BIOAQUAE Project

Biodiversity Improvement of Aquatic Alpine Ecosystems

Habitat Directive | eradication of invasive alien species | water habitats | improving biodiversity | renaturalisation | management tools techniques

PROJECT DESCRIPTION

The Alpine lakes and streams are among the most remote and apparently intact environments in the Alps. Mountain waters, in fact, are generally very far from the numerous anthropogenic stress factors that affect plain habitats. These environments offer a safe refuge for many aquatic organisms able to withstand the mountain climate and host a particular biocenosis typical of the Alpine ecosystem, which may include unique taxa.

In fact, aquatic ecosystems located at high altitudes are sensitive to different and numerous effects of human activities, both on a global and local scale, such as climate change or long-range transport of air pollutants, but also water exploitation for energy or industrial purposes, introduction of alien species and local pollution sources from mountain pastures and shelters, all with a significant effect on the biodiversity of the sites. Under natural conditions, the presence of physical barriers along mountain streams (i.e. steeply sloping stretches and waterfalls) prevents upward migration of fish and the colonization of lakes upstream of these barriers. Therefore, high mountain lakes are originally devoid of fish fauna. The presence of fish species in high altitude lakes is considered a direct consequence of more or less recent introductions by man. With the exception of very few introductions from medieval times and some introductions from pre-industrial times (limited to the European mountain ranges), the introduction of fish is a recent fact (second half of the 20th century) and in recent decades the biological invasion of Alpine lakes has undergone a critical acceleration, promoted by numerous public and private bodies and has been driven by the growing demand from the recreational fishing economy.

OBJECTIVES

To contrast two of the main factors that threaten these delicate and unique ecosystems, the BIOAQUAE project had as main objective the realization of concrete conservation and eradication actions, characterized by a strong demonstrative and innovative value, aimed at increasing the biodiversity of high altitude aquatic ecosystems within the **Gran Paradiso National Park** (PNGP - Parco Nazionale del Gran Paradiso) affecting habitats included in the SCI/SPA IT1201000. The Park hosts many alpine lakes that were originally devoid of fish fauna, however in the 1960s some salmonids were introduced from the valley floor or from distant biogeographical regions (North America). While alien species are able to acclimatize, changes in the biotic community can become irreversible. Despite numerous evidences of the ecological impact of fish at high altitudes and European legislation explicitly prohibiting the introduction of alien organisms, also in the Alps, fish introduction campaigns continue to be allowed under national and local legislation and promoted by public authorities.

The project has carried out interventions to combat the threats of alien fish species such as the Brook trout and Brown trout, which have been introduced throughout the Alps to promote sport fishing and which in recent years have produced enormous impacts both on high mountain habitats, with predatory impact on the most vulnerable native taxa (such as beetles, trichoptera, plecoptera, hydrachnidia, and generally all non-fossorial benthic and nektonic invertebrates and the comon frog), and on downstream habitats, with hybridization and other ecological interactions with native fish species. For these reasons, the presence of **Marble trout**, an autochthonous salmonid, included in Annex II of the Habitats Directive 43/92/EEC and classified as Critical Hazard in the Italian Red List of the IUCN, is now rarefied and conservation actions in favour of this species are necessary.

The project has foreseen four interventions to eradicate allochthonous fish from as many alpine lakes, aimed at restoring the natural functioning of ecosystems and restoring natural biodiversity, but also at experimenting and acquiring non-invasive eradication techniques on deep alpine lakes. Other interventions were aimed at preventing excessive quantities of nutrients entering the aquatic environment, resulting from mountain pastures, and the use of high altitude tourist reception facilities, which lead to eutrophication and therefore pollution of the Alpine lakes.

PROJECT PHASES

The main actions of the project were:

Eradication of allochthonous fish from some high altitude lakes. In order to restore the original biodiversity of some Alpine lakes, the action focused on the **removal of Brook trout**, a "super-predator" that has disrupted natural ecosystems by reducing biodiversity causing the disappearance of many species of zooplankton, including the rare populations of *Daphnia pulicaria* of the Gran Paradiso National Park, numerous aquatic arthropods (beetles, trichoptera, plecoptera, hydrachnidia) and the **comon frog**. The action's objective was the mitigation of the impact of the Brook trout on the aquatic ecosystems of the National Park through the eradication of this species from four Alpine lakes within the Park. The eradication was carried out in ice-free waters, **in three small and shallow lakes** (4-10 m): Lake of Djouan, Black Lake of Djouan and Black Lake of Dres **and a larger and deeper lake**: Lake Leynir (22 m). In this lake, due to its great depth, the action has had a highly experimental and innovative character as **intensive fishing with fishing nets** has been used, which resulted very efficient in small lakes.

Conservation actions for the Marble Trout. The threats for the Marble Trout (*Salmo marmoratus*), endemic in the rivers of the Po basin, are due not only to the alteration and fragmentation of the habitat but also to the presence of the Brown Trout (*Salmo trutta*) as the two species, given the great genetic affinity and the partial reproductive isolation, are able to reproduce giving rise to **hybridization** that over time determines the loss of the Marble Trout population's genetic identity. **For these reasons, Marble Trout has been in decline throughout its distribution range for several decades.** At European level, Marble Trout is included in Annex II of the Habitats Directive, while at national level it is listed by the International Union for Conservation of Nature (IUCN) as critically endangered (CR; the status before extinction according to the IUCN categories): therefore, conservation actions for this species is of high priority. The main actions carried out have been:

- **Realization of a fish hatchery for the breeding of Marble trout and its release into three waterways: Piantonetto, Campiglia and Forzo**. The hatchery is open to the public for eductional purposes on the themes of conservation of aquatic habitats and native fish fauna. A specific training on the hatchery's management was also carried out here for the Surveillance Body and the internal staff in order to allow the continuation of the activities beyond the end of the project.
- **Removal of Brown trout /reduction of its density** by collection and transfer downstream of the project sites with capture sessions in the Campiglia, Orco and Piantonetto streams. The captures, made during the minimum flow periods of the streams, were carried out by electrostunning, a widely used method because its advantages: it can catch small fish, and can operate in shallow or laminar water and in running water, as well as it does not cause irreversible damage to the fish. In addition, the action had a strongly demonstrative character concerning the gradual transition from an allochthonous to an autochthonous fish population with the progressive replacement of brown trout with marble trout, thus proposing a management model, and at the same time raising the awareness of local fishermen's associations and interested citizens on the conservation of mountain aquatic ecosystems.

The **discovery of a pure marble trout population within the Park** has pushed even more to the genetic conservation of what could perhaps be the last pure strains present.

Quality improvement of high altitude aquatic ecosystems. **Two experimental phytodepuration plants have been built** to reduce the excess of organic substances originating from the waste water of two refuges and an Alpine hut near Lake Nivolet, namely at:

- **Refuge Pontese**, located at about 2200 m a.s.l. The structure is equipped with an Imhoff pit that receives waste water and is in full compliance with the norms on civil discharges, but the purified waters of the Refuge reach the stream and the water network downstream and entering **Lake Teleccio**, thus increasing the load of nutrients. The phyto-pedo-purification and horizontal sub-surface flow treatment plant uses zeolites as bed filling substrate. This plant consists of waterproof basins where the surface of the water is always kept below the surface of the ground so that the inert material composed of crushed stone, gravel, sand and zeolite, is saturated with water. With this system, bad odors, hygiene risks and the development of insect colonies are significantly reduced.

As the plant was constructed at over 2200 m a.s.l, for the phytodepuration action specific plant types compatible with the site's climatic conditions were selected, including *Senecio cordatus, Leucanthemopsis alpina, Chenopodium bonus henricus*.

- **Alpine hut** located at an altitude between 2.520 m and the 2.620 m a.s.l. **near the lower Lake Nivolet** in the vicinity of the watershed between Valsavaranche, the secondary basin of the Dora Baltea river and the Orco Valley. The movement of water between the two lakes of Nivolet takes place under the countryside level, flowing through morainic scree. The interventions carried out at the hut were aimed at preventing and reducing the risk of discharging polluting substances due to waste from dairy processes and sewage. A **second phyto-pedo purification intervention involved the water released from the Savoia Refuge treatment system** and the water drained and treated by the filter ecosystem present downstream of the pasture.

Monitoring the eradication process and the recovery of high altitude lake ecosystems. The details of the monitoring and sampling methodologies are described in the "**Brook trout eradication plan**" drafted by the Gran Paradiso National Park as part of the preparatory activities of the LIFE+ BIOAQUAE project.

PROJECT RESULTS

During summer 2016, water was sampled to verify the effectiveness of the constructed phyto-pedo-purification systems. The output water of the phytodepuration system has shown very low nutrient values and these results indicated that the system is able to greatly reduce the nutrient load of the water thus achieving the aims of the project.

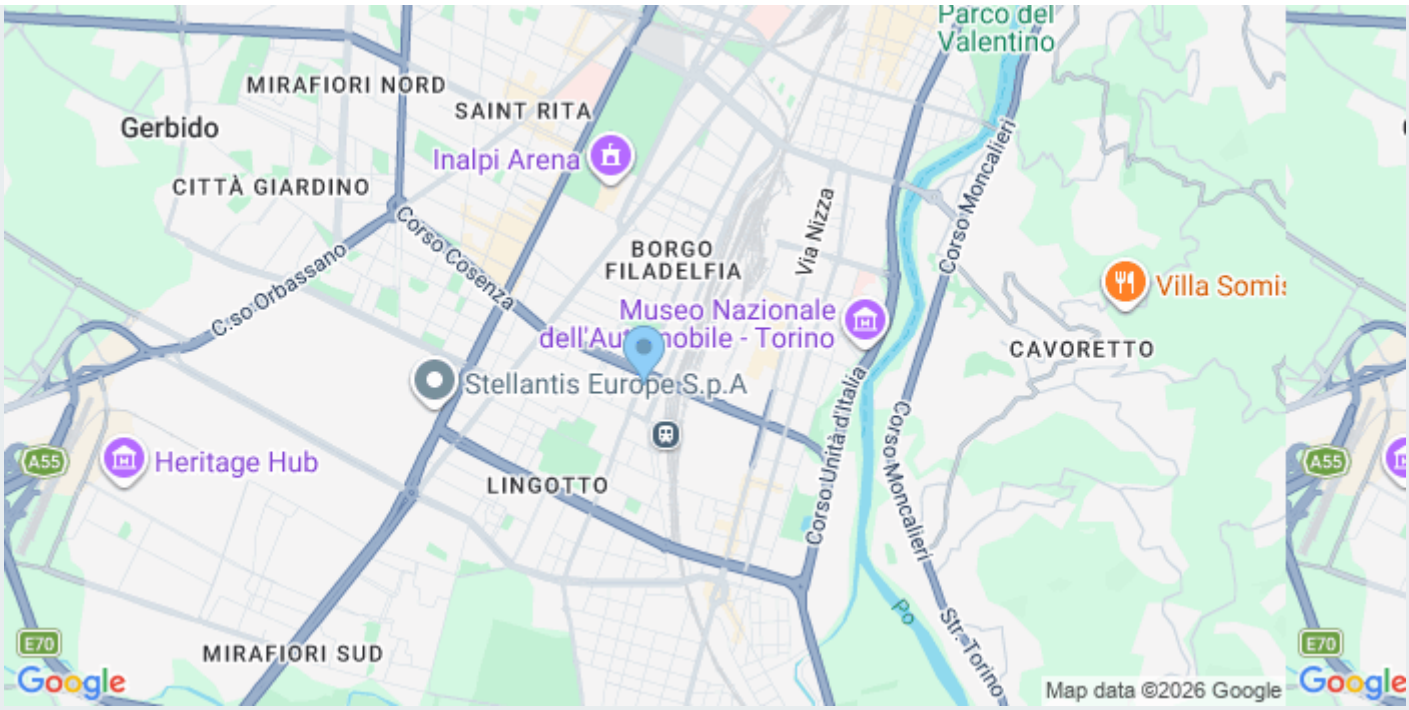
As part of the project, **three technical documents** were developed with the aim of giving valid guidance for replicating the implemented actions:

- **Eradication of allochthonous fish from lakes at high altitude;**
- **Actions for the conservation of marble trout;**
- **Interventions to improve the quality of high altitude aquatic habitats.**

The project provided also numerous dissemination and awareness raising actions addressing a heterogeneous public: locals and hikers, experts and people interested in the topic as well as students and children. Several guided excursions, evening events, thematic itineraries, and photographic exhibition were held. In addition, a **Hiking Guide** was created illustrating **six trails in the protected area** with arrival to the relevant intervention sites of the LIFE + BIOAQUAE project. These trails contain educational/ dissemination pathways on the conservation of aquatic ecosystems, peculiarities of the area and the results of the scientific research conducted in the area.

Below there are the important quantitative achievements of LIFE BIOAQUAE:

- **Removal of approximately 20.270 Brook trouts from 4 Alpine lakes**. Many species that had disappeared from the lakes have begun to reproduce, among others, the **comon frog**, dragonflies and other species of invertebrates.
- **Production of about 15.800 fry marble trout in the hatchery realized within the project**, and their release in 3 streams, already made devoid of brown trout. This has contributed to the conservation of the species, protecting it from hybridization and giving continuity to the action in the years following the project.
- **Removal of 1.291 breeding specimens of brown trout from streams**.
- **Discovery of one pure marble trout population** within the Park and improvement of its conservation status and **genetic purity**.
- **Realization of 2 phytodepuration plants at high altitude**, efficiently reducing the quantity of nutrients coming from the waste water of anthropic activities and contributing to the improvement of the delicate Alpine ecosystem's quality.
- **70 information events**.
- **6 trails within the protected area with arrival to the relevant intervention sites of the LIFE+ BIOAQUAE project**



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665.229,97

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