

Clear water sharks – muddy coastal habitats

New research shows that coastal mangroves and mudflats can be vital to reef shark populations

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Reef sharks live on coral reefs. This is where they are seen and photographed, and reefs are usually where fishermen catch them. The normal reef shark we see in the Pacific is a sleek grey animal against a background of clear blue water and corals. However, in some places, large numbers of reef sharks can be found in muddy coastal waters, mangroves and seagrass beds (Fig. 1), but it is only recently that research has documented what they are using these habitats for.

For artisanal fishers in many Pacific Island countries and territories (PICTs), reef sharks such as the grey reef shark, the blacktip reef shark and the whitetip reef shark, may be important sources of supplementary income (Armagan and Foale 2006). In some places (e.g. Fiji, Palau and French Polynesia) sharks are important to eco-tourism and provide a sustainable, long-term source of income (Clua et al. 2011; Brunnschweiler and Barnett 2013; Vianna et al. 2012). Sharks and rays can also be very important to the traditions and culture of Pacific peoples [Chin 2005], featuring in the dances, songs, myths and customs that contribute to cultural identity. Unfortunately, however, reef sharks in the Pacific are

under increasing pressure and there are many stories about shark declines that are supported by scientific studies (Nadon et al. 2012; Heupel et al. 2009; Robbins et al. 2006). The impacts of coastal and artisanal fishing are increasingly being recognised (Clua and Planes 2015) and threaten the social, ecological and economic values and services that sharks and rays provide.

The main pressure facing reef sharks in the Pacific is fishing. However, sharks and rays can also be affected by habitat loss, as important feeding and breeding grounds are disturbed by pollution and/or coastal development. Destruction of these habitats disrupts breeding cycles



Figure 1. Blacktip reef sharks are sometimes seen aggregating in murky waters in coastal habitats such as mangroves, seagrass beds and coastal mudflats. These sharks were photographed in Cockle Bay, North Queensland. (Image: Amos Mapelston, JCU)

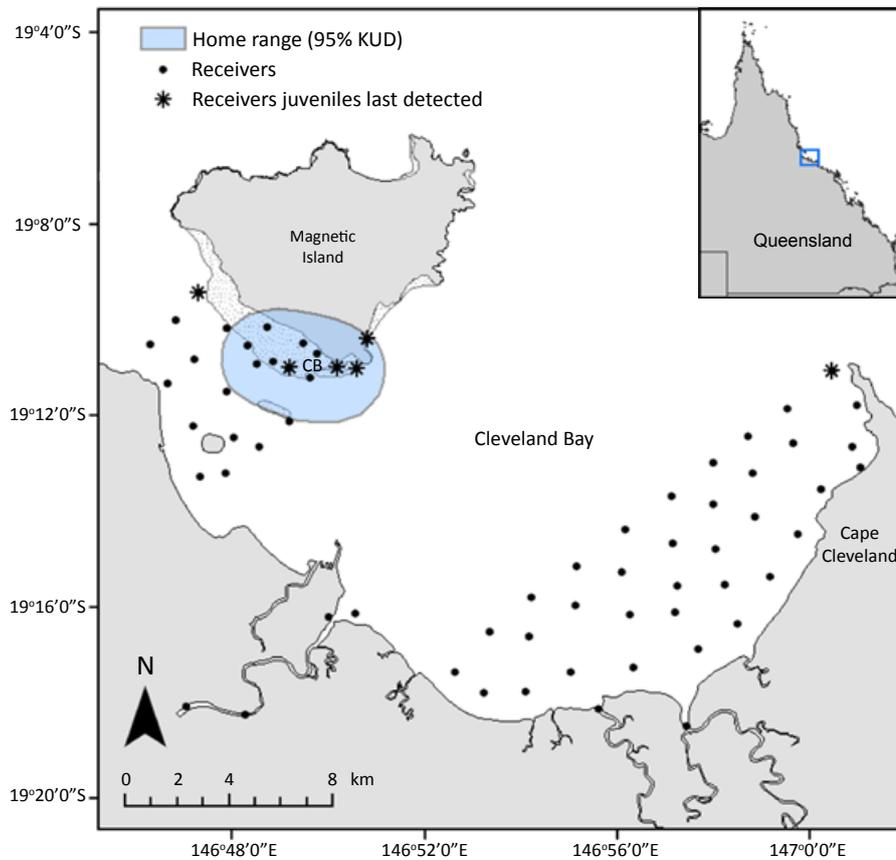


Figure 2. Map of Cleveland Bay including the nominal home range of juvenile blacktip reef sharks (A. Chin unpubl. data), the location of Vemco VR2W receivers in the eastern and western sides of the bay, and the locations of receivers where juveniles were last detected. CB = Cockle Bay.

and can reduce the number of pups entering the population. It has long been known that sharks such as bull sharks, sandbar sharks, bonnethead sharks, nurse sharks and the Atlantic lemon shark, use coastal habitats as nursery areas (Knipp et al. 2010). These coastal habitats include mangroves, mudflats, estuaries and seagrass beds, where the water may be very muddy; very different from the clear water environments of Pacific coral reefs. However, recent research on the Great Barrier Reef suggests that these muddy habitats may be crucial to reef shark survival in the Pacific as well.

Researchers from James Cook University in Queensland, Australia, have completed a three year tagging and tracking study of coastal blacktip reef sharks (*Carcharhinus melanopterus*) in Cleveland Bay, a muddy coastal bay on the Great Barrier Reef coast. Sharks were tagged with plastic fin tags and 27 blacktip reef sharks were also tagged with acoustic tags that reported their movements for up to 2½ years. As sharks swam throughout the area, their movements were recorded on Vemco VR2W receivers that were deployed throughout the bay and at other reefs and islands. The research team also worked with commercial net fishermen along the coast to record

shark catches and to tag sharks. The data from these efforts have revealed some unexpected results.

Catch data from along the coast showed that some reef sharks, such as grey reef sharks (*Carcharhinus amblyrhynchos*), whitetip reef sharks (*Triaenodon obesus*) and blacktip reef sharks, are being caught by net fishermen in inshore habitats. While the catches are small compared to those of other shark species, the data show that these reef sharks do occur around inshore reefs and shallow shorelines, where water clarity can be less than 1 m visibility (Chin et al. 2012). Of the reef sharks captured along the coast, the blacktip reef shark was the reef shark caught most often in these muddy coastal habitats (Chin et al. 2012).

Focusing on these sharks uncovered yet more surprises. Catch sampling, tagging and tracking across Cleveland Bay showed that, although the sharks had access to the whole Cleveland Bay area (Fig. 2), they mainly lived in a very small area (<2 km²) in Cockle Bay – a small bay on a coastal island (Chin et al. 2013b). While there were coral reefs nearby, the blacktip reef sharks spent most of their time on the sand and mud shorelines and in

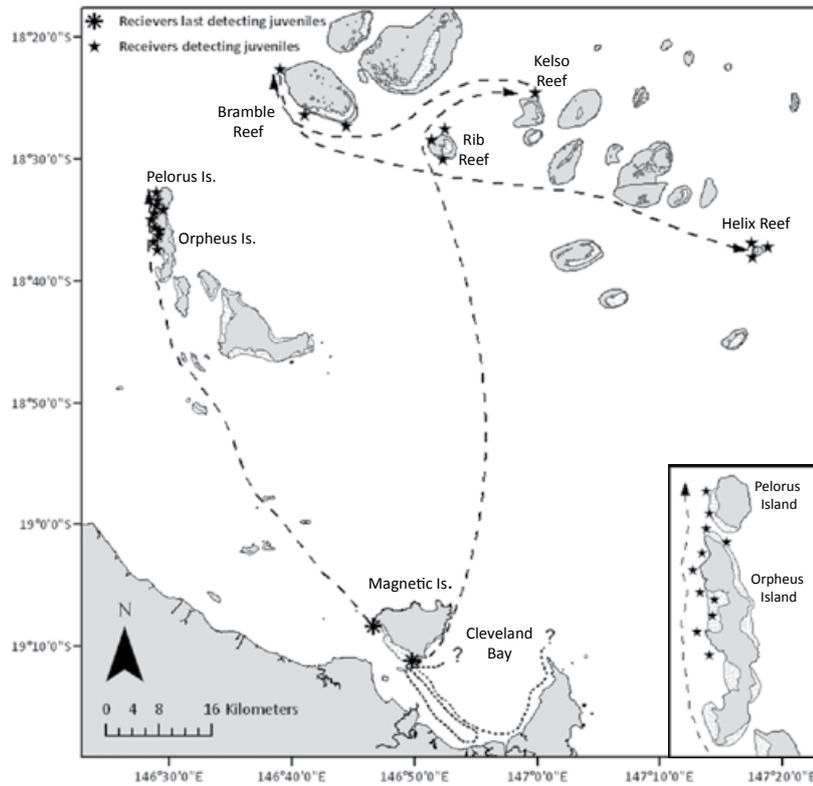


Figure 3. Movements of juvenile blacktip reef sharks that left Cleveland Bay and moved to mid-shelf coral reefs and Orpheus Island. Movements of two juveniles across Cleveland Bay followed by their departure to unknown locations are also shown. Inset map shows detail for Orpheus and Pelorus Islands.

seagrass beds. Juveniles were seen congregating in the mangroves. Surprisingly, the sharks did not use the reefs in other parts of the island, and they left Cockle Bay only on rare occasions.

The other surprise was the population structure. The normal patterns seen in coastal sharks are that adult females enter shallow coastal habitats to reproduce and, once the pups are born, the females depart, leaving the young sharks to mature in these coastal nurseries. The young can then forage without competition or predation from adult sharks, allowing them to survive and reach maturity faster. However, this new research turned this pattern upside down. In these coastal habitats, the resident population is comprised of neonates (new born sharks), juveniles, and adult females – and sharks of all three sizes shared the same small area over several years. These animals stayed in Cockle Bay all year round, even during a Category 5 cyclone that made other coastal sharks leave the bay for deeper water (Udyawer et al. 2013). In contrast, sub-adult/maturing sharks (animals between ~95 cm and 1.2 m) were never seen, and adult males were rarely present – only appearing during the breeding season and leaving shortly after (Chin et al. 2013b).

The second surprise came from an unexpected source. Researchers working on sharks and fish in other locations detected two of the juvenile sharks from Cockle Bay near other islands and at offshore coral reefs over 80 km from Cockle Bay (Fig. 3) (Chin et al. 2013a). Closer analysis of the neonates and juveniles uncovered another pattern. When the juveniles reached about 95 cm, they were detected leaving the Cockle and Cleveland Bay and never returned. These did not seem to be random movements as, once the animals broke away from their normal patterns, they very quickly left the bay.

The detection of juveniles at other locations indicated that these young sharks can cover over 80 km in two or three days. Another juvenile blacktip reef shark tagged at a different location along the coast was also caught three times at different places, providing additional data showing how young sharks can swim long distances away from their natal habitats (Chin et al. 2013a). While the pattern of fishes migrating from inshore coastal nurseries to offshore coral reefs has been shown for fish, these studies show that this process also occurs in reef sharks.

What does this mean for shark management?

These research projects highlight again how important it is to protect and manage the coastal habitats of mangroves, seagrass beds, and shallow mud and sand flats. They also demonstrate that to effectively protect reef sharks, managers may need to understand if and where breeding females are aggregating. In Pacific countries with large islands that have coastal mangroves, seagrass beds, and mud and sand flats, managing agencies and communities should recognise that these places may be vital to reef sharks, and actions to protect or rebuild reef shark populations may need to consider protecting these coastal habitats. If these breeding and nursery habitats are lost, reef shark populations in distant locations may be severely affected and cause loss of fishing and tourism income. Action is also needed to make sure that fishing is sustainable. Overfishing one coastal area could reduce the flow of young sharks replenishing another distant island or reef, which, in turn, could reduce the number of adult sharks returning to coastal areas in future years. The high concentration of sharks in very small coastal areas could also make it very easy to deplete these resources if fishing is not managed properly. Protecting the Pacific's reef sharks will need multiple approaches that include managing fishing impacts on reefs and in coastal habitats, and in protecting the key habitats that support reproduction and eventual restocking of shark populations.

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