New technology helps scientists shed light on fish movement in estuaries

Scientists from the South African Institute for Aquatic Biodiversity (SAIAB) are employing the latest available technology to study the behaviour of fish in the Bushmans River Estuary, in the Eastern Cape. Lani van Vuuren reports.

Often dubbed the 'nurseries' of the aquatic environment, estuaries hold a special place in the ecosystem. While they are among the most productive habitats found in nature, they are also among the most threatened, and it is often the ignorance of the complex dynamics of these systems that lead to their mismanagement.

One way of improving our knowledge about estuaries is to study the movement of the fish within them, and this is exactly what SAIAB post-doctoral researcher Dr Alistair Becker is doing along with his colleagues at the Bushmans River Estuary. He notes the two main questions he hopes to gain insight on through this project: "Firstly, I want to know how artificial light (that which is emitted from brightly lit marinas, bridges, wharfts etc) impact on fish at night. Secondly, I am interested in how tides can influence the movements of large fish within estuaries. There is some evidence that fish will often migrate upstream with the incoming tide, then move back downstream on the outgoing tide, yet it is very difficult to actually quantify this behaviour."

The study of fish movements and behaviour within estuaries and coastal areas is still relatively new. The Bushmans River Estuary is an interesting system in that it is permanently open. "This estuary is the ideal system to test both questions as it is a tidal system with relatively high velocity currents, driven by tides," explains Dr Becker. "There is also a restaurant on the estuary with a floodlight which illuminates the water around the structure in a similar way to wharfs and marinas. We arranged to have this light switched on some nights, and off on others. This allowed us to address both questions simultaneously with simple experiments."

What makes SAIAB's research here so unusual is the technology being used – a Dual Frequency Identification Sonar (DIDSON) – basically an acoustic camera which acts as a very sophisticated fish finder and produces near-quality images from underwater using sound. As far as is known, SAIAB is the only institution in the country currently making use of this technology to study fish behaviour. The device used was brought over from Norway in collaboration with the Norwegian Institute for Nature Research. It was placed next to the channel in the lower reaches of the estuary.

"The DIDSON emits 96 beams of sound (up to 70 m long) through the water and form a high-resolution image from the sound that is bounced back. The sonar is capable of producing 12 images or 'frames' per second, which allows for the creation of free-flowing videos," explains Dr Becker. The images are so clear that the fins of fish can be seen. Because the technology can be used in both clear and turbid water, it offers significant advantages over conventional technologies to study

fish behaviour, such as underwater cameras or direct observations, which become impractical when it is dark or when the water is turbid – which is often the case with estuaries. The fish images are recorded continuously on a computer linked by a cable to the submerged device. The footage is the analysed manually at SAIAB headquarters using various measuring and counting techniques.

In a previous Bushmans River Estuary study which focused on the behaviour of fish in seagrass beds and how changing water levels influence their abundance, SAIAB scientists made use of regular underwater cameras. "Due to the turbidity this study was restricted to areas near the mouth where the water is clear," notes Dr Becker. The DIDSON was first tested last year on a project in the East Kleinemonde Estuary where scientists studied the movement of fish into very shallow littoral habitats at night time. They also looked at the distribution of small and large fish along the estuary.

The biggest surprise to date has been the observation of massive numbers of baitfish, which appear to move out from the shallow edges of the estuary into the deeper main channel during the slack tide period.

The project has not been without its challenges though. Since the Norwegian scientists were only in South Africa for 12 days, this meant very little time for fieldwork, and careful planning was necessary to avoid wasting valuable time spent in the estuary. As a result of the pre-planning, the team managed to collect a massive 260 hours of footage – more than enough to test their hypotheses. "The biggest problem turned out to be supplying the DIDSON with continuous power," says Dr Becker. "Without power the sonar will obviously not work. During our fieldwork period we had two electrical storms, which knocked out the mains power for hours, forcing us to use backup batteries and, once they ran out, to run a generator."

Despite the challenges experienced, the use of the technology in the Bushmans River Estuary is paying off, according to Dr Becker. "Browsing through the footage we collected shows huge numbers of fish swimming around at night time. These range in size from less than 10 cm to large individuals well over a metre long. This footage will certainly allow us to address the questions we have regarding estuarine fish, which simply could not have been answered using any other methods. We are only just beginning to see how useful this technology can be. It is simply a matter of combining an understanding of the capabilities of the DIDSON with novel questions and experiments."

While the footage is still being analysed some interesting patterns are already emerging. It appears that there are many more fish present at night when the floodlight was on, compared to nights when it was turned off. "This is what we anticipated, although we have been surprised at the numbers of fish milling around when the light was on," notes Dr Becker.

The biggest surprise to date, however, has been the observation of massive numbers of baitfish, which appear to move out from the shallow edges of the estuary into the deeper main channel during the slack tide period. "At first we thought we may have been looking at seagrass obscuring the view of the sonar, until we realised it was a mass of fish. It appears to be a common pattern and certainly something neither myself nor the other scientists ever thought to occur."

Dr Becker believes that this research will make an important contribution to our understanding of estuarine fish. "The light experiment will show how artificial lighting can impact on fish behaviour using a simple experimental approach, and I expect it will act as a stepping stone to more comprehensive studies. In turn, the tidal study will provide us with information regarding the movements of fish with tides, which will complement other detailed tagging and monitoring studies which focus on particular species. The end result will be a greater understanding of the ecology of estuarine fish that can be fed directly into the management of fish as well as developments which may impact on estuarine habitats." ❑

All photographs courtesy Alistair Becker

Below: *The Dual Frequency Identification Sonar or DIDSON was used for the first time in South Africa to track fish movement in the Kleinemonde Estuary.*
Below middle: *The DIDSON can provide a 'clear' picture of fish movement even in turbid water. It acts as a very sophisticated fish finder and produces near-quality images from underwater using sound.*
Bottom: *The Bushmans River Estuary.*