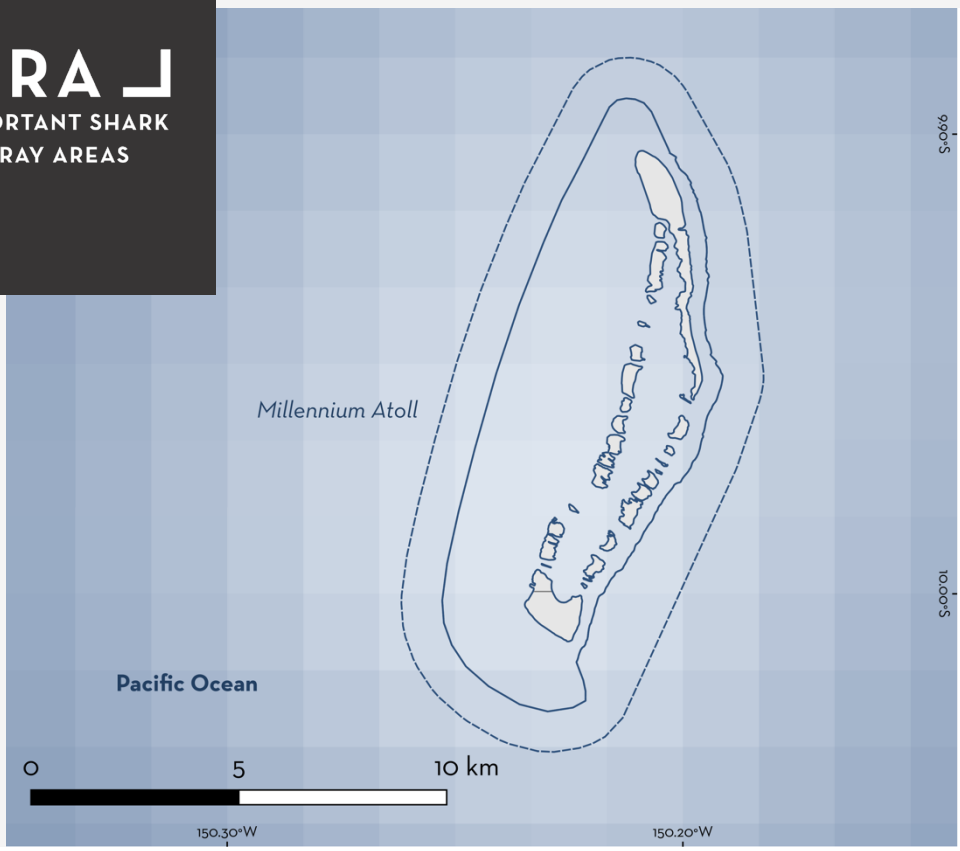
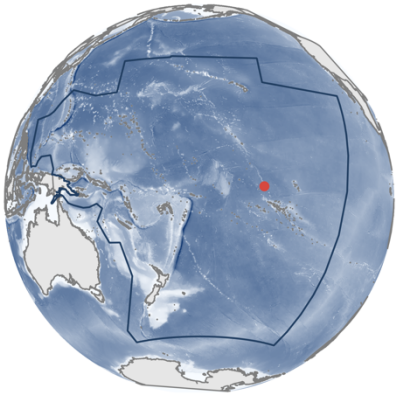
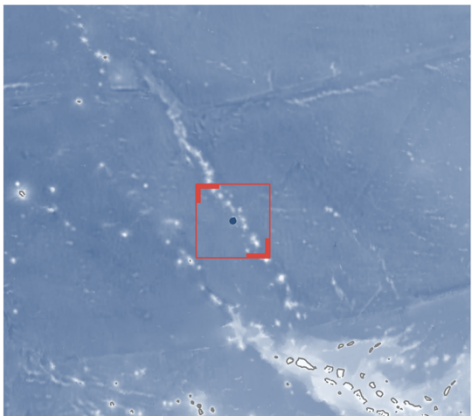
ISRA
IMPORTANT SHARK AND RAY AREAS







Blue lines indicate the area meeting the ISRA Criteria; dashed lines indicate the suggested buffer for use in the development of appropriate place-based conservation measures

MILLENNIUM ATOLL ISRA

New Zealand & Pacific Islands Region

KIRIBATI

0–70 metres

51.34 km²

SUMMARY

Millennium Atoll is located in Kiribati in the central Pacific Ocean. This area is the easternmost of several uninhabited and remote coral atolls comprising the Southern Line Islands. It is part of a seamount chain that extends for 4,800 km. The area consists of the western side of the atoll and a narrow, semi-enclosed lagoon, and is characterised by a high coral coverage. Within this area there are: **threatened species** (e.g., Blacktip Reef Shark *Carcharhinus melanopterus*) and **undefined aggregations** (e.g., Grey Reef Shark *Carcharhinus amblyrhynchos*).

CRITERIA

Criterion A – Vulnerability; Sub-criterion C5 – Undefined Aggregations

DESCRIPTION OF HABITAT

Millennium Atoll, also known as Caroline Island, is located in Kiribati in the central Pacific Ocean. It is the easternmost of the Southern Line Islands. This area is isolated, located 230 km from the closest land at Flint Island. The Southern Line Islands are composed of five islands (Flint, Vostok, Millennium, Starbuck, and Malden) that are part of a seamount chain consisting of a series of ridges and seamounts that extend 4,800 km across the central Pacific basin (Keating 1992). The seamounts rise abruptly from a sea floor >5,000 m deep. The islands are influenced by the South Equatorial Current and by easterly trade winds (Maragos et al. 2008). The Southern Line Islands reside near the transition zone between the western warm pool and the equatorial cold-tongue. Sea surface temperatures, ocean currents, precipitation, and primary productivity in the region are highly variable between years due to the El Niño Southern Oscillation (Friedlander et al. 2022).

Millennium Atoll has a slight crescent shape, consisting of 39 separate islets surrounding a narrow lagoon. The area extends ~9 km from north to south and 2 km from east to west, and the islets rise to a height of 6 m above sea level. The central lagoon is crossed repeatedly by narrow coral heads and patch reefs. Reef flats generally extend ~500 m from shore (National Geographic 2009). The lagoon is enclosed but with small, shallow passages or channels through the reef that allow water exchange with the open ocean. The depth reaches a maximum of 33.3 m in the centre of the lagoon and averages between 8.8–13.7 m in most of the pools (Barott et al. 2010). The deepest areas harbour large platforms of the stony coral *Dipsastraea matthaii* which presumably provide a base upon which the dominant corals (*Acropora* spp.) grow to form the reticulate reef structure (Barott et al. 2010).

This Important Shark and Ray Area is benthopelagic and is delineated from inshore and surface waters (0 m) to 70 m based on the depth range of Qualifying Species in the area.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Two Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species regularly occur in the area. These are the Endangered Grey Reef Shark (Simpfendorfer et al. 2020a) and the Vulnerable Blacktip Reef Shark (Simpfendorfer et al. 2020b).

SUB-CRITERION C5 – UNDEFINED AGGREGATIONS

Millennium Atoll is an important area for undefined aggregations of two shark species.

Aggregations of Grey Reef Sharks and Blacktip Reef Sharks are regularly observed in this area and have been documented by underwater visual censuses and baited remote underwater video station (BRUVS) surveys (Kerr & Wragg 2008; National Geographic 2009; Friedlander et al. 2022).

In 2008, two underwater visual censuses were undertaken at three islands in the Southern Line Islands (Malden, Flint, and Millennium Atoll). A diver recorded all shark observations, during a period of 30 minutes between depths of 8–25 m (Kerr & Wragg 2008). Of these surveyed islands, Millennium Atoll had the highest abundance of sharks, which dominated the fish community. In this area, the mean abundance was 7.5 for Grey Reef Sharks and 3.0 for Blacktip Reef Sharks.

Two further expeditions were undertaken in the Southern Line Islands (National Geographic 2009; Friedlander et al. 2022). Between March–May 2009, underwater visual censuses were conducted by

a team of paired divers at ~15 m depth at 29 sites (National Geographic 2009). During each survey, divers counted all sharks encountered along three fixed-length (25 m) corridor transects separated by ~10 m. Between 9–20 October 2021, these surveys were undertaken at 17 sites (Friedlander et al. 2022). Each site was surveyed using three transects. Sharks were also measured and the average body size was reported for each survey.

In 2009, total fish biomass ranged between 2.1–5.8 tonnes per 0.01 km^2 for the five islands assessed in the Southern Line Islands. Millennium Atoll had the second highest biomass (~ 5.5 t per 0.01 km^2). This area is among the top seven highest fish biomass ever reported globally (National Geographic 2009). Top predators, including sharks and other fish (e.g., Twinspot Snapper *Lutjanus bohar*, trevally *Caranx* ssp.), accounted for most of the biomass (~70%). The most abundant top predators were Grey Reef Sharks and Blacktip Reef Sharks (National Geographic 2009). Fish biomass was highest on the windward side of the island or near the island tips, where dominant currents form eddies and enhance water motion.

In 2021, BRUVS were deployed and the maximum number of each species in a single video frame (MaxN) was recorded (Friedlander et al. 2022). Mid-water BRUVS were deployed at 10 survey sites in the area at a depth of 10 m and ranged in distance from shore from 500 m to 5 km (Friedlander et al. 2022). BRUVS were deployed in mesophotic reefs at nine survey sites in this area at depths between 50–65 m and in habitats from plate coral reefs to rubble/sand slopes (Friedlander et al. 2022). Despite a more than six-fold decrease in shark biomass between 2009 and 2021 across the Southern Line Islands, Grey Reef Sharks and Blacktip Reef Sharks were still present in relatively high numbers compared with most other regions around the world (Friedlander et al. 2022).

The underwater visual censuses showed that the Grey Reef Shark was the first-ranked species with an average of 14.7 (SD = ±38.3) individuals per 0.01 km^2 (Pristine Seas unpubl. data 2022). In 13 surveys, 100 sharks per 0.01 km^2 were recorded, and in one survey, 200 individuals per 0.01 km^2 were recorded (Pristine Seas unpubl. data 2022). In 15 surveys, Grey Reef Sharks had an average body size that ranged between 68–158 cm total length (TL) with a mean average of 120 cm TL (Pristine Seas unpubl. data 2022). Considering the size-at-maturity (120–142 cm TL for females, 130–145 cm TL for males), and the size-at-birth (45–64 cm TL) for this species (Ebert et al. 2021), individuals in this area were young-of-the-year, juveniles, and adults. From the mid-water BRUVS surveys, it was estimated that Grey Reef Sharks had a maximum MaxN of 12 and an average of five individuals, with an average size of 117 (SD = ±11.7) cm TL and a range of 98–143 cm TL indicating most individuals were juveniles. Sites close to the northern and southern tips of Millennium Atoll with more active sea states had higher numbers of Grey Reef Sharks compared to the other areas surveyed. From the BRUVS surveys in mesophotic reefs, it was estimated that Grey Reef Sharks had a maximum MaxN of 12 and an average of four individuals (Pristine Seas unpubl. data 2022).

The underwater visual censuses revealed that the Blacktip Reef Shark was the second-ranked species with an average of 2.9 (SD = ±16.9) individuals per 0.01 km^2 (Pristine Seas unpubl. data 2022). In three surveys, 100 sharks per 0.01 km^2 were recorded (Pristine Seas unpubl. data 2022). During these underwater visual censuses, an aggregation of at least eight Blacktip Reef Sharks was recorded (Friedlander et al. 2022). The Blacktip Reef Shark aggregations in this area could be for reproductive purposes. The lagoon could be used as a nursery for the Blacktip Reef Shark (Barott et al. 2010). Numerous Blacktip Reef Sharks, many of which were estimated to be juveniles (<100 cm TL), were observed inhabiting shallow back reef habitats throughout the lagoon's perimeter (Barott et al. 2010). The body size of Blacktip Reef Sharks was visually estimated to range from 30–90 cm TL (G Wragg pers. obs. 1991). The size-at-birth for the Blacktip Reef Shark is 30–52 cm TL (Ebert et al. 2021). In addition, many of the larger (>100 cm TL) adult females on the forereef during concurrent surveys

exhibited mating scars and appeared to be pregnant (Barott et al. 2010). Further information is needed to determine the nature and function of these aggregations and determine the importance of the area for reproductive purposes.

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QUALIFYING SPECIES

Scientific Name	Common Name	IUCN Red List Category	Global Depth Range (m)	ISRA Criteria/Sub-criteria Met								
				A	B	C1	C2	C3	C4	C5	D1	D2
SHARKS												
Carcharhinus amblyrhynchos	Grey Reef Shark	EN	0–280	X						X		
Carcharhinus melanopterus	Blacktip Reef Shark	VU	0–100	X						X		

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
Carcharhinus albimarginatus	Silvertip Shark	VU
Triaenodon obesus	Whitetip Reef Shark	VU

IUCN Red List of Threatened Species Categories are available by searching species names at www.iucnredlist.org Abbreviations refer to: CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient.

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