BIOAQUAE
Biodiversity Improvement of Aquatic Alpine Ecosystems

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LIFE BIOAQUAE, Action C.4: phyto-pedo depuration treatment of sewage from a mountain hut

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INTRODUCTION

Sewage from mountain huts can affect the trophic state and the water quality of downstream aquatic habitats. Treatment of this sewage may be problematic in high-mountain areas because of the local climatic conditions, which weaken the effectiveness of the techniques usually adopted to reduce the nutrient load, such as Imhoff tanks [1,2]. Therefore, *ad hoc* sewage treatment methods are needed in these areas, to reduce touristic impact and preserve the ecological status of high-altitude aquatic habitats [2]. Among other conservation actions, the LIFE+ BIOAQUAE project aims to flank traditional water treatment systems with phyto-pedo depuration techniques, to assess their efficacy and feasibility in alpine areas. In particular, an experimental ecological filter was developed within the project, supplementing the pre-existing treatment with Imhoff tank, to reduce the nutrient loads from the Pontese hut (2217 m a.s.l., Gran Paradiso National Park; Fig. 1). Imhoff outflows are forced to flow into the ecological filter which consists of a pool waterproofed with polymers, filled with a substrate made of porous rocks (zeolites), and topped with a layer of soil (naturally colonized by local vegetation; Fig. 2).

Fig. 1 Pontese hut (2217 m a.s.l.) can host up to 70 people and is open from April to the 15th of May and from the 15th of June to the 15th of September.

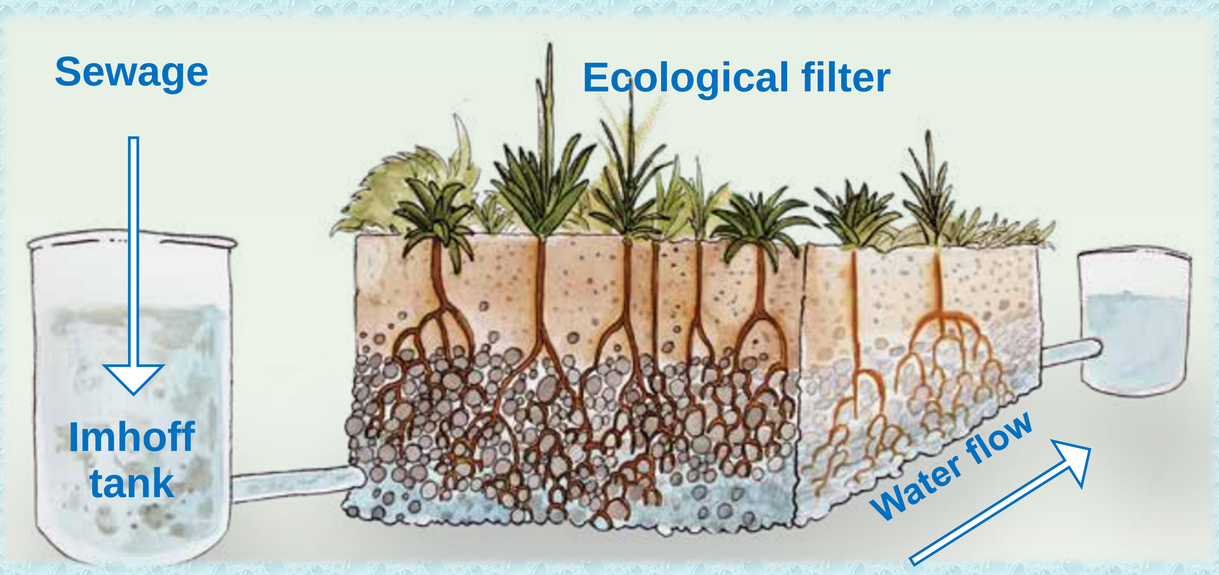

Fig. 2 Functioning of the ecological filter: Imhoff outflows are forced to flow into the ecological filter where the combined action of zeolites and vegetation reduces the nutrient concentration.

METHODS

Outflows from the Imhoff and the ecological filter were repeatedly sampled, fixed with HCl, and analyzed for nutrient contents (Total phosphorous- TP, ammonium and Total Nitrogen – TN) to assess the depuration capacity of the filter.

RESULTS AND DISCUSSION

Preliminary data collected in summer 2016 indicate that this system can strongly reduce the nutrient load: total phosphorous (TP) reduction was between 75 and 95 %; ammonium reduction >99%; total nitrogen (TN) reduction around 96% (percentages calculated over three repeated samplings before/after the ecological filter; Table 1).

Sampling Date	TP (mg P L^{-1})	NH_4 (mg N L^{-1})	TN (mg N L^{-1})
04/07/16	7.9 → 0.2	57.2 → 0.08	66.8 → 2.0
17/08/16	15.9 → 1.6	103 → 0.07	108 → 3.8
01/09/16	10.4 → 2.5	78.9 → 0.10	93.6 → 3.4

Table 1. Nutrients concentrations in the outflows of the depuration devices used at Pontese hut: Imhoff tank → ecological filter outflows.

The high nutrient concentrations in the Imhoff outflows (Table 1) indicate that sewage treatment by Imhoff tank only has a limited capacity to abate nutrients. However, concentrations in the water flowing out from the ecological filter remain quite high (Table 1), suggesting that phyto-pedo treatment has the potential to reduce the impact of mountain huts, but that they cannot completely solve the problem of mountain huts sewage management at high altitudes. These results should be considered preliminary because in the future the depurative efficiency of the created ecological filters could either 1) increase, thanks to the colonization by native vegetation or to the growth of the bacterial community inside the plant litter, or 2) decrease, due to the saturation of the depuration plant. The long-term efficacy of the adopted depuration methods should be tested over a longer period.

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