

# An assessment of biological and sanitary condition of alien fish in a high-altitude lake

Paolo Pastorino<sup>1, 2\*</sup>, Vasco Menconi<sup>1</sup>, Giuseppe Esposito<sup>3</sup>, Marco Bertoli<sup>2</sup>, Michele Ottino<sup>4</sup>, Elisabetta Pizzul<sup>2</sup> and Marino Prearo<sup>1</sup>

<sup>1</sup> Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle d'Aosta, Italy

<sup>2</sup> Department of Life Sciences, University of Trieste, Italy

<sup>3</sup> Department of Veterinary Medicine, University of Sassari, Italy

<sup>4</sup> Ente di Gestione delle Aree Protette delle Alpi Cozie, Italy

Alpine lakes are extreme ecosystems located mostly in remote areas populated by peculiar flora and fauna. Owing to the relatively small number of native species, these lakes have low resilience to disturbances and can be especially sensitive to the introduction of alien fish. Alpine lakes are usually fishless, and the introduction of fish is mainly related to recreational fishing. The introduction of fish can produce a drastic reduction or elimination of native species, especially on macroinvertebrate during their emergency phase when passing through the water column, which results in a substantial alteration of their emergency rates. This is also linked with indirect effects on surrounding habitats through resource depletion for terrestrial insectivores, including amphibians.

The aim of this research was to collect information on fish population and selectivity of gill-nets fish that could be useful to design a plan to reduce or eradicate the fish in Balma Lake, a typical high-altitude lake located above the tree line.

Balma Lake is located at 2100 m a.s.l. in the Municipality of Coazze, a small urban centre near Turin (Northwest Italy). This lake is quite far away from direct industrial sources of pollution and the principal pressures are pasture and fishing activities. The lake is included in the Site of Community Interest/Special Area of Conservation IT1110006 “Orsiera Rocciavrè” and it was an originally fishless lake, where fish were introduced in the past.

Fish sampling campaign was performed in August 2018 following the protocol of the Lake Fish Index (LFI) (Volta, 2009) that is a multimetric index proposed for the evaluation of the ecological status of Italian lakes according to the European Water Framework Directive 2000/60/CE. The LFI consists of 5 metrics. The final value of the index is calculated from the sum of the values assumed by the individual metrics. The metrics considered are: a) relative abundance of key species; b) the population structure of the key species; c) the reproductive success of key and specific species; d) the decrease in the number of type-specific species; e) the presence of alien fish.

The LFI sampling protocol is based on a stratified random sampling of the water column and on the definition of random sampling stations. The gill-nets used were monofilament multimesh gill-nets in nylon (1.5 m high and 30 m long) assembled from 12 panels of different-sized mesh. According with the LFI protocol, the number of sampling stations and gill-nets were determined on the basis of the area and the maximum depth of the lake (Volta, 2009).

For all specimens, total length (g), weight (cm) and a sample of scales was collected for each specimen for the determination of age by the scalimetric method. The CPUE (catch per unit effort) and BPUE (biomass per unit effort) were calculated separately for each mesh size. Furthermore, stomach contents analysis on each specimen was performed to explain interactions with other organisms such like predation or competition.

For sanitary evaluation, specimens were necropsied and evaluated for eventual pathological alterations. The bacteriological exam was performed from kidney and the inoculum was directly plated out on first isolation media as Columbia Blood Agar or Tryptic Soy Agar. The colonies, eventually grown after 24-72 hours of incubation at  $22 \pm 2^\circ\text{C}$ , have been cloned and identified by phenotypical and biochemical tests (API System 20E, NE, bioMérieux, France). Phenotypic bacteria identification was confirmed by Matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS) technology on VITEK MS system (bioMérieux, France).

Only specimens of brook trout (*Salvelinus fontinalis*) were caught, and results showed a well-structured population. Fish population mostly feed on terrestrial invertebrates, demonstrating a pressure on terrestrial biodiversity.

As regard bacteriological analysis, we isolated both environmental (*Plesiomonas shigelloides*, *Aeromonas hydrophila*, *A. sobria*) and pathogenic bacteria, demonstrating how alien species may introduce pathogens even in Alpine lakes, contributing to the deterioration of these pristine ecosystems. In particular, we isolated *Yersinia ruckeri*, a primary pathogen often presents in aquaculture facilities that reared salmonids. Despite this, fish sampled didn't show any clinical signs. This phenomenon can be easily explained because the disease could appear as a chronic condition.

As regard the application of LFI, it is important to underline that although the index was designed also for Alpine lakes, this index is

not recommended in these lakes, since most of them are originally fishless and the presence even just of a single species determines the bad class of quality.

Nevertheless, results showed how brook trout population have a negative pressure on terrestrial insects' biodiversity and may introduce bacteria that could threaten aquatic biodiversity, especially amphibians.

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\* **Correspondence:** Dr. Paolo Pastorino, Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle d'Aosta, Turin, Piedmont, Italy, [paolo.pastorino@izsto.it](mailto:paolo.pastorino@izsto.it)