Tracking inshore fish

Ryan Daly

Rebecca Vuyolwethu Mxo tells us how sound is used to understand the movements of coastal fishery species

As a young African woman, the thrill of going to sea is sometimes hard to put into words. At the back of my mind, I often hear my brother's voice saying, "why this kind of work, can't you do something less dangerous?" when we set off from shore. But watching the land slowly fade away, and hearing the seabirds' beautiful harmony, brings a wonderful sense of calmness. Most of all, falling asleep while listening to the waves bashing on the boat after a long day of work is incredibly rewarding. I cannot recall the first day I undertook a sea-going field trip, but each time I go I feel so refreshed and fortunate.

The purpose

South Africa is home to more than 2 000 species of marine fish. Of those, approximately 250 species are caught in recreational, commercial and subsistence fisheries along the coastline. The stocks of many coastal fishery species are overexploited, and their future sustainability relies on improved management measures. Studies on the migrations and longshore movements of such species are important for the fisheries managers to consider new ways to protect them. Knowledge of movement patterns is also needed for the effective design of marine protected areas.

Unlike many terrestrial animals that are strongly associated with certain habitats or areas, or even confined to game reserves by fences, marine fish have unrestricted potential to move. Some important fishery species are known to occupy small home ranges while others migrate long distances. Their effective protection depends on answers to questions such as:

- where do they spend most of their time?
- are they dependent on critical habitats?
- where do they go when they move?
- do they return to favoured areas?

Researching the movements and behaviours of animals that live underwater poses different challenges due to the physical characteristics of water. For example, direct observations by divers, cameras or even remote underwater vehicles can only be performed for short periods – usually during daylight hours – and are restricted to small areas. Various approaches have been used to infer fish movements, each with their advantages and limitations. For example, fisheries catch data can be used to reveal seasonal trends in abundance as fish stocks move from one area to another. At the individual level, dart tagging has been widely used, where a uniquely numbered tag is attached to a fish that is then released back into the water. Anyone who subsequently catches the fish is meant to report it, giving the tag details as well as the size of the fish. The tag-recapture method is relatively cheap but requires many individual fish to be tagged to obtain meaningful data. Furthermore, the whereabouts of the fish between the release and the recapture site remains unknown.

Paul Cowley

Prof. Paul Cowley with an adult white steenbras.

Acoustic Tracking Array Platform

There are many large-scale acoustic telemetry arrays in the world, including the Integrated Marine Observation System – Animal Tracking Facility in Australia, the Florida Atlantic Coast Telemetry working group in the United States and the European Tracking Network throughout Europe, among others. South Africa has its very own network called the Acoustic Tracking Array Platform (ATAP), which is managed by the National Research Foundation-South African Institute for Aquatic Biodiversity (NRF-SAIAB) in Makhanda (formerly Grahamstown), Eastern Cape. The network is made up of more than 200 acoustic receivers deployed in the sea and estuaries along 2 200 km of the South African coastline, from the Berg Estuary in the Western Cape, through to Ponta do Ouro on the South Africa–Mozambique border, allowing the movements and migrations of aquatic animals to be monitored.

Paul Cowley

Instrument scientist Dr Taryn Murray holds a juvenile leervis before it is tagged with an acoustic transmitter at the Kowie Estuary. Its movements will be monitored by an array of receivers moored in the estuary.

Acoustic telemetry

One tool that has become extremely popular and has proven successful in studying the movement behaviour of fish is acoustic telemetry. 'Acoustic' relates to sound and 'telemetry' is the remote transfer of information from a transmitting to a receiving device, which in this case is via the transmission of sound waves. The acoustic transmitters, or tags, are surgically implanted inside the fish, while the acoustic receivers, or listening stations, are moored at fixed locations in the sea or in estuaries. Each tag has a unique identification code, and a battery life of up to 10 years. Once deployed inside a fish, the tag continuously gives off signals, which are picked up and recorded when the fish swims past an acoustic receiver. Along with the unique identification code of the fish, date and time are also recorded, so this allows researchers to track the movements of tagged fish as they swim around within a network of receivers. Amazing!

White steenbras and leervis

The research that I am currently conducting at the South African Institute for Aquatic Biodiversity (SAIAB), under the supervision of Prof. Paul Cowley, Dr Taryn Murray and Mr Matt Parkinson, aims to investigate the longshore movement patterns of two important coastal fishery species – white steenbras and leervis.

Why study these two species? Overexploitation combined with ineffective traditional management measures, such as size and bag limits, have resulted in the collapse of stocks of both species; it is thought that only 5% of spawning adult white steenbras and only 14% of spawning adult leervis remain. In addition, they have similar life histories in that the juveniles of both species are dependent on estuaries. While considerable past research has focused on the movements of juveniles of both species in estuaries using acoustic telemetry, and large-scale movements of adults have been studied using dart tagging, detailed tracking of their coastal movements using acoustic telemetry is yet to be explored.

Paul Cowley

An acoustic transmitter is surgically implanted into a juvenile white steenbras.

With this in mind, our study aims to determine where the adults of these two species are throughout the year, whether they undertake annual spawning migrations and if all the adults migrate each year, and how important estuaries are for the adults of both species.

To answer these questions, data from 34 white steenbras and 79 leervis, which were tagged with long-life acoustic transmitters between July 2010 and February 2018, will be used. To date, more than 112 000 detections of white steenbras and more than 740 000 detections of leervis have been recorded on acoustic receivers in the ATAP. This means that there is a lot of work to do and a lot of data to analyse, but we cannot wait to learn more about what these animals have been getting up to!

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Rebecca Mxo with instrument technician Matt Parkinson after a receiver retrieval.