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Tracing the origin of invasive salmonids

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Project "Protecting galaxiids from salmonid invasions in Chile and the Falklands" (Project ref EIDPO041; Post-Project Darwin Award) (www.biodiversity.cl).

Invasive salmonids represent one of the biggest threats to native freshwater fishes in Patagonia, the Falklands Islands and other temperate zones of the Southern Hemisphere (*Garcia de Leaniz et al 2010*). Both the Chilean and Falkland Islands Biodiversity Strategies recognize the need to restore ecosystems as the first step towards reversing the loss of biodiversity. Furthermore, the Falklands Islands Draft Action Plan for the endangered Aplochiton zebra recognizes the need to maintain AZ as a component of its native fresh water fish fauna and to prevent further loss of populations. Our project is using molecular and isotopic tools to help identify the origin of invasive salmonids (*Schröder & Garcia de Leaniz 2010; Consuegra et al. 2011*), as a first step towards quantifying threats to native galaxiid populations. Our work is thus particularly timely and fully in line with the host countries' Biodiversity Strategies, given the dramatic recent increase in the spread of invasive salmonids and the widespread decline of native freshwater fish fauna.

Photo 1. Rainbow trout escapee preying on native galaxiids. (Photo K. Young)

Like Chile, the Falkland Islands have a wealth of biodiversity but limited access to skilled practioners in assessing and managing key biodiversity goals in freshwater environments. With more than 40 endemic freshwater species (most of which are barely known to Science), there is increasing evidence that the widespread decline of native galaxiid fishes is associated with the spread of invasive salmonids (*Young et al 2009, 2010*), and that many of these salmonids represent escapes from open fish-cages and other aquaculture facilities. However, establishing a link between salmon farming and the spread of invasive salmonids has until recently proved elusive. The industry continues to argue that most fish escaping from aquaculture

facilities are maladapted to survive in the wild, and do not represent a threat to local biodiversity.

To tackle this problem, we screened 15 populations of rainbow trout and four commercial trout farms in Chile with microsatellite DNA markers. We found that farmed trout were very different from those found in many rivers, and used these differences to identify farm escapees. Our results, recently published in Evolutionary Applications (*Consuegra et al 2011*) indicate that rainbow trout escapees represent 16% of all free-ranging rainbow trout we collected, and were present in 80% of study rivers. Hybrids between farm escapes and established trout were present in all rivers at frequencies ranging between 7 and 69%. We also found that the incidence of trout escapees was positively and linearly related to the number and distance to neigbouring trout farms (which we combined in an index of aquaculture propagule pressure). Thus, rivers with many farms nearby had significantly more trout escapees than those with fewer neighbouring farms.

Our findings provide a strong causal link between salmon farming and presence of invasive salmonids, and can be used to inform policy in relation to conservation of native galaxiid fishes in the region. In particular, we recommend that for the effective protection of native galaxiids, two action points should be urgently considered, namely (1) improvements in bio-containment of salmon farms, and (2) the creation of aquaculture-free areas in local biodiversity hotspots not yet affected by salmonids.

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