Alpine lakes and streams are among the most remote and apparently intact environments of the Alps. However, they are facing several issues that are jeopardizing their conservation. Among the others, two of the principal risks are related to pollution and introduction of alien species.

Examples of these issues can be found also in protected areas such as the Gran Paradiso National Park. In the 60s the brook trout was introduced from North-America in many Alpine lakes of the Park depleting the ecosystems up to the disappearance of many taxa of invertebrates and of the common frog. Also Alpine streams and rivers host only a small proportion of the original species, some of which are endangered. Among the others the presence of the autochtonous and locally endangered Marble trout deserves a special conservation effort. Finally, anthropic activities in high mountains, such as huts and pasturelands through their waste waters, may introduce in the aquatic ecosystems excessive quantities of nutrients leading to eutrophication.

The LIFE+ BIOAQUAE project aimed at experimentally solving some of these issues applying the most advanced available techniques and involving the local community in order to enhance the common perception of what is a natural environment and why it is important to preserve it.

**INTRO**

I laghi e i torrenti alpini sono tra gli ambienti più remoti ed apparentemente incontaminati delle Alpi. In realtà sono sottoposti a numerose minacce che mettono a rischio la loro conservazione. Due dei principali rischi sono legati all'inquinamento e all'introduzione di specie aliene. Esempi di ciò si possono osservare anche in aree protette come il Parco Nazionale Gran Paradiso. Negli anni ‘60 il salmerino di fontana è stato introdotto dal Nord America in molti laghi alpini e ha impoverito gli ecosistemi portando alla scomparsa di molte specie di invertebrati e della rana temporaria.  Anche i fiumi ospitano ormai solo una piccola porzione delle specie che li abitavano originalmente e molte specie sono tuttora in pericolo. La presenza, seppur rarefatta, della trota marmorata, un predatore introdotto che ha danneggiato fortemente questi ecosistemi.

### THE ACTIONS

#### ERADICATION OF NON-NATIVE FISH FROM ALPINE LAKES
In order to restore the original biodiversity of Alpine lakes, the project aimed at removing from four Alpine lakes the brook trout, an introduced predator that extensively damaged the natural ecosystem.

#### ERADICAZIONE DI PESCI ALLOCTONI DA ALCUNI LAGHI ALPINI
Al fine di ripristinare la biodiversità originale di alcuni laghi alpini, il progetto mira alla rimozione del salmerino di fontana, un predatore introdotto che ha danneggiato fortemente questi ecosistemi.

#### CONSERVATION ACTIONS FOR THE MARBLE TROUT
This autochthonous species, endemic of the Po basin, is endangered because of habitat loss and cross breeding with the brown trout. The aim of the project was to strengthen the marble trout population thanks to the building of a fish hatchery and to the removal of brown trout from some rivers.

#### AZIONI DI CONSERVAZIONE PER LA TROTA MARMORATA
Questa specie autoctona, endemica del bacino del Po, è in pericolo a causa della distruzione del suo ambiente e dell’ibridazione con la trota fario. Obiettivo del progetto è quello di rinforzare le popolazioni di trota marmorata grazie alla costruzione di un incubatoio ittico e alla rimozione delle trota fario da alcuni torrenti.

#### IMPROVE THE QUALITY OF HIGH ALTITUDE AQUATIC ENVIRONMENTS
To reduce the excess of organic substances originated from wastewaters of mountain huts and pastureland that can cause anoxia in aquatic ecosystems, the creation of phyto-pedo deputation systems for cleansing wastewaters was planned.

#### MIGLIORAMENTO DELLA QUALITÀ DEGLI ECOSISTEMI ACQUATICI DI ALTA QUOTA
Per ridurre l’eccesso di sostanze organiche originate dalle acque di scarto di pascoli e rifugi, che possono causare il soffocamento degli ecosistemi acquatici, è prevista la creazione di due impianti di fitodepurazione per purificare le acque.
To reach the aims of the project, the most advanced technique developed in the last years were used. The main ideas that drove the choice of the methods used were:

**Feasibility.** Most of the actions were carried out in high mountains with complex logistic situations so the methods used had to take this into account.

**Sustainability.** Eradication actions were carried out with fishing nets and electrofishing, two sustainable methods that did not compromise the rest of the ecosystem. Helicopter transports were reduced to the minimum and most of the transports were carried out walking. For the pytodepuration systems only local vegetal species were used and the visual impact of the structure was reduced.

**Participation.** Several activities were planned at different levels in order to explain the aims of the project. The actions included specific activities for school children at the didactic fish hatchery, guided excursions to the action sites for tourists, the involvement of anglers during the first stages of the brook trout eradication action and educational events for the local communities. Moreover, several publicity materials were produced and distributed, 5 series of didactic panels on the conservation of aquatic ecosystems were positioned on paths going to the action sites and a photographic exhibition was produced and presented. Finally, several presentations of the project were performed at universities and at scientific conferences.
ERADICATION OF NON-NATIVE FISH FROM ALPINE LAKES

RESULTS

This action was extremely successful, all the 4 lakes included in the project were freed from brook trouts. The results of the eradication actions are already visible: many species that were absent from these lakes started again to reproduce there such as the common frog, dragonflies and other invertebrate species.
CONSERVATION ACTIONS FOR THE MARBLE TROUT

RESULTS

The building of the fish hatchery helped to reach different results. Pure marble trouts fry were produced at the fish hatchery and released in selected streams previously freed from brown trouts; this will enhance the conservation of this species protecting it from crossbreeding. Moreover, the fish hatchery has an important didactic value. Both marble trout breeding and tourist education actions will continue in the next years.
IMPROVE THE QUALITY OF HIGH ALTITUDE AQUATIC ENVIRONMENTS

RESULTS

In the framework of this action, the construction of two phytodepuration systems was completed. The first analyses carried out on the water that passed through the plants demonstrated that the reduction of the nutrient quantity was effective and this will improve the quality of the whole ecosystem.

MIGLIORAMENTO DELLA QUALITÀ DEGLI ECOSISTEMI AQUATICI DI ALTA QUOTA

RISULTATI

Nell’ambito di questa azione sono stati costruiti due impianti di fitodepurazione. Le prime analisi effettuate sulle acque in uscita dagli impianti dimostrano che vi è un’effettiva riduzione della quantità di nutrienti e ciò contribuirà al miglioramento della qualità dell’intero ecosistema.
The LIFE+ BIAQUAE project ended in summer 2017 but the main actions and a constant monitoring of the status of the ecosystems will continue in the next years as well as the effort of Gran Paradiso National Park for the conservation of Alpine aquatic ecosystems.

Il progetto LIFE+ BIOAQUAE è terminato nell’estate 2017 ma le azioni intraprese e il monitoraggio degli ambienti coinvolti nel progetto proseguiranno nei prossimi anni così come gli sforzi del Parco Nazionale Gran Paradiso per la conservazione degli ecosistemi acquatici di alta quota.