International Journal of Ecosystems and Ecology Science (IJEES) **Vol. 14 (4):** 49-54 (2024)
https://doi.org/10.31407/ijees https://doi.org/10.31407/ijees14.4

COMMENTS ABOUT THE GENETIC DIVERSITY PHENOMENON IN THE FISH COMMUNITY OF LAKE SHKODRA

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Received September 2024; Accepted October 2024; Published November 2024;

DOI: https://doi.org/10.31407/ijees14.407

ABSTRACT

This article presents some scientific comments on the genetic diversity phenomenon appearing in some fish species of Lake Shkodra. The material is taken from various publications that are in the references for some of the species that are included in the list of fish species of Lake Shkodra by Dhora (2020), Maric (2018). In particular, data were obtained on the intraspecific diversity of the most important fish in fishing sector. These phenomena have been commented on by linking them to various ecological factors. The concrete phenomena discovered and commented on in this article are *Alosa agone*, *Carassius gibelio*, *Chondrostoma nassus*, *Cyprinus carpio*, *Leucos basac*, *Perca fluviatilis*, and *Salmo farioides.* The experienced geneticists, who have been missing until now, should be included in studies and monitoring. Maybe it's time to establish special institutions that would contribute to the smooth running of these developments.

Keywords: intraspecific diversity, population, evolution, fish, species, genotypes, phenotypes.

INTRODUCTION

Genetic diversity is the set of different inherited traits within a species. Intraspecific diversity occurs in subspecies and forms, creating polymorphism of individuals in a population and population variation. It is precisely this phenomenon that enables the species to adapt to the changing environment. An important factor is also the feed process, which depends on ecosystem conditions. The quality and quantity of suitable feed in the early larval life can impact the life process of fish, including growth and survival (Budi, 2023).

Also, the environmental conditions effect directly the health and of course the development of fish species. Genetic variability allows genetic traits to change, which create opportunities to evolve. A species with high genetic diversity has individuals with a wide variety of different traits. This article comments on some of these phenomena, appearing in some fish species of Lake Shkodra.

MATERIAL AND METHODS

The material is taken from various publications presented in the references for some species included in the list of fish species of Lake Shkodra by Dhora (2020) and Maric (2018). In particular, data were obtained on the intraspecific diversity of the most important fish species in fishing. These phenomena have been commented on by linking them to various ecological factors.

RESULTS AND DISCUSSIONS

The material was written for each studied species and is presented in the following, arranged according to the fish classification system.

Clupeiformes
Clupeidae

***Alosa agone* (Scopoli 1786)**

In the list of fish species of Lake Shkodra, which is included in the article by Dhora (2020), this species is written: With two ecological forms, migratory and continental, sympatric in the lake. Probably two species: *Alosa fallax*, marine migrant, as well as *Alosa agone* or *Alosa* sp, only of the lake, non-migratory.

Alosa fallax of Lake Shkodra is a marine migratory species. The reproductive individuals of this species enter the Buna River from the Adriatic Sea and throw their sexual products into the trans-boundary waters, in a deep-water surface near the shore of the lake.
Small fish do not migrate to the sea in the first 2-3 years. We believe that they spend the winter on the Albanian shores with the sources of Lake Hoti, which is connected to Lake Shkodra, and at the age of three, they migrate to the sea through the Buna River.

Also, for years, a part of the individuals who have passed the age of three may not have been involved in the migration to the sea. Over the years, a non-migratory population has probably been created, which may have adapted to life on the northeastern coast of the Albanian part of the lake and perhaps even reproduce here. The individuals of this population are smaller than the migratory ones, the head is shorter, the points on both sides of the body are less in number, etc. (Kottelat & Freyhof, 2007). This population formed over the years is *Alosa agone*, which lives in sympatry with *Alosa fallax* (Rakaj, 1995), but in fact *Alosa agone* is considered synonymous with the non-migratory *Alosa* of the lakes of Italy. This phenomenon is also known for Neretva River in Croatia (Bianco, 2002). We can also consider the non-migratory forms of Lake Shkodra in this way, but which have some changes, among them the bio-ecological one, which do not migrate to the sea.

The idea of the possibility of the development of the *Alosa fallax* population from the migratory form to the non-migratory form was also presented in the book of Poljakov (1958), which was probably addressed earlier by Kasimati (1948), but this has not been confirmed.

Cypriniformes
Cyprinidae

***Carassius gibelio* (Bloch 1782)**

The Prussian carp was introduced through the fishing of Lake Shkodra 4-5 decades ago. From all the species that were weighed at that time, only the Prussian carp survived the conditions, adapted so much that today it is among the most important fish for fishing.

Below we have noted some data obtained from a scientific report prepared by Dhora (2012), especially for some data on the competition with the carp fish of this Lake.

Carassius gibelio, is seen as the most productive species in the lake if managed well in terms of population development and occupancy. It not only meets the quantitative requirements in the market, but also leaves opportunities for the stabilization of the carp population, thanks to some of its biological features.

C. gibelio competes with carp in many aspects, but is particularly prolific in the lake. It eats the same food, reproduces in the same place and at the same time, even its eggs can be stimulated by carp spermatozoa, shelters in the same place, etc.

The weight of *C. gibelio* is much smaller than that of the carp. So for the same weight, more than twice as many *C. gibelio* individuals are counted and this ratio depends on age. This fish starts breeding a year before the carp. Female have slightly higher egg production than female carp. Almost all carp individuals produce eggs, as it is known that the ratio M/F = 1/100.

From a rough calculation, we come to the opinion that the *C. gibelio* increases at a rate of 6-8 times greater than the carp. The productivity figure of *C. gibelio* in the lake, compared to that of the carp, should be corrected by slightly reducing it, since the average weight of a catching individual is about two times smaller than the average weight of a carp individual.

***Chondrostoma scodrense* (Elvira 1987)**
***Chondrostoma nasus* (Linnaeus 1758)**

According to Elvira (1997), Maric & Soric (2009), etc., *Chondrostoma scodrense* has had a large population decline in Shkodra Lake in recent decades and we think it may have disappeared. The reason is the indiscriminate catching, but also the destruction of the breeding habitats on the shores of the lake and the lower part of the Drin River, from the discharge of pollutants.

Even the population of *Chondrostoma nassus* found in Lake Shkodra and some rivers connected to it has suffered a great decline.

***Cyprinus carpio* (Linnaeus 1758)**

The subspecies *Cyprinus carpio carpio* is the Common European Transcaucasian Carp. Today this carp is found all over Europe, and in some other countries, including North and South America. Several other subspecies are also known that were found mainly in Asia. Froese and Pauly (2011) consider common carp as one of the freshwater fish with the greatest variability in body shape, as well as among the most invasive fish. Common carp is one of the most widely cultured fish on Earth.

The first undertaking to make an assessment at the molecular, genetic level of the carp populations in Albania was made using microsatellites, as molecular markers to assess the variability at the DNA level of the carp populations in Lake Shkodra and Lake Ohrid. In this study, it is found that only the carp of the Shkodra Lake population, for the MFW6 locus, is in genetic balance (Biba, et al., 2013).

The distribution of wild autochthonous populations of this carp is in a limited number of European countries and primarily in the countries that are part of the Danube River basin.

In Albania, this fish was brought by the Romans, who cultivated it. Considering the ability to be adopted, Shkodra Lake carp can be considered as an autochthonous species of Shkodra Lake.

The preservation of the autochthony of the common carp in Lake Shkodra should be done by taking care of its increase based on individuals from the lake with a controlled technology, as it was done in 2022.

On the other hand, it must be strictly controlled to prevent discarding of the plant produced by crossing with the Asian subspecies of carp *Cyprinus carpio rubrofuscus* or any other, such as *Carassius auratus*, with which the crossing can be carried out.

***Leucos basak* (Heckel 1843)**

Bianco & Ketmaier (2014) revised the *Rutilus* complex of Mediterranean Europe. *Rutilus karamani* and *Rutilus ohridanus*, known so far for Lake Shkodra as separate species, they consider them synonyms of only one species, *Leucos basak* (HECKEL 1843).

Before that, the two synonymous species were considered as subspecies: *karamani* as yellow and *ohridanus* as white (Dhora et al. 2008). We think that again this difference can be considered as a manifestation of intraspecific diversity, perhaps as forms with color differences, which may be related to the characteristics of the aquatic habitats where they live and their adaptive abilities.

Perciformes
Percidae

***Perca fluviatilis* (Linnaeus 1758)**

It entered Albania in 1976 through the Drini River. In Lake Shkodra, there is the ecological form of the banks, which is smaller and feeds mainly on invertebrates (Rakaj, 1995). The pelagic ecological form is not found in Lake Shkodra, it is larger and feeds on different fish.

In recent years *Perca fluviatilis* of the ecological form of the shores has an increasingly important role on fishing in this lake. Its fishing has been increasing year by year, so much that it can now be considered among the most important species in the fish catching in Lake Shkodra.

The population of *Perca fluviatilis* has developed in Lake Shkodra, where there are favorable living conditions.

Salmoniformes
Salmonidae

***Salmo farioides* (Karaman 1938)**

This species is difficult to determine, as trout have high phenotypic population diversity.

CONCLUSIONS

- In today's conditions when issues of biodiversity conservation are raised, and especially in the conditions of today's climate changes, great care must be taken to the phenomenon of intraspecific diversity, as it allows species to adapt to this changing environment. The concrete phenomena from the Shkodra Lake fish community, which are discovered and commented in this article, are: *Alosa agone* - sea-migrating and non-migratory forms, *Carassius gibelio* - its population in the lake without damage to the carp, *Chondrostoma nassus* - population decline , *Cyprinus carpio* - great variability in body shape, genetic balance, ability to be adopted, *Leucos basac* - two forms with color differences, *Perca fluviatilis* - coastal ecological form, *Salmo farioides* - high phenotypic diversity.
- Genetic variability enables the change of the genetic features of the species, which enables their evolution. These developments occur in populations; therefore, they must be followed carefully by the best specialists of the scientific and management institutions of Lake Shkodra so that they develop in natural conditions.

- These developments must be studied hand in hand in the entire fish community of Lake Shkodra, so that they are harmonious, and integrated. They must be complex, phenotypic and genotypic. Therefore, experienced geneticists, who have been missing until now, should be included in studies and monitoring. Maybe it is time to establish institutions that contribute to the smooth running of these developments.

Acknowledgements. I am grateful to the University of Shkodra "Luigj Gurakuqi" which made it possible and offered support for the publication of this article.

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