

Length-Weight Relationship of Ohrid Trout, *Salmo letnica* (Karaman, 1924), Inhabiting Transboundary Ohrid Lake (Albania-Macedonia)

Viola Prifti¹

PhD Student, Department of Biochemistry – Agriculture, Faculty of Agriculture, University “F. Noli”, Korça,
Albania¹

ABSTRACT: Length-weight and total length- standard length, relationships were derived for Ohrid trout, *Salmo letnica* (Karaman), inhabiting the ancient Ohrid Lake, at the transboundary area shared between Albania and Macedonia. Sampling was done between January–December of 2014 using different approaches including fishing gears and direct sampling at the hatcheries in two localities, Lin and Zagorçan. The relationships between lengths were all significantly linear (r^2 from 0.975 to 0.855) and there are significant differences of r^2 at the localities Zagorçan to Hudënisht. The Ohrid trout through different authors has been considered like polymorph species regarding the taxonomical and ecological features: *Salmo letnica typicus*, *Salmo letnica balcanicus*, *Salmo letnica lumi* and *Salmo letnica aestivalis*. According many authors four forms of Ohrid trout can be distinguished with different place, time and substrate for spawning. 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. Further to that the length-weight approach was developed to see different patterns in different supposed localities.

KEYWORDS: length-weight relationship, Ohrid trout, *Salmo letnica*, southeast Albania, polymorph species

I. INTRODUCTION

According to [1] the considerable confusion regarding the taxonomy of brown trout *Salmo trutta* L. 1758 species complex originated from the complicated and incompletely described evolutionary history of the taxa. The situation within *Salmo* genus seems to be more complicated in Balkan region due to that the area hosts the most diverse phenotypic variation among *Salmo* spp. populations [2] [3]. Thus, numerous *Salmo* taxa have been described within this important region, and it is still debatable if these taxa should be considered as phenotypic variants or true Linnean species. On the other hand, it is well established that the use of molecular markers can provide clues regarding the evolutionary origin and useful tools for the conservation and management of populations and species [1]. Following different approaches and survey in regard to *Salmo* spp., population with analyses and application of allozymic loci, mitochondrial (mt) DNA and microsatellites, it has been concluded that Balkan area constitute a region where *Salmo* spp. populations exhibit particularly high levels of genetic variation [1] and [4]. Further to that [5] and [6] with the mtDNA analyses revealed that four of the five major evolutionary lineages identified throughout the species range were present in the region. Moreover, most of the populations examined were genetically highly divergent, possessing private genotypes, indicating that they may represent distinct and potentially locally adapted gene pools [1].

The Ohrid trout (koran after the local name in Albanian part of the lake), *Salmo letnica*, from various authors [7], [8] [9], [10] and [11] has been considered like polymorph species regarding the taxonomical and ecological features: *Salmo letnica typicus*, *Salmo letnica balcanicus*, *Salmo letnica lumi* and *Salmo letnica aestivalis*. According the above mentioned authors four forms of Ohrid trout can be distinguished with different place, time and substrate for spawning. This species, in the conditions that are present in the lake, reaches weight of 1 kg in the seventh year of its

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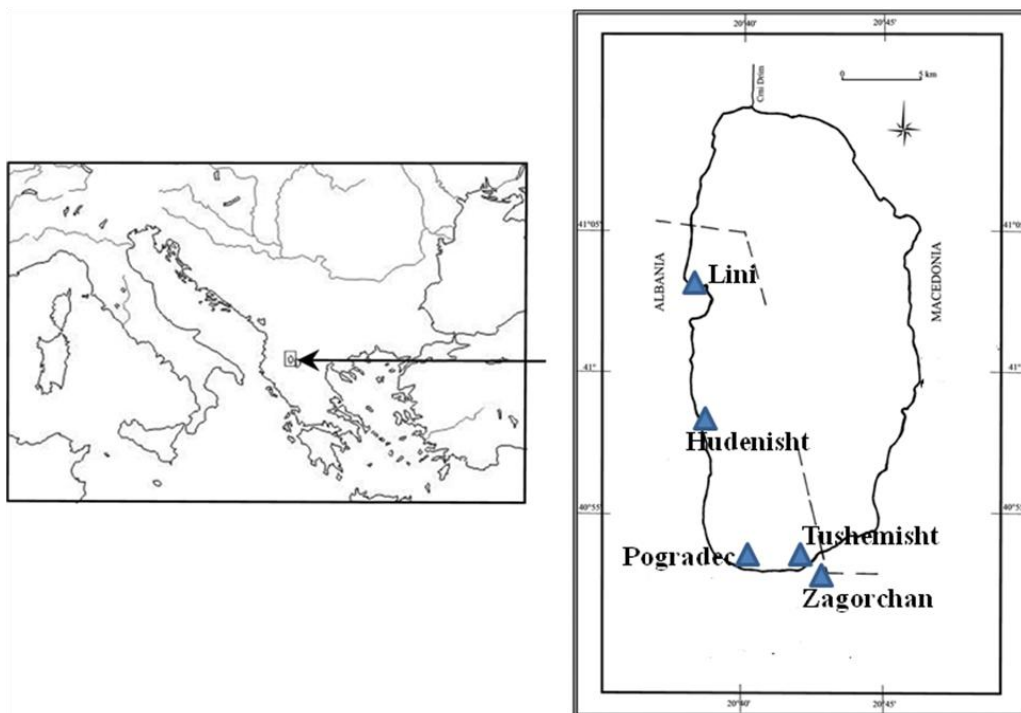


Figure 1. Sampling locations at the Albanian side of Ohrid Lake (Lin, Hudënisht, Pogradec, Zagorçan and Tushemisht).

II. MATERIAL AND METHODS

This study was carried out in Ohrid Lake (41°05" N, 20°45" E), an important transboundary lake ecosystem (Albania-Macedonia border). The lake itself is a karstic one, tectonic and oligotrophic with maximum length 30.4 km, max. width 14.8 km), the oldest one in Europe (4–10 million years) and one of the oldest in the world, situated in the western part of the Balkan Peninsula, in the Ohrid valley, at 693.17 m above sea level (Figure 1). The lake has one outlet, the River Crni Drim (22.24 m³ /s), which belongs to the Adriatic drainage area. Downstream on the river, six dams for electricity (two in Macedonia and three four in Albania) power stations were constructed in the early 1970s. The strongly marked endemic character of the Ohrid's living world has been stressed by many authors [8]. Fish samples were collected directly at the boat fisherman landings and in the hatcheries between January and December of 2014. In Figure 1 there are the position of Ohrid Lake in Europe Continent and the sampling locations that are defined to take measurements of the fishes; Lin location, Hudënisht, Pogradec (in front of the city), Zagorçan and Tushemisht. Sampled fish were measured to the nearest 1 mm (TL, FL and SL), and weighted to the nearest 1 g. The relationships between total and standard lengths were determined according to the linear regression model. The length-weight relationship was discussed; Weight-length relationships' curves were compared for different lakes localities with intention to discover weather differences accrued.

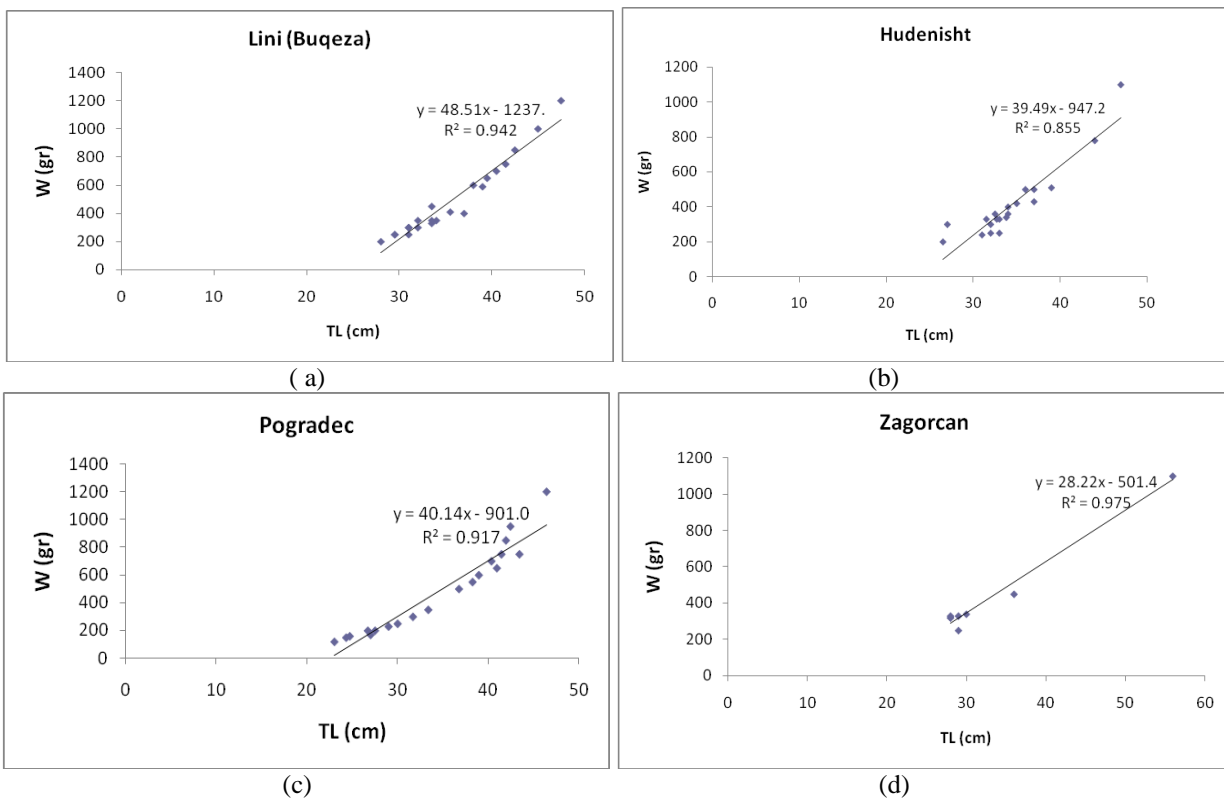
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III. RESULTS AND DISCUSSIONS

Length-weight (according to different locations and sampling time) and length-length (overall) relationships of *Salmo letnica* inhabiting transboundary Lake Ohrid in south east Albania was estimated. According to [10] the relict nature and taxonomic value of the endemic trout species *S. letnica* has been disputed and is still uncertain. Further to that [7] has shown, on the basis of detailed research, that the *letnica* species comprises three distinct populations, probably different races inhabiting the lake: *Salmo letnica typicus* Stefan., *S. l. aestivalis* Stefan., and *S. l. balcanicus* (Karam.). Biometric analysis revealed significant differences in a great number of meristic and morphological characters [10]: These populations also differ in their intralacustrine distribution, ecology and the season of spawning [7], [10]. The *typicus* population spawns mainly in January and February, between stones, gravel and sand in littoral and sublittoral (east and west coast of the lake). The spawning season of the *aestivalis* population lasts over the summer months, June and July. Its spawning habitat is the edge of the sublittoral and profundal zone (45–60 m), with a rocky bottom, around underwater springs, where the water temperature is *c.* 11° C. Thus, reproductive isolation and consequently independent development of these two populations may be hypothesized. The third population (*balcanicus*) inhabits the north and south coast of the lake and spawns in the proximity of the lake outlet, in December–January [10], [11].



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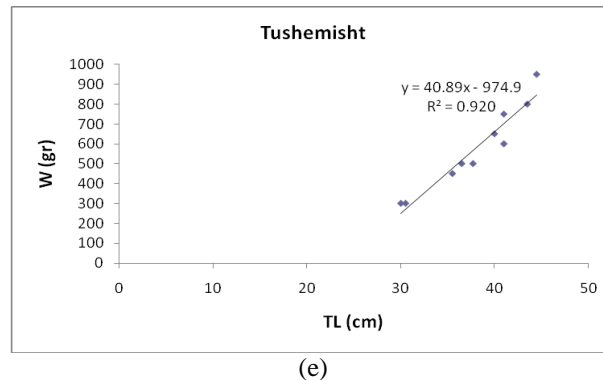


Figure 2. Length-weight relationships according to different sampling locations in Albanian side of the Ohrid Lake. (a) L-W relationship of fishes caught in Lin (b) L-W relationship in Hudënisht fishes (c) L-W relationship in Pogradec fishes (d) L-W relationship in Zagorçan fishes (e) L-W relationship in Tushemisht fishes.

In the Figure 2 the charts show the length- weight relationships according to the sampling locations used in this study (in Albania side of Ohrid Lake). The length weight relationships were found to be significantly linear in all cases. These significantly linear relationships among the length and weight parameters showed that individuals of this fish species exhibited characteristic morphological features.

Two more stocks occurring in Lake Ohrid have been described: *S. l. lumi* Poljakov, Filipi & Basho, 1958 (river form, inhabiting the tributaries of the western shore; spawns in November-January) and *Salmo farioides* Karaman, 1938 (river form, inhabiting the small tributaries of the eastern lakeshore). [13], [14], [15] on the basis of the available data, considered these stocks valid species and proposed the following changes in the nomenclature: *Salmo aphelios* Kottelat (1997) (earlier *S. l. aestivalis*), *Salmo balcanicus* (previously *S. l. balcanicus*), and *S. letnica* (earlier *S. l. typicus*).

Based on above particularities we followed the length-weight relationship to see whether the ratio in different localities reveals differences in these contexts (Figure 2). In five considered stations i.e. Lin, Hudënisht, Pogradec, Zagorçan and Tushemisht, the rate of correlation measured through r^2 , was at the respective values of: 0,942; 0, 855; 0,917; 0,975 and 0,920. The confidence rate seems to be high in all considered station except Hudenisht. Based on different sub populations discussed at the introductory part of this paper, the length-weight relationships may present spatial and temporal variations due to water temperature, food availability and reproductive activities [16], [17]. Further studies are required for assessing the influence of different environmental variable on growth rate and relationship of length parameters with weight considering different localities.

IV. CONCLUSIONS

In five considered stations i.e. Lin, Hudënisht, Pogradec, Zagorçan and Tushemisht, the rate of correlation measured through r^2 , was at the respective values of: 0,942; 0, 855; 0,917; 0,975 and 0,920. The confidence rate seems to be high in all considered station except Hudënisht.

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