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# FROM SEA TO SOURCE

International guidance for the restoration of  
fish migration highways



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# EXAMPLE

## Assessing the impact of culverts on population connectivity of endangered galaxiid fishes in the Falkland Islands

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### INTRODUCTION

There are an estimated 786 km of road tracks in the Falkland Islands crisscrossing a dense network of streams, lakes and ponds. Most of these tracks have been built over the last two decades and use culverts, rather than bridges, to negotiate stream crossing. The actual number of culverts is not known, but a conservative estimate would be in the hundreds. In a pilot survey, Ross reported finding culverts in 22 of 38 sampling locations (58%) in both West and East Falkland, but this is almost certainly an underestimate (Ross, 2009).

Concerns have been raised about the potential impacts of culverts on the connectivity of the two native galaxiid fishes, *Galaxias maculatus* (Falklands minnow) and the endangered *Aplocheilichthys* sp. (confusingly named 'zebra trout'), which rely on a marine larval phase for completing their life cycle, as well as on the introduced sea trout (*Salmo trutta trutta*) which forms the basis of a valuable sport fishery.

Costs, and not fish passage, has been the overriding criterion for designing such culverts, and assessing their impact has been flagged as a high conservation priority, particularly for the endangered *Aplocheilichthys*.

### WHAT ARE WE DOING?

That culverts hinder, or even impede, fish passage is implicitly recognised in local fishing regulations which forbid angling within 100 m on either side of such structures on government land. Yet, there is no information on the effects of culverts on Falkland fish populations, and no guidelines to help mitigate their impacts. As part of a DEFRA (UK)-funded Darwin Initiative designed to protect native galaxiid fishes ([www.biodiversity.cl](http://www.biodiversity.cl)) we are compiling information on the number, characteristics, and location of culverts (and other potential barriers) in Falkland Islands waterways. We are also developing a field assessment of their likely impact based on culvert dimensions, location within the waterways, and data on water velocity and depth profiles. Culvert maintenance tends to be carried out on an ad-hoc basis, and it is hoped that our study can at least influence the replacement of older culverts across the Islands.

### WHAT DID WE FIND?

This is an ongoing study and our data are hence preliminary, but our first surveys indicate that culverts in the Falklands are widespread and vary widely in size, from 30 to 200 m in diameter, and can be over 15 m long. They are now being favoured over bridges to create causeways over

all types of waterways, from head streams as small as 1.5 m wide, to stream mouths under tidal influence 155 m wide. Small culverts are made of PVC, but large ones tend to be made of corrugated iron. Average bottom water velocities (at 5 cm from the bottom) were 60 cm/s (range 0-125 cm/s) and 55 cm/s (range 0-113 cm/s) at the upstream and downstream ends of nine culverts, respectively. Similar values for water depth were 34.6 cm at the upstream end and 35.2 cm at the downstream end. We found instances where culverts were dry because water was infiltrating under rock gabions, as well as perched culverts that made fish passage impossible.

### LESSONS LEARNED

Culverts are widespread in the Falklands, and yet their impacts on native fauna have not been addressed. As old culverts need replacement and new tracks are being planned, it is essential to develop a sound system for assessing their impacts, and for suggesting mitigation or alternative measures. We are using a simple field

inventory to identify potential barriers for fish migration, and will make use of genetic data to estimate levels of gene flow to infer connectivity between populations. No information is available on the swimming stamina of native galaxiids (and was not, therefore, a factor that could have been taken into account in their design), but studies on 7 fish species indicate that water velocities in culverts should not exceed 92 cm/s for any species, and should not exceed 45 cm/s for brown trout (Tudorache *et al.*, 2008), the species that most closely resembles the native *Aplochiton* sp.

On this basis, it would thus appear that many of the culverts in the Falklands constitute a significant barrier for fish migration. We also encountered, just like Ross, dry and perched culverts that were impossible for fish to ascend under all conditions (Ross, 2009). Data are still very limited, but we suspect that culverts may pose one of the biggest threats to the conservation of native galaxiid fishes in the Falkland Islands.

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### FIELD ASSESSMENT OF CULVERTS ON THE FALKLAND ISLANDS

