where for the same total number of fishing days for all landing sites is 48 days but with drastic difference in the number of fish caught - 12686 in 1997 versus 2998 in 2003 when it represents only 1/4 of the one in 1997. This is strong argument for the severe reduction of the trout population in the lake itself, within just several years.

From other hand the data shown in Fig. 2 are ex-

pressing the population condition of the spawners. Several moments can be considered from them. If we consider the length and sex composition of the spawning population in 1997 like the one that is the closest to normal population distribution of the trout in terms of catch able range (according the used fishing gears - gill nets with mesh size 45 and 50 mm) than in different years we have different situations like: smaller number of length (age) classes, dominance of young (non matured) fish, dominance of males versus females, discontinuity in the presence of subsequent length (age) classes. These moments are clearly expressing another negative situation - the disruption of condition of the Lake Ohrid trout population as well.

Hence, we can withdraw two main conclusions that the Lake Ohrid trout population is affected not only by abundance reduction but also with disruption in the population conditions in terms of self-recruitment.

This can be supported also by the data in Fig. 3, about the number of collected eggs during the spawning period. For better comparison for this purpose a larger time scale period is given (1984-2003). The highest value of 20.5 millions eggs was obtained in 1991 when more than 37 tones of trout were caught during the spawning period and the lowest 2.65 millions eggs in 2003 when 3,3 tones of trout were caught. Both values of the eggs and trout caught in the forth-mentioned years differ with ten times. These data once again are expressing the worsened condition of Lake Ohrid trout.

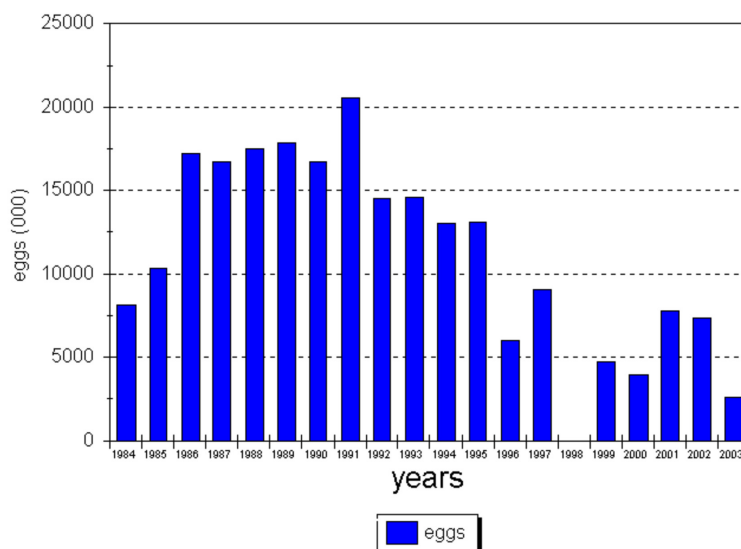
During the winter spawning period of trout 5-6 years ago, there were clearly designated zones in the upper littoral, at water depths from 0.5 – 3 m, where the trout mated and spawned. In these areas, the trout nest

density was 5-8 per 10m<sup>2</sup>. Today, it is almost impossible to find nests in the whole upper littoral; the trout spawning that is occurring is happening at greater depths.

Overfishing seems to be the major cause of the decline of the trout population. Controls on the number and size of fish must be implement and coordinated on both sides of the lake. Because the fish in the lake are one single, linked population, they must be managed collectively, with similar requirements in both Macedonia and Albania. The socio-economic pressures that have led to overfishing have impacted the trout more than other fish stocks because of greater demand and higher economic value of this fish. To manage this fishery appropriately in the future, stock estimates based on independent sampling should be performed. With this information a sustainable level of harvest might be estimated.

### Reference

- Berg,L.S.1932: Ébersicht der Verbreitung der Süßwasserfische Europas. Zoogeografica, 1: 107-208  
 Dimovski,A., Grupce,R. & Spirkovski,Z. 1992: Taxonomical investigations of Lake Ohrid trout. The compilation of scientific works from the symposium in Ohrid "The conditions and the perspectives for protection of the Lake Ohrid and its surroundings" (In Macedonian with English abstract).  
 Karaman,S. 1924: Pisces Macedoniae. Split: 1-90  
 Kottelat, M. 1997: European freshwater fishes. Biologia, Bratislava, 52/ Supplement 5: 1-271  
 Spirkovski,Z. 1991: The autochthonous salmonid fish of Lake Ohrid. Macedonian Veterinary Revue, Skopje, I/II: 61-66.  
 Spirkovski,Z. 1992: The condition of the population



**Fig. 3.** Number of collected and incubated eggs of Lake Ohrid trout in the hatchery of the Hydrobiological Institute - Ohrid

**Сл. 3.** Број на собрана и инкубирана икра од охридската пастрмка во мрестилишните инсталации на Хидробиолошки завод - Охрид

of ohrid trout *Salmo letnica* (Karaman) in the Lake Ohrid and its artificial stocking. The compilation of scientific works from the symposium in Ohrid "The conditions and the perspectives for protection of the Lake Ohrid and its surroundings": 94-100 (In Macedonian with English Abstract)

Stankovic,S. 1960: The Balkan Lake Ohrid and its living world. W.Junk, Den Haag, Monogr.biol.9, pp 357

Stefanovic,D. 1948: Race and ecological investigations on Ohrid salmonids. SAN, Beograd, Posebna izdanja 139/38: 1-207 (In Serbian)

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### **Summary**

The spawning population of Lake Ohrid trout, *Salmo letnica* (Karaman) in the last three years has tremendous decrement (Tab. 1). Also the population structure has significantly been worsened - smaller number of length (age) classes, dominance of young (non matured) fish, dominance of males versus females, discontinuity in the presence of subsequent length (age) classes (Fig.2). All these conditions are also negatively expressed in the amount of collected trout eggs for stocking the lake (Fig. 3).

Considerable changes have been evidenced in the spawning grounds. During the winter spawning period of trout 5-6 years ago, there were clearly designated zones in the upper littoral, at water depths from 0.5 – 3 m, where the trout mated and spawned. In these areas, the trout nest density was 5-8 per 10m<sup>2</sup>. Today, it is almost impossible to find nests in the whole upper littoral; the trout spawning that is occurring is happening at greater depths.

Overfishing seems to be the major cause of the decline of the trout population. Controls on the number and size of fish must be implemented and coordinated on both sides of the lake. Because the fish in the lake are one single, linked population, they must be managed collectively, with similar requirements in both Macedonia and Albania.