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Evaluating the effectiveness of large-scale marine reserves on wide-ranging sharks

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INFORMATION PAPER

TITLE: Evaluating the effectiveness of large-scale marine reserves on wide-ranging sharks

THEME: Ecosystem and Bycatch

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INTRODUCTION:

Commercial fisheries threaten many species of pelagic sharks. Marine sanctuaries/zones that provide refuge from commercial fishing have potential for conserving coastal sharks. Pelagic sharks, however, perform long-distance migrations making it difficult to assess efficacy of sanctuaries/zones since individuals are likely to move between multiple jurisdictions. The Cook Islands established a 2,000,000 km^2 "shark sanctuary" by regulation under the Marine Resources Act in 2012. Six EEZ-wide shark sanctuaries exist in the Western and Central Pacific Ocean (WCPO); however, it is unknown whether large spatial closures protect wide-ranging sharks.

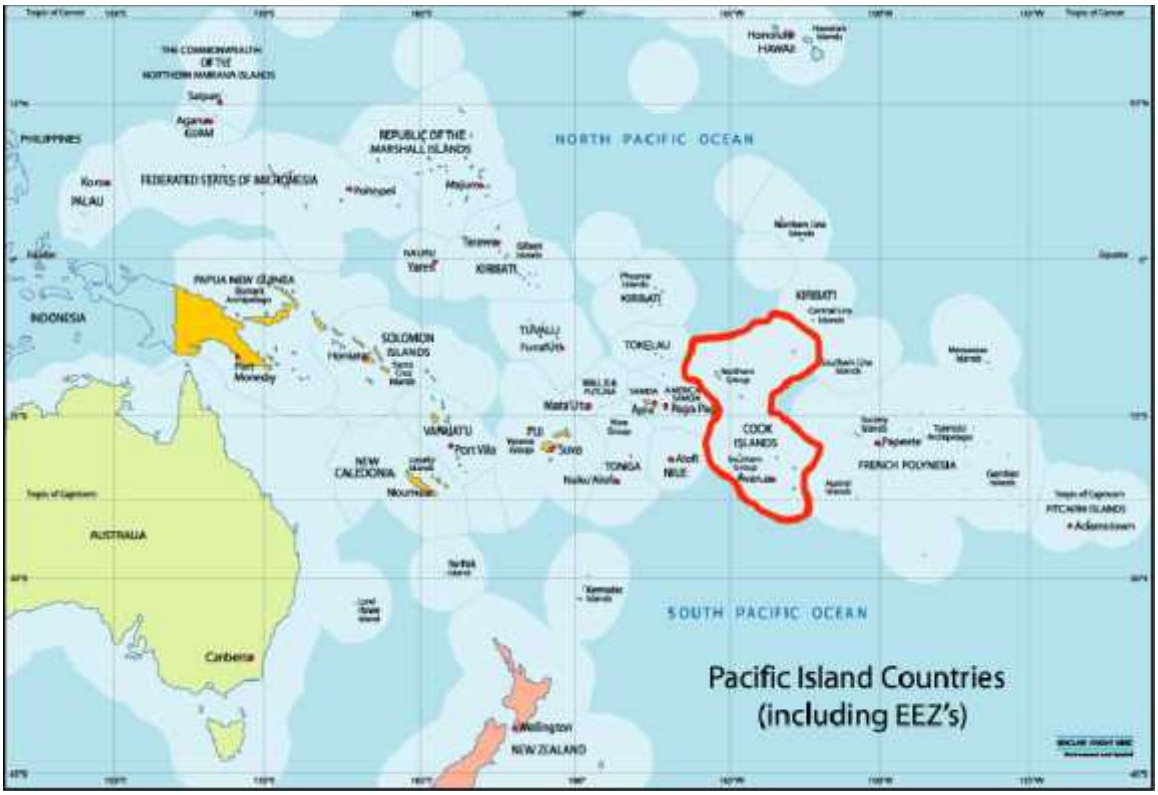
PURPOSE:

The proposed research will evaluate the effectiveness of large-scale marine reserves (shark sanctuaries), and the ability of spatial management, to reduce mortality of pelagic sharks by undertaking a biophysical and socio-economic assessment of two key shark species of the WCPO—Oceanic Whitetip (*Carcharhinus longimanus)* and Silky (*Carcharhinus falciformis*). Individual sharks will be tracked to define their extent of movement relative to sanctuary zone size and location.

Research is proposed within the EEZ of the Cook Islands (Figure 1) and is supported by Cook Islands Research Permit #06/16. Methods include shark capture (hook and line), handling (>120 cm sharks remain in water) and tagging (identification, acoustic and satellite tags) from recreational and commercial (longline) vessels, as well as genetic samples (fin clip) from captured animals. The researchers are listed as co-investigators on James Cook University Animal Ethics Permit #A2310. Retention of the proposed study species is banned within the WCPO under CMM2011-04 (Oceanic whitetip) and CMM2013-08 (Silky) and per paragraph 2 on both CMMs all vessels are required "*to release any oceanic whitetip [or silky] shark that is caught as soon as possible after the shark is brought alongside the vessel, and to do so in a manner that results in as little harm to the shark as possible*." In addition, per paragraph 5 "*observers shall be allowed*

to collect biological samples from [sharks] that are dead on haulback in the WCPO, provided that the samples are part of a research project approved by the Scientific Committee." This study seeks approval by the Scientific Committee to undertake the proposed research in the WCPO. Sharks will be held briefly for sampling and tag attachment. All individuals will be released at their point of capture as soon as practicable and in the best condition possible to ensure survival and maximum data collection. Specific methodologies to be used during the project are outlined below. Methods are in accordance with the Conservation and Management Measures associated with the target species and follow globally accepted best practice.

Figure 1: Map of study areas: Cook Islands EEZ



(Map courtesy of Secretariat of Pacific Community, 2016)

METHODS:

Sharks will be captured using standard hook and line techniques used by commercial and/or recreational fishers. Once captured, sharks will be secured to the side of the research vessel or brought onto the research vessel. Captured individuals will be measured, sexed, tagged (fin), a small fin clip taken for genetic analysis and the hook will be removed. The entire process will take < 5 minutes. Two types of identification tags will be used – fin tags and dart tags. A subset of animals will also be fitted for telemetry studies. A maximum of 20 silky and 20 oceanic whitetip sharks will be fitted with

satellite tags. Only animals alive and in good condition[1] will be fitted for telemetry studies:

Pop-up archival transmitting tags (PAT) are designed to be attached externally to a large shark or fish to study their movements using light based geolocating techniques. The tags (c. 15 cm long and maximum diameter is 3 cm) store data and at a pre-programmed time detach from the animal, float to the surface and transmit data via the ARGOS satellite system. . Individuals >1.4 m in length and in Good condition†, will be retained briefly for tag application. A small cut will be made in the skin at the base of the first dorsal fin and the plastic headed dart inserted into the rays below the dorsal fin using a stainless steel tag applicator. The dart and short monofilament leader are retained by the animal after the PAT tag detaches from the animal. The tagging process takes less than 30 seconds and the animal can be immediately released. This is a standard technique used worldwide in the study of the movement of sharks and large fish (Hammerschlag et al 2011; Carlson et al. 2014).

Acoustic transmitters will be surgically implanted into shark species for long-term acoustic monitoring studies of movement, residence and behaviour patterns. To facilitate acoustic transmitter insertion individuals will be held in an inverted position, a small incision made in the abdominal wall and transmitter inserted. The incision will be closed using via sterile sutures and non-continuous stitches to ensure wound closure and facilitate healing. The entire procedure should take less than 10 mins (including measurement and genetic sampling). This approach is the global standard in deploying acoustic transmitters and J Cramp has been trained in these techniques by M Heupel who has over 15 years conducting surgeries for acoustic telemetry studies.

ANTICIPATED BENEFITS:
An improved understanding of the movement patterns of pelagic species relevant to current management and conservation approaches, specifically protected area zones such as sanctuaries. The intention of this work is to provide advice to improve management and conservation of these species.

References
Carlson, A. E., E. R. Hoffmayer, C. A. Tribuzio and J. A. Sulikowski (2014). The use of satellite tags to redefine movement patterns of spiny dogfish (*Squalus acanthias*) along the U.S. east coast: implications for fisheries management. PLoS ONE 9(7): e103384.

Hammerschlag, N., A. J. Gallagher and D. M. Lazarre (2011). A review of shark satellite tagging studies. Journal of Experimental Marine Biology and Ecology 398(1–2): 1-8.

[1] †Condition Codes from the observer data collection forms. AG (Sharks and Rays only) = Alive, in Good condition - Animal appears lively and healthy with no obvious signs of injury or lethargy (animal should appear active). This condition code is used when **ALL** of the following criteria are observed and met: 1) no bleeding, 2) shark swims away, 3) not sinking, 4) no external injury, 5) not hooked in the stomach or the gills. (NOAA_shark research_PIFSC USA)