

Killer whales drive white sharks away: A shifting predator seascape

Text by Alison Kock & Alison Towner

The presence of apex predators profoundly affects land and ocean ecosystem structure and function. While losing top predators can disrupt ecosystems and trigger trophic cascades, the introduction of novel apex predators remains poorly understood. In our study, we documented the emigration of white sharks at a prominent white shark aggregation site in South Africa in response to novel predation pressure by killer whales. We also studied the impact of this predation risk on predator-prey dynamics. Highly unusual events occurred between February and June 2017 in Gansbaai.

This study showed profound differences from traditional white shark behaviour at Gansbaai. Typically, the sharks would stay at this site year-round, but the presence of the killer whales triggered an immediate flight response and prolonged absence in the area. The absence of white sharks, in turn, created a void that another predator, the bronze whaler shark, filled.

In our first study, we relied on examining shark carcasses to confirm killer whales as the predators, with no direct observations of this predatory behaviour. Shortly

EVIDENCE SUGGESTS THAT KILLER WHALES ARE DISPLACING WHITE SHARKS FROM THEIR TRADITIONAL AGGREGATION SITES IN THE WESTERN CAPE

Five white shark carcasses were discovered on beaches, with distinct wounds and missing livers. Through careful investigation, we identified the likely culprits behind these occurrences. The mysterious shark deaths were due to two killer whales, specifically two known shark-hunting specialists, Port and Starboard. Their presence in the area coincided each time with the appearance of the deceased sharks, providing clear evidence of their involvement.

Through careful analysis of sightings per unit effort and telemetry data, we discovered that white sharks left Gansbaai in response to the predations and presence of killer whales. Tagging data provided more compelling evidence, showing that some sharks ventured far away from their usual habitat in response to a predation event. Overall, white shark sightings at the aggregation site significantly declined, and the absence of white sharks increased after each predation event, eventually resulting in complete abandonment of the site for 2.5 years.

after, extraordinary videos by a hobbyist drone and a helicopter pilot provided undeniable evidence of killer whale predation on white sharks off the coast of Mossel Bay. The drone and helicopter footage revealed unique behaviour employed by the killer whales during the predation event. One killer whale held a white shark in a semi-inverted position, potentially inducing a motionless state known as tonic immobility. The killer whales appeared to use a specialised foraging tactic, focusing on the energy-rich liver of the sharks while leaving the rest of the carcass behind.

The study also gave new insights into sharks' attempts to evade capture by killer whales. On two occasions, killer whales approached sharks closely and slowly. Instead of fleeing as one might expect, the shark stayed close to the killer whale, circling it and keeping it in view – a common strategy that seals and turtles use to evade sharks. However, killer whales are social and hunt in groups, and we believe the circling strategy is ineffective for white sharks when two or more killer whales are



Series of images taken off Hartenbos Beach, Mossel Bay, South Africa. Panel 1: screen grabs from the video filmed from a drone by Christiaan Stopforth showing the first confirmed observation of a group of killer whales killing a white shark. Inset in (d) shows killer whale 1, an animal with a bent dorsal fin known as "Starboard," one of the pair of killer whales previously implicated in shark predations in South Africa, which was part of the group. Panel 2: A series of photographs taken on a mobile phone from a helicopter (D. Archer, Mossel Bay Helicopters) showing the potential consumption of a free-floating shark liver. Panel 3: Screen grabs from a video taken on a mobile phone showing the circling behaviour of a white shark avoiding a killer whale while a second killer whale approaches.

present, as the shark cannot keep more than one killer whale in view at a time, enabling a second killer whale to ambush the shark.

Following the predation events, there was a significant change in the behaviour of white sharks in Mossel Bay, as we had documented in Gansbaai. Observations by beachgoers, drone flight data, and encounters by commercial white shark cage diving operators indicated that white sharks fled the area and remained absent for several weeks (Fig. 1, next page). This response suggests that the fear induced by killer whale predation can profoundly impact white shark populations.

The implications of killer whale predation on white sharks are far-reaching. The South African white shark population, already small and facing numerous human-induced threats, experienced further displacement from their natural aggregation sites due to the presence of the shark-hunting killer whales. The consequences extended beyond ecological impacts. The tourism and filming industries, heavily reliant on the presence of white sharks, suffered severe financial losses as the smaller shark species took over the once-popular aggregation sites. Fortunately, these industries have adapted to the changes and have started marketing diving with these smaller species of sharks with some success.

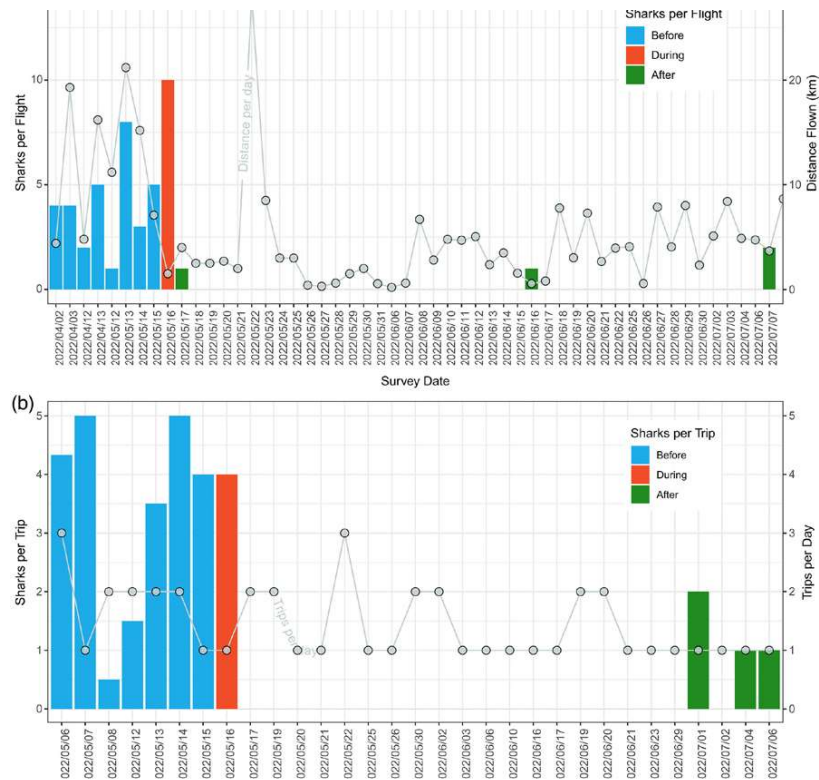


Figure 1. Bars show the number of white sharks observed per drone flight (a) and commercial cage diving trip (b) in Hartenbos, Mossel Bay area, before, during, and after a predation event where two killer whales attacked and killed a great white shark. The line shows the total flight distance per day for drone flights from pilot logbooks (a) and the number of trips per day (b).

These findings demonstrate how the fear induced by top predators can lead to significant changes in predator behaviour and subsequent ecological shifts. The consequences extended beyond ecological impacts. The tourism and filming industries, heavily reliant on the presence of white sharks, suffered severe financial losses as the smaller shark species took over the once-popular aggregation sites. Fortunately, these industries have adapted to the changes and have started marketing diving with these smaller species of sharks with some success.

Killer whales displacing white sharks raises challenging questions regarding the management of these apex predators. Traditional solutions for terrestrial predators, like translocation, fences or removal of damage-causing animals, do not apply to endangered, intelligent, and wide-ranging marine species. Perhaps the only feasible option is to continue researching the drivers behind this novel behaviour, assess its potential transmission within the killer whale population, and quantify the overall impacts on white sharks, killer whales, the ecosystem, and the livelihoods dependent on them.

Towner AV, Watson RG, **Kock AA**, Papastamatiou Y, Sturup M, Gennari E, Baker K, Booth T, Dicken M, Chivell W & Elwen SH. 2022. Fear at the top: killer whale predation drives white shark absence at South Africa's largest aggregation site. *African Journal of Marine Science*, 44(2), 139-152. <https://www.tandfonline.com/doi/abs/10.2989/1814232X.2022.2066723>

Towner AV, **Kock AA**, Stopforth C, Hurwitz D, & Elwen SH. 2022. Direct observation of killer whales preying on white sharks and evidence of a flight response. *Ecology* 27:e3875 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10078210/>

A trip of a lifetime to Antarctic Sea ice

Text by Yonela Mahamba
Photos by Kurt Martin, Lisa Kumadiro, Susanne Fietz & Sandra Maluleke

ABOARD A RESEARCH VESSEL VISITING ANTARCTIC SEA ICE. "NO TRIP IN THE FUTURE WOULD EVER COMPARE"

I was thrilled to learn that I was among ten applicants selected as SAPRI (South African Polar Research Institute) trainees to participate in the SCALE (Southern Ocean seAsonal Experiment) winter research cruise in 2022. The opportunity for SAPRI trainees was made available by the South African Environmental Observation Network (SAEON), funded by the Department of Science and Innovation (DSI) for early-career scientists who had no exposure to polar research. For me, a trip to Antarctica would only ever be possible through an expedition of this kind. And I must admit, I was anxious, and the expectations I had built for this trip were high.

I have been to sea many times, and I joined an expedition on board SA Agulhas II before. Yet, this opportunity was different in that it was going to Antarctic waters, and the Antarctic region is both utterly unique and rarely visited. I was particularly excited to get to the sea ice and explore one of the most isolated and remote regions on earth, though aware that no trip in the future would ever compare.

The morning that we embarked on the SA Agulhas II research vessel it dawned on me that we would not see any shores on this trip - we would mostly be in the deep embrace of the Southern Ocean and not within view of land. The voyage was from Cape Town to Cape Town!

The first night aboard ship, I struggled to sleep due to the rough seas and bad weather. Sea sickness followed soon after; I woke up feeling nauseous and sweating and could not eat the whole day. I must admit, my mentor had advised me to take motion sickness medication a day before departure, which I did not do. Luckily, the doctor on board gave me



SAPRI trainees with DFFE team during top predator observations, back row left to right: Matthew Germishuisen, Thamsanqa Wanda, Estefan Pieterse, Makhudu Masotla, Oduka Ogugua. Middle row left to right: Lefa Morake, Mpumalanga Mnyekemfu, Sandra Maluleke, Yonela Mahamba. Front row: Jennifer Whittingham and Annah Mthombeni.



SAPRI trainees with the chief scientist (third from left, Marcello Vichii) during sea ice coring.