

Original Research

ASSESSMENT OF THE LENGTH–WEIGHT RELATIONSHIP AND RELATIVE
CONDITION FACTOR OF SCADAR BLEAK IN THREE WESTERN BALKAN
LAKES

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Abstract

*Length–weight relationship gives information on the condition and growth patterns of fish. This study presents the weight–length relationship and relative condition factor of *Alburnus scoranza* (Bonaparte, 1845) in Lake Ohrid, Lake Skadar, and the Vlasina Reservoir. The *b* value from the length–weight relationship indicates negative allometric growth, ranging from 2.572 to 2.660. The relative condition factor (*Kn*) varied from 0.656 to 1.792, indicating differences in the well-being of individuals across the studied populations. The results of this study will support fisheries researchers, environmentalists, and scientists in developing future monitoring and conservation strategies for this fish species.*

Keywords: Scadar bleak, Allometric growth, Lake Ohrid, Lake Skadar, Vlasina Reservoir.

INTRODUCTION

Alburnus scoranza (Bonaparte, 1845) is one of the 20 species of bleaks recognized in European freshwater systems [1]. Contrary to the situation with *Alburnus alburnus* (Linnaeus, 1758) which has the widest distribution range, *A. scoranza* is endemic to the Southeaster Adriatic Ecoregion. According to Marić (1995) [2] the *Scoranza* bleak inhabits only Ohrid-Drim – Skadar system, but Simić et al. (2012) [3] confirmed the presence of this species in the Vlasina reservoir in southern Serbia. The occurrence of the *A. scoranza* population in the Vlasina reservoir represents an extension of this species' range from the Adriatic to the Black Sea basin.

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According to the IUCN, the Skadar bleak was classified as Least Concern (LC) in 2008. However, based on new analyses, its status was updated to Near Threatened (NT) in 2023. Over the last five decades, a statistically significant decline in the abundance of this species has been observed in Skadar Lake [4], but it is still very important for recreational and commercial fisheries. These data indicate the need for continuous monitoring of fish populations, especially those with small ranges and affected by multiple threats. Fish population studies are an essential element contributing to understanding the health of fish populations, which is also needed for sustainable management strategies [5].

The parameters length–weight ratio (LWR) and condition factor (CF) play a key role in biological studies of fish and fisheries [6]. These indices provide valuable insights into the growth patterns, general health, and well-being of fish populations, and can be used as indicators of environmental quality and anthropogenic impacts. Given the limited distribution and the recent decline in abundance of *A. scoranza*, it is essential to establish baseline data on these parameters for populations outside its core range.

The aim of the present study was to determine the size structure, length–weight ratio and relative condition factor of *A. scoranza* populations from Lake Sladar, Lake Ohrid and Vlasina Reservoir, thus providing the first data for this translocated population.

MATERIALS AND METHODS

Samples were collected from two natural lakes, Ohrid and Skadar, as well as from the artificial lake Vlasina. Lake Ohrid is oligotrophic, and of the 20 autochthonous fish species, 35% are endemic to the lake [7]. Lake Skadar is the largest lake on the Balkan Peninsula and, like Ohrid, also represents a biodiversity hotspot for many biotic groups. The Vlasina reservoir was formed on the upper reach of river Vlasina (belonging to the Danube basin), by flooding a large mountain peat bog [3]. Since its formation, it has been a place of active anthropogenic introduction of fish species with the purpose of increasing its fishing attractiveness. The geographical location (south Serbia) and ecological status (cold water oligotrophic accumulation) of the new reservoir probably contributed to the decision to perform the first and subsequent stockings with species from the territory of Macedonia and Montenegro [8], namely the Ohrid–Drim–Skadar hydrosystem, belonging to the Adriatic basin.

The field research was conducted during the summer of 2014. Fishes were sampled using netting tools (gill nets with mesh size 0.5, 10–12 and 14–16 mm). In the laboratory sampled fish specimens were identified to species according to Kottelat and Freyhof (2007) [1] and Simonović (2001) [9], and measured to the nearest 1 mm (total length, L) with a sliding caliper, and weighed to the nearest 0.1 g (weight, W).

The length-weight relationship was calculated using the following Le Cren (1951) [10] equation:

$$W = a L^b$$

where W is the total weight (expressed in grams), L is the total length (expressed in centimetres), a is a coefficient related to body form and b is an exponent indicating isometric

growth when equal to 3. The parameters a and b were estimated by linear regression on the transformed equation:

$$\log(W) = \log(a) + b \log(L)$$

The degree of correlation among the variables was evaluated using the determination coefficient r^2 [10]. If $b = 3$, growth is isometric, if $b < 3$, it is negative allometric and if $b > 3$, it is positive allometric [11,12].

RESULTS AND DISCUSSION

The length-weight relationships (LWR) are very useful tools in ecological studies. This parameter, associated with the condition factor, is considered an excellent indicator of animal welfare [13]. A total of 250 individuals from three distinct ecosystems were analyzed during the research (Table 1).

Table 1 Descriptive statistics and estimated parameters of the length–weight relationship and condition factor for *A. scoranza* from the studied localities

	N	TL range	W range	a	b	SE (b)	R ²	Kn
Ohrid	100	10.2–15.5	9.3–25.5	0.017	2.660	0.172	0.708	0.990
Skadar	100	12.1–16.1	17.5–33.9	0.035	2.617	0.132	0.769	0.656
Vlasina	50	11.9–14.3	11.1–20.2	0.011	2.572	0.230	0.759	1.792

The exponent of the length–weight relationship (b) indicates negative allometric growth in all three analyzed populations of *A. scoranza*, meaning that individuals grow faster in length than in weight. Our results are consistent with previously published studies conducted on this species in Lake Skadar and Lake Ohrid [14,15].

The highest b value was recorded in the population from Lake Ohrid (2.660), while the lowest value was observed in individuals from Lake Vlasina (2.572). Although the differences are relatively small, they may indicate certain environmental differences among the studied localities. The species *A. scoranza* was probably introduced into the Vlasina reservoir from Lake Ohrid in 1989, under the name used then, *A. albidus* (plašica), with the purpose of providing natural food for the Ohrid trout (*Salmo letnica*) introduced earlier. Simić et al. (2012) [3] based on the analysis of the units of roach captured during 2003 and 2011, confirmed the presence of the species *A. scoranza*. The presence of the *A. scoranza* population in the Vlasina reservoir in southern Serbia signifies an expansion of this species' range from the Adriatic to the Black Sea basin.

The most comprehensive analysis of the *Scoranza* bleaks in Skadar Lake was carried out by Marić in several studies [2,16,17]. His research also focuses on length-weight ratios and suggests that for the analysis age groups need to be analyzed separately because of different growth models. This is a very important recommendation that could be used in future research.

Body condition is a key indicator of health at the individual or population level since it is closely related to important fitness variables, such as growth, reproduction, behavior and survival [18] The highest mean condition factor (1.792) was recorded in the Vlasina

population, suggesting favorable environmental conditions and adequate food resources for this species in the reservoir ecosystem. In contrast, the lowest value was observed in Lake Skadar (0.656), while individuals from Lake Ohrid showed intermediate values (0.990). The condition factor value recorded for the Lake Ohrid population is in agreement with the findings of Trajchevski and Talevska (2020), who reported a similar value (0.95) for *A. scoranza* in Lake Ohrid. [19].

CONCLUSION

In conclusion, this study contributes to the knowledge of the biology and ecology of *A. scoranza* and provides baseline data useful for future conservation programs, fisheries management, and comparative studies of populations within and outside the species' native range.

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