Population structure of a predatory demersal fish (*Argyrosomus japonicus*, Sciaenidae) determined with natural tags and satellite telemetry

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Cover image: Every anglers dream – photo courtesy of Michael Hammer

Contents

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Abstract

Predatory demersal fish are declining on a global scale but in many cases there is a lack of ecological information to assist management agencies in reducing the decline. Information on population structure and connectivity is central to our ecological understanding, not just for fisheries biology but also more broadly for conservation and persistence of species. Natural tags and satellite telemetry can help address population structure questions. Various tags were used to investigate population structure and connectivity of the important mulloway (*Argyrosomus japonicus*) in southern Australia.

Fifteen microsatellite markers were developed to help determine the genetic population structure of mulloway. These markers were tested, and found to be useful, on other members of the family sciaenidae and hence can be used to investigate molecular structure in other sciaenids. Within mulloway, broad scale genetic structuring between South African and Australian mulloway was evident. Within Australia, four genetic populations across the range of mulloway were also evident. Biogeographic factors drove population structuring, as determined using decomposed pairwise regression, a rarely applied approach in the marine environment. Furthermore, our results form a growing body of evidence suggesting population structure is possible in the connected marine environment.

The various natural tags have different advantages and disadvantages, hence, by applying multiple approaches concurrently a greater scrutiny of population structure can be achieved. However, there is continuing debate on how best to integrate multiple approaches and thus condensing and producing simplified results ready for managing agency interpretation. Three approaches, namely, microsatellites, otolith chemistry and otolith shape were applied to the same mulloway samples. These three approaches are each affected by different intrinsic and extrinsic factors and are informative over different temporal scales. Thus, an overall integrated tag was obtained that provides a broader 'body of evidence' to population structure. The results also demonstrated that

integration of different data sets was feasible prior to statistical testing, facilitating a single overall result. However there were some slight differences in the results produced by the different approaches, which highlights the need for a thorough understanding of the influence of intrinsic and extrinsic factors on natural tags.

To properly interpret data from natural tags it is useful to understand factors contributing to variation in the tag. Otolith chemistry is a widely used natural tag, but differing responses to environmental parameters have been reported. Temperature and salinity were manipulated in a controlled laboratory setting along with intrinsic (population) differences and their effects on the otolith chemical tag investigated. A significant influence of genetic population on otolith chemistry was found and also evident was a response to temperature. This understanding of mulloway otolith chemistry will enable more accurate estimation of environmental patterns and supports the view that the otolith chemical tag is more complex than previously thought.

Satellite telemetry can be used to track fish movement while also logging environmental information. This technology has been used on pelagic and benthic predatory fish, but has not been used on demersal finfish. Whilst the natural tags can provide indirect evidence of movements, satellite telemetry has the ability to provide direct information on fish movements. Satellite telemetry was utilised on an isolated population of mulloway to provide information on the spatial scale of movements of mulloway; this information was related to movement in and out of marine parks. The results demonstrated the medium spatial scale of movements (up to 500 km) was similar to other predatory demersal fish and whilst undergoing these movements the fish interacted with marine park boundaries. Thus satellite telemetry was a useful approach for understanding demersal fish population dynamics.

Several approaches were successfully implemented to investigate population structure and movements of a large predatory fish, mulloway. A better understanding of population structure could assist management of some species. An enhanced understanding of predatory fish populations and the associated scientific approaches used to study such populations is urgent, due to the worldwide decline.