Conservation forensics help unlock tuna mysteries

Tunas are highly mobile fish that often undertake long-range movements to track food and to reproduce at distant spawning grounds. Information on these movements underpins the effective management of commercially important tuna stocks. In the case of South Pacific albacore (*Thunnus alalunga*), longstanding questions remain regarding the number and location of spawning areas, the degree of connectivity among larval sources, the migration routes of juveniles and adults and the biophysical factors influencing these processes.

To answer some of these questions, we applied a conservation forensics approach to examine the otoliths (ear bones) from albacore (Fig. 1). We collected otoliths from albacore captured across the South Pacific Ocean, in French Polynesia, New Caledonia and New Zealand. We then used a high-precision laser to measure the amount of trace elements (i.e. those elements that are present in very low concentrations such as strontium, barium and magnesium) in each otolith. By measuring the concentration of different trace elements at the edge of the otolith, which contains material deposited in the last few weeks before capture, we were able to obtain a clear chemical "signature" that was unique to each of the three locations (Fig. 2).

We then measured the concentration of trace elements in the core of each otolith, which contains material deposited in the first few weeks of life. We found that the trace elements from otolith cores sampled from New Caledonia and New Zealand were quite similar, suggesting that albacore from these locations may have originated from the same location. However, trace elements in otolith cores from French Polynesia were distinctly different from the others, suggesting that albacore from French Polynesia originate from a different location. These results provide important preliminary insights into connections between larval sources and adult populations of South Pacific albacore, and suggest that further application of conservation forensics to albacore will refine our knowledge of movement patterns and population structure for this species. The full results of this study have recently been published in *Fisheries Research*.[1]

In addition, expanding the use of conservation forensics to other tuna species will broaden our understanding of movement patterns of tuna in general, without the need for tagging fish. Extensive tagging of yellowfin, bigeye and skipjack tuna at tropical latitudes has generated a wealth of information about tuna movement patterns. However, difficulty with tagging programmes for these species at subtropical and temperate latitudes has limited our knowledge of the broader movement patterns of these species throughout their range. Applying a conservation forensic approach to the otoliths of all commercial tuna species provides the opportunity

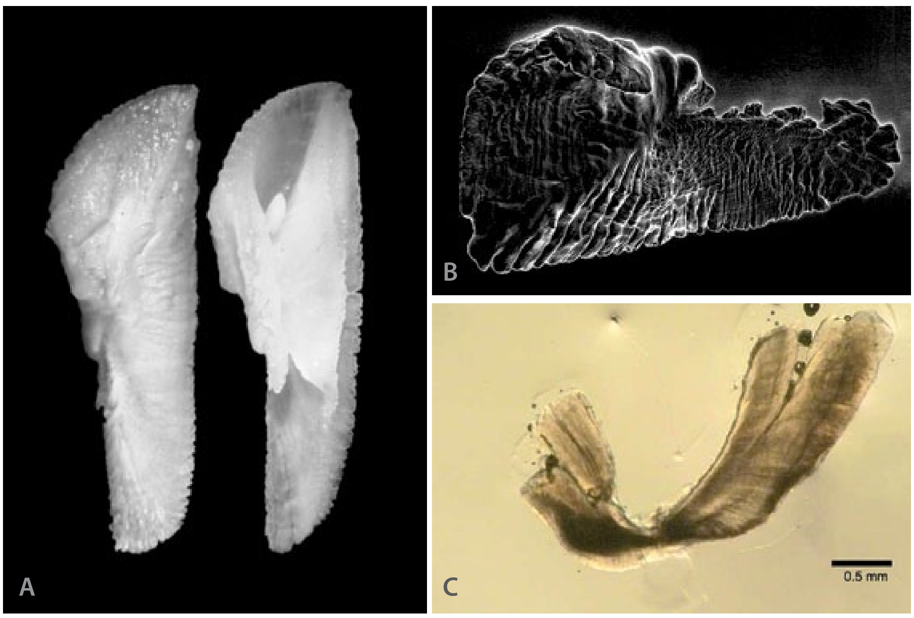

Figure 1. Whole (A and B) and transverse sectioned (C) otoliths from a South Pacific albacore.

[1] Macdonald et al. 2013. Fisheries Research 148:56–63 [http://dx.doi.org/10.1016/j.fishres.2013.08.004].

to attain a stock-wide picture of tuna movement across the Pacific Ocean. Since 2012 the Western and Central Pacific Fisheries Commission has been implementing a programme to collect biological samples from bigeye, yellowfin, skipjack and albacore tuna throughout the western and central Pacific Ocean. The samples include fish hard parts and the number of samples collected is now approaching a sufficient quantity to start a rigorous assessment of the benefits of trace element markers and other stable isotopes (e.g. oxygen and carbon) for deciphering tuna movements in the Pacific Ocean.

For more information:

Dr Simon Nicol
Principal Fisheries Scientist, SPC
simonn@spc.int

Jed Macdonald
PhD student, University of Iceland
jed@marice.is

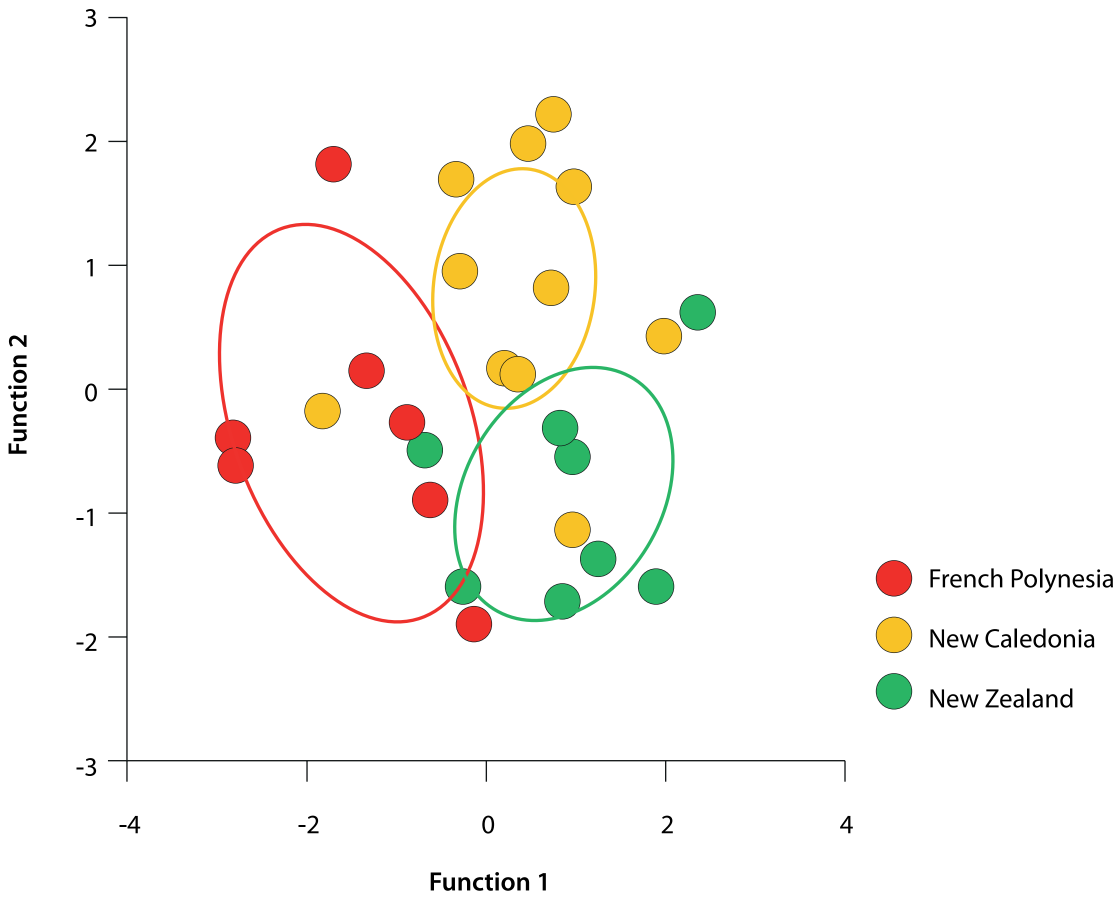

Figure 2. Discriminant function plots showing variation in trace element chemistry measured at the otolith edge among the three capture locations. Ellipses represent 95% CIs around the centroid for each location, and data points reflect the relative position of individual fish in two-dimensional space. Analyses are based on natural log transformed data.