# DEEP-SEA DRUMMING

*Dave Japp and Kerry Sink explain whether something fishy is going on*

On the edge of the continental shelf at the south-eastern tip of Africa, a rocky ridge rises from the ocean floor in the murky depths some 750 m beneath the surface. Beyond this submarine feature, which is no more than 500 m wide, 300 m high and 40 km long, the shelf falls away steeply and the warm Agulhas Current rushes past. On the landward side, the ridge forms a natural amphitheatre, and here the kingklip take 'centre stage', their calls booming out across the seascape.

**Dave Japp with a kingklip caught during the longline experiment in the 1980s.**

This is how we imagine the 'Kingklip Kingdom', which lies more than 30 nautical miles off the coast between Port Elizabeth and Cape St Francis.

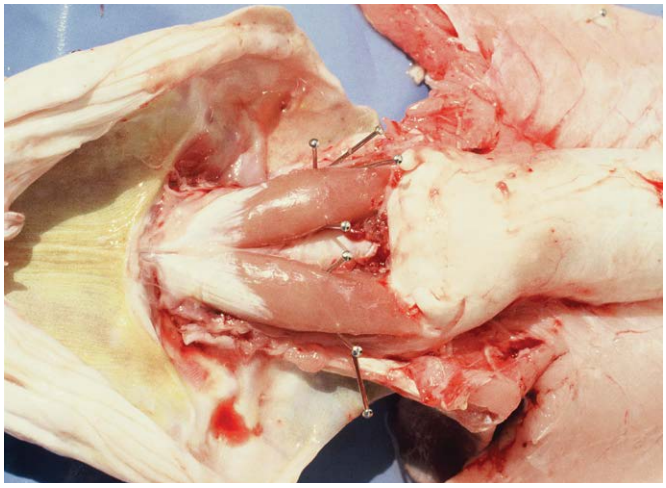
Kingklip, or 'king of the rocks', were caught even before trawling began in South Africa's seas in the early 1900s, and they remain one of our most valuable seafoods. They are part of a large group of bony fish known as cusk-eels or Ophidiiformes, a name derived from the Greek word for 'snake' – *ophis* – because of their eel-like appearance. Although rather ugly, slimy fish, they are among the most delicious to eat, providing a tasty and firm white fillet on the plate.

The genus *Genypterus* is only found in the southern hemisphere and the species known as kingklip, *Genypterus capensis*, occurs only in the waters off southern Africa, its range extending from Namibia, around our three Cape provinces, into KwaZulu-Natal and possibly even southern Mozambique. Adult fish can reach a length of 1.5 m during their approximately 40-year lifespan, and they are ferocious predators, active mostly at night. Since they in any case live mainly in deep, dark bottom waters, they have physical and behavioural adaptations for finding food in the dark, including whisker-like barbels for feeling seafloor organisms, and a 'sit-and-wait' approach to ambush and stalk passing prey. The most interesting part of their biology, though, is that they are underwater acoustic champions, and this is how they probably find one another for something akin to an orgy at particular times of year.

## Kingklip sound production

Sound is used by many fish species as a means of communication, whether to signal to competitors, scare intruders away from eggs or young, send alarm calls or attract mates. Different mechanisms of sound production are used, but most either involve the swim bladder or stridulation – the rubbing together of teeth or bones, such as the spines in the pectoral fins.

In kingklip, sounds are produced using sonic muscles located on or near the swim bladder, in a mechanism



**A dissection of a male kingklip showing the large sonic muscles.**

known as drumming. Both males and females have tough swim bladders – so tough in fact that they are only possible to cut with strong, well-sharpened blades. Both sexes have sonic muscles too, but they are significantly larger in males than in females, particularly at peak spawning time from July through to September.

The sonic muscles attach directly to the swim bladder and insert firmly on the vertebrae with ligaments at a position directly adjacent to a large pair of otoliths, the fish ear bones that are essential for hearing. The muscles, swim bladder, otoliths and bone attachments (rocker arms) form a sophisticated and complex acoustic structure used for both the production and reception of drumming sounds. Tank-based studies of similar ophid species have shown that the males and females may produce sounds of different frequencies. In the kingklip's natural environment, where visual cues are not likely except at close range, this would clearly be an advantage in finding a mate.

Some other fish species also engage in drumming, and have similar seasonal and spatial patterns of sound production. Identifying such patterns can provide useful information for managing certain fish stocks or the different habitat types they occupy. What makes kingklip particularly interesting is that we have been exploiting them for over a century, but remained largely oblivious to the importance of the biological and behavioural mechanisms they evolved over millions of years, and the significance this might have for their management as a commercial fishery.

## The kingklip fishery

Kingklip are caught in the bottom-trawl fishery, which primarily targets Cape hake. Early studies on kingklip focused on basic stock dynamics of the species such as trawl catch rates, age and growth, and reproductive biology. That changed in the 1980s, when an experimental fishery was conducted over six years using a completely different fishing method – bottom longlines. This entailed setting lines on the seafloor, each containing up to 15 000 hooks spaced at 1.5 m intervals. Initially intended for hake, fishers soon found that the longlines were perfect for catching kingklip.

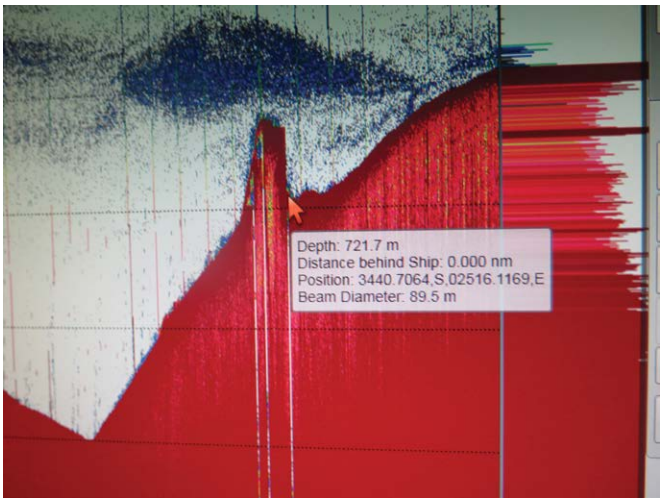
In such 'offshore' fisheries, little is often known about the life histories of the many different fish species that occur in deep waters. When exploiting these deep-sea species, a cautious approach should be followed, at least until sea-based studies can be done to assess the impacts of the new fishery. The 'kingklip experiment' therefore focused on getting the information needed to determine the potential of establishing a sustainable longline fishery for kingklip. Managers controlled how many boats could fish, and for the duration of the experiment kingklip were more intensively sampled than ever before. While kingklip were caught around the entire coast from Namibia and southwards towards Port Elizabeth, the fishery very quickly focused where catches were highest – on the eastern side of the Agulhas Bank in an area that has since been called the 'Kingklip Box'. In this area, the longline skippers discovered large seasonal aggregations of kingklip.

Speaking to the 'old salts' of the trawl fishery is enlightening too, though, because many skippers knew of the ridge and amphitheatre we call the Kingklip Kingdom, but which they called the Chalk Line Grounds. They knew that kingklip could be caught there in large numbers at certain times of the year. It was said that if they 'hit the gold pot', up to 40 tonnes of kingklip could be caught in a single trawl. Likewise, skippers participating in the longline experiment knew that if they set their lines in one particular depth and area, it was possible to catch a kingklip on every hook.

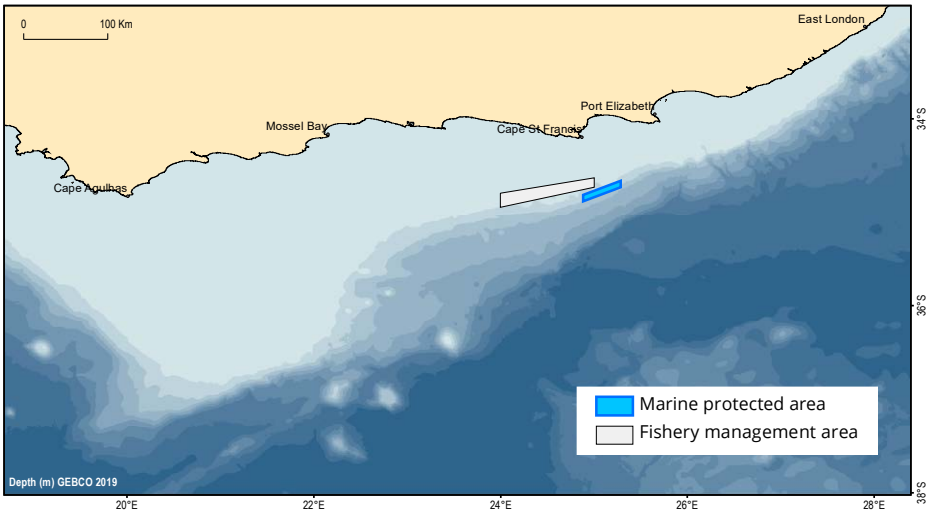
By the end of the 1980s, this intensive fishing caused a sharp decline in kingklip catch rates, so the experimental fishery was stopped and precautionary catch limits were introduced for the trawl fishery to rebuild the kingklip stocks. In an effort to protect spawning aggregations, a seasonal closure of the Kingklip Box was implemented, representing South Africa's first offshore fishery management area (FMA). Today, kingklip continue to be caught as bycatch in a small longline fishery for hake and in the much larger hake trawl fishery, and kingklip catches are back to where they were before the experimental longline fishery began, at around 4 000 tonnes per year.

## Protecting the Kingklip Kingdom

The importance of the Kingklip Kingdom from a biodiversity perspective was first recognised in 2016, when sonar




**A single-beam echosounder image showing a cross section of the ridge and amphitheatre where kingklip aggregate to spawn on the continental shelf off Port Elizabeth. The image depicts a 'cloud' of plankton and fish (blue) above this bathymetric feature on the seabed (red).**




**The Port Elizabeth Corals MPA protecting the 'Kingklip Kingdom' lies close to the 'Kingklip Box' FMA that is closed to fishing during the spawning season.**

mapping of the area was conducted during the search for deepwater ecosystems warranting protection, including habitats, species and ecological processes. After the ridge and a series of underwater hills were detected on echosounder images, a towed camera was deployed for a closer look. This revealed that the ridge is covered in deepwater corals, including calcareous stony coral species that build complex three-dimensional reefs much like shallow-water coral reefs in tropical and subtropical waters.

A 270 km$^2$ marine protected area (MPA) was proclaimed in 2019 to protect part of the ridge, and encompasses depths ranging from 300 m to 1 000 m. The area is also recognised as an ecologically and biologically significant area (EBSA) because of its importance in the life history of a wide variety of marine species, including kingklip. The MPA protects the seabed and the reef structure of the deep corals, which provide habitat for plants and animals and probably a nursery area for young kingklip and other juvenile fish, as they offer hiding places and suitable food sources. The MPA also excludes activities like seismic surveys for oil and gas exploration and habitat-damaging fishing practices that could not only disrupt the calls and aggregations of kingklip gathering to spawn, but might also result in their injury or death.

While sensitivity of marine mammals to noise is fairly well understood by scientists, the same cannot be said of fish. Their responses to sound is a growing area of research, but there have been clues in the past that kingklip could be negatively affected by the pressure waves associated with noise-related impacts. For example, an earthquake in the early 1900s on the south coast apparently resulted in many kingklip washing up on beaches, presumably due to seismic waves in the seabed causing injury or sudden changes to their surroundings. And crew working on the support vessels for oil and gas rigs on the Agulhas Bank report that 'stunned' kingklip often rise to the surface when activities with a high-acoustic signal are undertaken – no doubt providing fresh fish fillet for their dinner!

## Kingklip future

Fishery science has evolved into the realm of computer modelling, much of it beyond the skills of traditional fishery managers, who in the past relied largely on a combination of biological knowledge and experience related to the historical performance of the fishery. Management decisions were often made without fully understanding the general ecological and biological impacts of the fishery. Fishing gear has been used over centuries (bottom-trawling dates back to about 1350 in England, for example) with little regard for the habitat it may be damaging. Managers did not comprehend the implications this might have on fish stocks, such as disturbing the vulnerable life history stages, let alone other components of the ecosystem. Increasing noise in the oceans is adding another dimension to the cumulative effects on our marine resources. The impact this may be having on natural biological characteristics of many fish species, as well as the habitats they occupy, should not be underestimated.

The global adoption of the Ecosystem Approach to Fisheries (EAF) has in recent years been promoted as an alternative solution to the sustainable management of fisheries. This EAF approach in fact underpins the current management of South Africa's most valuable fishery – hake trawl – through certification by the Marine Stewardship Council (MSC). While the MSC indirectly supports the management of kingklip as a bycatch, there remain many unanswered questions about the long-term sustainability of the kingklip stocks in our waters.

The story behind the kingklip resource is just one example of our need to change our approach to fisheries management to better account for habitat and life history, in addition to monitoring stocks and catches.

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*Kerry Sink is a scientist who leads the marine programme at the South African National Biodiversity Institute (SANBI), and is a professor at Nelson Mandela University. Her research conducted as part of the NRF-funded African Coelacanth Ecosystem Programme's Deep Secrets and Deep Forest projects revealed the Kingklip Kingdom and led to its protection within the Port Elizabeth Corals MPA.*