FRESHWATER BIODIVERSITY

Dealing with diversity dwarf galaxias style

Richard Allibone

Biodiversity studies – whether they result in new species or not – can provide valuable information on how our native fish should be managed.

Over the last ten years the number of native freshwater fish recognised in New Zealand has increased by 33% – from 27 to 36 species. The nine new species have come about from new discoveries during surveys in remote areas, from natural colonisation by a **diadromous** eel and from detailed studies of some **non-diadromous** fish.

Non-diadromous fish spend all their life cycle in fresh water. Therefore, populations of the same species are restricted to separate river systems and are isolated from their neighbours in adjacent rivers. Over tens of thousands of years such isolation sometimes allows the populations to evolve separately, eventually forming new species.

A recent NIWA study examined populations of the dwarf galaxias *Galaxias divergens*, a non-diadromous galaxiid. This is one of the most widely dispersed freshwater fish in New Zealand, occurring in western and northern South Island, and throughout the lower North Island, with outlying populations in the Bay of Plenty and Waihou River, Waikato. Because of the isolation of some populations, dwarf galaxias was a good candidate for an investigation into the species status of its populations. The question we aimed to answer was: are there any unrecognised species within dwarf galaxias?

For the study, we used a simple genetic technique called electrophoresis (see *Water & Atmosphere 8(3)*: 17), along with body measurements, to compare dwarf galaxias from 24 populations from the Grey River on the West Coast to the Waihou River in the Waikato.

The electrophoresis results showed that there were five groups of populations among our samples and some differences are shown in the figure opposite (top). In the South Island, populations in adjacent catchments were often very distinct, indicating long-term genetic isolation. For instance, the dwarf galaxias in the adjacent Buller, Motueka and Wairau catchments were all very distinct (circled area in the figure). On the other hand, dwarf galaxias populations in north-eastern South Island and southern North Island were similar. This

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"White spots red faces" again

Many years ago an article appeared in *Freshwater Catch* (a predecessor to *Water & Atmosphere*) entitled "White spots red faces". The article referred to the feature commonly used to identify the alpine galaxias (*Galaxias paucispondylus*): a white spot or chevron immediately in front of the dorsal fin. This character was regularly used to distinguish alpine galaxias from Canterbury galaxias (*Galaxias vulgaris*) and dwarf galaxias (*Galaxias divergens*). On one occasion the author identified a number of rather heavily built alpine galaxias, only to discover later that the white spots used to identify the fish were in fact parasite cysts and the fish were not alpine galaxias after all.

The recent study of the morphology of the dwarf galaxias found that many populations of *dwarf* galaxias – all the North Island populations and those from the Wairau River, South Island – also had a white spot immediately in front of the dorsal fin. The spot is often fainter than that seen on alpine galaxias, but is still evident. This represents an identification problem in the Wairau River where white-spotted dwarf galaxias and alpine galaxias coexist. The problem is further complicated by the presence of some small galaxiids with no white spots. These may be dwarf galaxias or, rarely, alpine galaxias or juvenile koaro (even 100 km up-river from the mouth). To obtain reliable identification of any small galaxiids in this river system we now recommend fin-ray counts and careful examination of the fin shapes and colour patterning.

In fact, on recent return visits to "alpine galaxias" locations in the Wairau catchment it was found that the fish present were usually dwarf galaxias with a white spot, and not alpine galaxias at all. The result: some changes in the New Zealand freshwater fish database for the Wairau catchment and some red faces for fisheries biologists including this author!

Further reading: Eldon, A.E. (1989). White spots red faces. *Freshwater Catch 40*: 10.

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Dwarf galaxias. (Photo: Bob McDowall)

Diadromous and non-diadromous fish

About half of New Zealand's native freshwater fish species are diadromous. That is, they spend part of their life cycle at sea and migrate to fresh water for the remainder of the cycle. The rest – such as the galaxiids discussed in this article – are non-diadromous and pass their entire life cycle in fresh water. For further explanation on types of diadromy, refer to *Water & Atmosphere 3(2)*: 19.

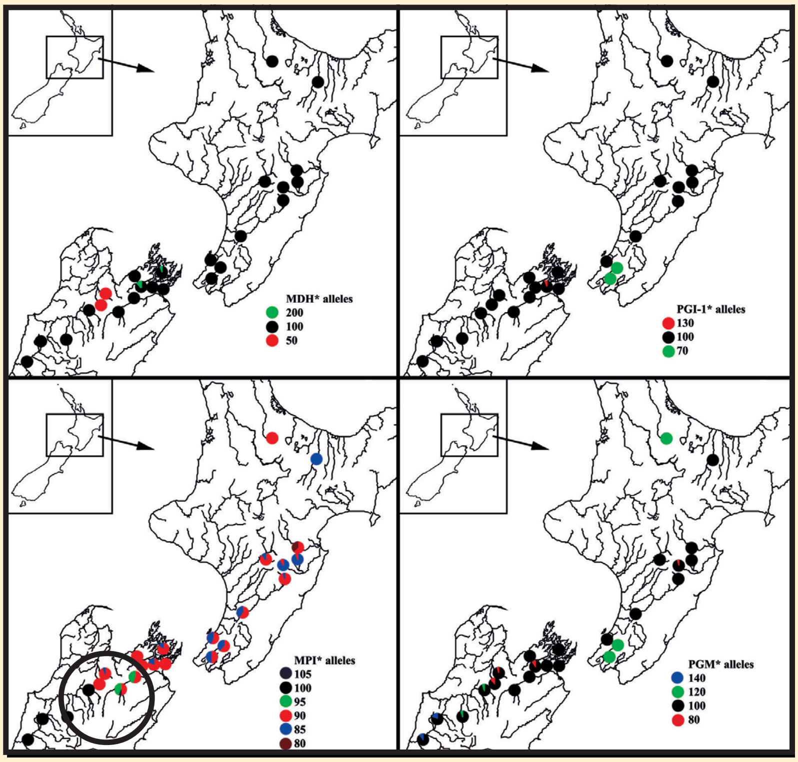
indicates that populations on either side of Cook Strait have mixed and inter-bred far more recently than have populations within the South Island. This mixing most likely happened during the last glacial ("Ice Age") that ended about 14,000 years ago. At that time sea level was much lower. The North and South Islands were connected (see figure, right) and rivers and fish could have met in areas that are today under the sea.

New species, or not?

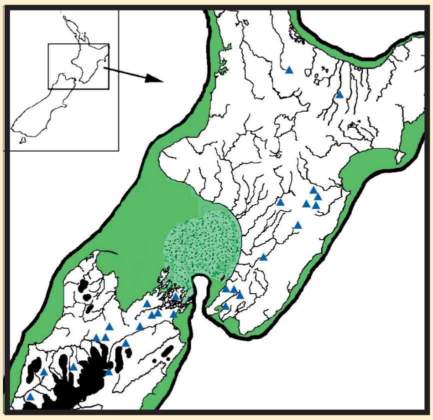
So, do these separate groups within the dwarf galaxias represent more than one species? Answering this question is not simple because a number of different concepts have been proposed to define a species. One of the most frequently used concepts requires that for different species to be recognised it must be shown that the potential species do not interbreed and produce fertile offspring. In the case of the dwarf galaxias, as with many of New Zealand's freshwater fish, the different species or genetic groups do not co-exist. Therefore there are no natural tests of the interbreeding potential and this species concept is of no use. An alternative concept required that we demonstrate that the groups are genetically distinct to recognise distinct species. In this case the different groups of dwarf galaxias could be recognised as separate species.

However, in previous freshwater fish investigations in New Zealand new species have been recognised *only* when there have also been differences in body shape, colour pattern and fin structure among the new species. No consistent body feature differences were found amongst the dwarf galaxias groups. Therefore, in this study it was decided *not* to recognise any new species from within dwarf galaxias, even though there were genetic differences among different populations.

Nevertheless, the results of the electrophoresis revealed important population structures within dwarf galaxias. Populations in adjacent catchments can be genetically distinct and this should be recognised during the management of dwarf galaxias. Actions that may lead to the mixing such populations should be carefully considered, as they will modify population structures that have developed over thousands of years. Maintaining the population structure will help to retain genetic diversity, and encourage this process of speciation in action. ■



above:
Pie diagrams indicate the occurrence of different isozyme alleles that distinguish the five genetic groups with dwarf galaxias. Differences across Cook Strait are less than those among the South Island populations. Note the three distinct populations in adjacent catchments, circled lower left (see text).



The exposed areas of seabed around New Zealand during the last ice age (green) and glacial areas in the South Island (black) approximately 14,000 years ago. The area where North and South Island rivers met (speckle green) appears to have promoted the movement of dwarf galaxias between the two islands and the present day genetic structure reflects this historic event.