

Taking a 3D look at sharks to assess the impact of berleying

Scientists are using real-time three dimensional (3D) acoustic tracking technologies to model the swimming behaviour of tagged white sharks in the Neptune Islands, South Australia. The use of berleying (a combination of minced fish and blood) by the cage dive industry to attract sharks for tourists occurs up to 300 days/year in this region yet little is known about its effects on sharks. Tracking the fine-scale movements of sharks during berleying and non-berleying periods will provide information that is vital for the sustainable management of the cage-diving ecotourism activities in this region.

Sharks as apex predators play an integral role in maintaining a balanced ecosystem. Their long life span, slow growth, late maturity and low reproductive potential have led to concerns regarding their population status. Internationally they are listed as 'vulnerable' and while fully protected in Australian waters they are still potentially threatened by a range of anthropogenic activities, such as ecotourism and cage-diving operations.

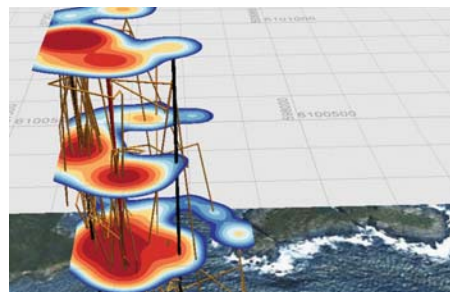
The Neptune Islands, home to the largest aggregation of pinnipeds in Australia, is an active feeding area for sharks. Tagging studies have demonstrated the significance of this location with individual sharks regularly making return visits while travelling across their Australian range. It is at these sites where white sharks are most vulnerable to interactions and interference from human activities.

In South Australia two companies currently have cage-diving licenses to operate in the North Neptune Island region with additional licenses under consideration. An increase in the number of days operators are on site, up to 300 days/year, combined with requests for additional licenses has led to a review of industry policy and the need for a better understanding of the impacts of berleying.

Current research, led by Dr Charlie Huvneers (SARDI / Flinders University), funded by the Wildlife Conservation Fund, the Nature Foundation of South Australia, the Neiser Foundation, and the WV Scott Charitable Trust is using 3D models to examine the shark's movement through the water column in the region of cage-diving operations, observing their behaviour during berleying and non-berleying periods. Sophisticated continuous acoustic tracking technology (VEMCO Radio Acoustic Positioning -

VRAP system), fitted with additional depth transmitters record time, day, depth and the sharks position triangulated within 1 metre, providing a 3D visualisation of the behaviour of 13 white sharks tagged in the region between 3 and 4.5 metres long.

Data collected, analysed using Kernel Density Estimation, demonstrated shark movements at North Neptune Island vary in response to the presence of berleying vessels, with some sharks spending 50 percent of their time within 60 metres of the boats during berleying periods compared with animals spending only 6 percent of their time in the same area during non-berleying periods, otherwise 'patrolling' the study area for natural prey.



Kernel Density Estimates with three depth intervals showing movement patterns of white sharks in the Neptune Islands, with movement concentrated around berleying boats.

Sharks were also found to partition their time between the two vessels when they were present simultaneously, suggesting that competition between boat operators and related berleying could be reduced.

Depth data identified that sharks spent more time at the surface when the boats were present further demonstrating how the presence of berleying vessels alters the natural movement of sharks.

The movement patterns revealed in this project provide the first step in increasing our understanding of shark time partitioning and the influences of berleying, underpinning sustainable management of the cage-diving ecotourism activities in this region. Further tagging will be carried out in July this year to increase the sample size and build on this knowledge.

The results from this project will be combined with a CSIRO led project looking at the broad scale movements of white sharks. These combined projects will determine whether cage diving operations impact the behaviour and residence times of white sharks in Neptune Islands.

Key Points

Little is known about the impacts of cage diving operations on white sharks.

The behaviour of white sharks in the Neptune Islands during berleying and non-berleying periods is being assessed.

Three-dimensional models reveal shark movements varying in response to berleying.

Some sharks spent more time at the surface in the vicinity of the boats, as well as partitioning their time between boats.

Further tagging studies will be carried out in July this year.

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