Could electric fish barriers help to manage native populations of European crayfish threatened by crayfish plague (*Aphanomyces astaci*)?

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Introduction

European native crayfish species are threatened and one of the main conservation problems is the crayfish plague caused by the oomycete *Aphanomyces astaci* (Schikora) (Schrimpf et al. 2012). In some cases during a mortality event of crayfish plague, a part of the native crayfish populations survive upstream of an important river discontinuity (e.g. big waterfall or dam) because these interruptions hinder the movement of infected crayfish upstream in the river. Consequently, the current distribution area and the main refuges of the European native crayfish species are low-order mountain streams (Füreder et al. 2013). As a result, we decided to use an electric fish barrier during an event of crayfish plague to increase the discontinuity of the river to avoid the progression of individual infected crayfish upstream.

An electric fish barrier produces an electrical field and it is widely used to discourage fish movements and to create fish exclusion areas, for example in canals of hydropower stations (Clarkson 2003; Smith-Root 2012). Moreover, not only are fishes affected by electric field, but all the other aquatic fauna (e.g. amphibians and crayfish) may be sensitive to electric discharges (Alonso 2001; Olson and Rugger 2007). Therefore, if an electric fish barrier is installed, it could be possible to restrict aquatic fauna movement and to avoid the dispersal of infected crayfish by *A. astaci* upstream in the river.

The aim of this poster is to share our expertise and to show requirements, problems and opportunities of using an electric fish barrier in order to help native crayfish populations conservation.

Figure. Electric fish barrier installation pictures in Joanetes stream. a) Circuit box and display inside a plastic box to protect them from rain. Metallic nets (b) and poster signs (c) were also installed to avoid accidents with wildlife fauna, farm animals or humans.

Methods

In August 2008 on Joanetes stream and July 2011 on Llosses stream, we detected events of crayfish plague on populations of *Austropotamobius pallipes* (Figure 1). We installed an "Electric Fish Barrier IG201-1FS", provided by the Acuitec Company, 200 meters upstream of the last dead crayfish detected. Little power was applied (output: 70 volts and 1 ampere; frequency of discharge: 1 pulse per second) because both streams have low conductivity (180 to 320 µS/cm) and are only 2-3 meters wide and 20-40 cm deep. We connected the electric fish barrier to a nearby house using an electric cable 400 meters long. Then, in order to monitor the progression of crayfish plague and the efficiency of electric fish barrier, every 48 hours we sampled the stream to detect dead or moribund individuals. During monitoring, we walked from upstream to downstream and we never went into the water to avoid dispersing the crayfish plague.

Results and discussion

After these two experiences, here we list the issues that we consider that might be important to use this technique successfully:

1. The electric fish barrier should be installed in a site where a small water discontinuity already exists (e.g. small waterfall 2 - 3 meters in height). The electric fish barrier should be established just upstream of this discontinuity to increase the difficulty for crayfish to move upriver. Therefore, it is an important requirement to first detect some river discontinuities (natural or not).

2. As it is possible for a crayfish to harbor internal infections without showing obvious visual signs, it is essential to be sure that the disease is not present in crayfish at the chosen site or close to it before installing the electric fish barrier. As a result, we would recommend installing the electric fish barrier a minimum of 300 meters upstream from the last dead or moribund crayfish.

3. This technique should only be used when mortality due to crayfish plague is detected at the beginning of the outbreak, not when the entire population is already infected. For this reason, it is very important to conduct a continuous and intensive monitoring of crayfish populations, particularly those with high probabilities to be affected by crayfish plague (e.g. populations near American crayfish populations).

4. Another important aspect is to clearly designate the electric fish barrier area with signs, as well as to close the area (e.g. with metallic net) around the electric fish barrier to avoid accidents with wildlife fauna, farm animals (e.g. cow, sheep) or even humans (Figure).

5. Sometimes, obtaining the electricity necessary for the electric fish barrier could be a problem because crayfish populations are in isolated places. In this case, a solution could be to use solar panels to power the electric fish barrier.

As a result of our experience using this tool, and being conscious of its limitations, as it has been exposed, we think that the use of an electric fish barrier can be useful to stop the progression of infected crayfish upstream and to improve European crayfish populations' conservation.

Published on: Management of Biological Invasions. Volume 6, Issue 3: 307. 2015. Could electric fish barriers help to manage native populations of European crayfish threatened by crayfish plague (*Aphanomyces astaci*)?.