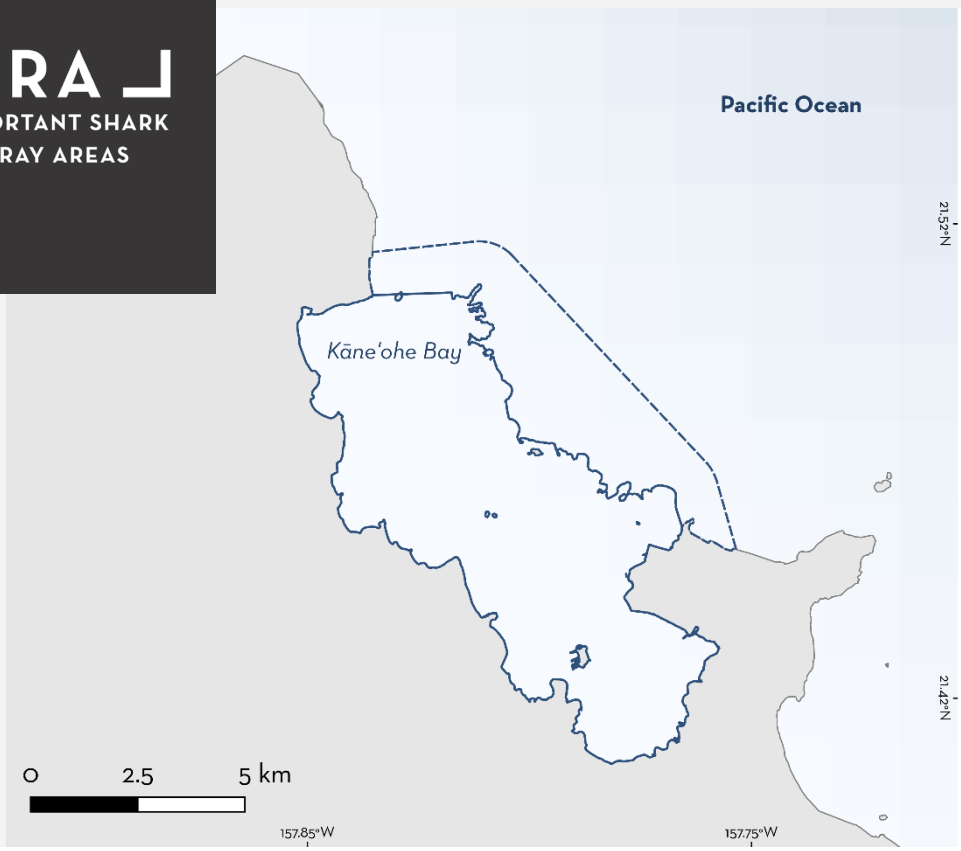
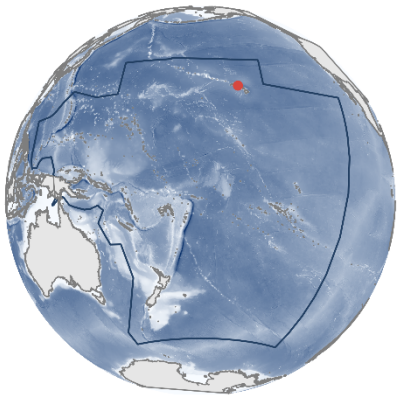
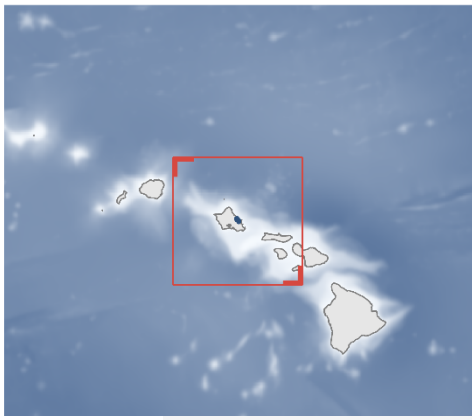
ISRA
IMPORTANT SHARK AND RAY AREAS







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

KĀNE'OHE BAY ISRA

New Zealand & Pacific Islands Region

HAWAII

0–20 metres

49.04 km²

SUMMARY

Kāne'ohe Bay is located on the east coast of O'ahu in the Hawaiian Islands of the United States of America. The area includes a small island and is characterised by its extensive barrier coral reef, mangrove forests, and seagrass beds. The area overlaps with the Hamakua Marsh Complex Ramsar site. Within this area there are: **threatened species** (e.g., Brown Stingray *Bathytoshia lata*); **reproductive areas** (e.g., Scalloped Hammerhead *Sphyrna lewini*); and **feeding areas** (Reef Manta Ray *Mobula alfredi*).

CRITERIA

Criterion A – Vulnerability; Sub-criterion C1 – Reproductive Areas; Sub-criterion C2 – Feeding Areas

DESCRIPTION OF HABITAT

Kāne'ohe Bay is located on the east coast of O'ahu in the Hawaiian Islands of the United States of America. The bay is bordered by the Ko'olau Mountain Range to the west and the Pacific Ocean to the east and includes Coconut Island, a small island in the southeast part of the bay (Bush 2003). Kāne'ohe Bay is characterised by its extensive barrier coral reef, one of only two in the Hawaiian archipelago, along with over 100 patch reefs that create diverse sheltered, shallow marine habitats (Hunter & Evans 1995). The bay's bathymetry includes shallow reef areas and deeper channels, with a maximum depth of ~20 m (Dale et al. 2011). The barrier reef runs parallel to the coastline, forming a natural breakwater that protects the bay from ocean swells, contributing to its calm waters (Hunter & Evans 1995). The patch reefs vary in size and structure, supporting both benthic and pelagic species. The bay's coastline also features mangrove forests and seagrass beds, which serve as important nursery habitats for various marine organisms (Duncan & Holland 2006).

Freshwater inputs from surrounding streams and tidal exchange with the open ocean shape Kāne'ohe Bay's oceanography (Ringuet & Mackenzie 2005; Tanaka et al 2013). The bay experiences semi-diurnal tides, which influence water circulation and nutrient cycling, supporting the bay's productivity (Tanaka et al 2013). Periodic plankton blooms, driven by nutrient inputs and upwelling, sustain rich biodiversity within the bay's waters (Ringuet & Mackenzie 2005). Mixing freshwater with the bay's saline waters creates a unique planktonic environment, supporting diverse communities of phytoplankton and zooplankton (Ringuet & Mackenzie 2005).

The area overlaps with the Kawainui and Hamakua Marsh Complex Ramsar site (RAMSAR 2024).

This Important Shark and Ray Area is benthic and pelagic and is delineated from inshore and surface waters (0 m) to 20 m based on the bathymetry of the area.

ISRA CRITERIA

CRITERION A – VULNERABILITY

Three Qualifying Species considered threatened with extinction according to the IUCN Red List of Threatened Species regularly occur in the area. These are the Critically Endangered Scalloped Hammerhead (Rigby et al. 2019); and the Vulnerable Brown Stingray (Jabado et al. 2021) and Reef Manta Ray (Marshall et al. 2022).

SUB-CRITERION C1 – REPRODUCTIVE AREAS

Kāne'ohe Bay is an important reproductive area for one shark and one ray species.

Based on the ongoing presence of neonates and young-of-the-year (YOY) Scalloped Hammerhead since the 1970s (Clarke 1971), Kāne'ohe Bay has been proposed as a nursery area for the species. Between July–October 1990, six individuals (measuring between 47.8–53.5 cm total length [TL]; converted from fork length based on Holland et al. 1993) were actively tracked (9–72 hours) and showed high residence to the area (Holland et al. 1993). Size-at-birth for this species is between 31–57 cm TL (Ebert et al. 2021), confirming that these individuals were neonates or YOY. Between 1995–1998, 779 individuals (median TL = 55.0 cm, range: 42.2–104.5 cm TL) were sampled with gillnets (2x30 m), and 136 (17.5%) had open umbilical scars (Bush 2003). Further, between 2000–2002 juvenile Scalloped Hammerhead (n = 4,120), including neonates with open umbilical scars and YOY were caught with handlines and tagged in the area (Duncan & Holland 2006). Neonate and YOY were

caught between late May and early September, with higher catch rates found in deeper parts of the bay, which had muddy and silt substrates (Duncan & Holland 2006). Presence of these life-stages is higher in the boreal summer and decreases in the winter, which seems to be related to starvation-induced mortality due to high daily food requirements (Lowe 2001, 2002; Bush & Holland 2002; Bush 2003; Duncan & Holland 2006). Based on mark-recapture models, it has been estimated that ~10,000 pups are born each spring in the area (Duncan & Holland 2006) and even if pup mortality is very high (90%), survivors stay in Kāne'ohe Bay for 1-2 years before emigrating (Duncan & Holland 2006). These life-stages are still regularly and predictably observed by scientists and caught by recreational fishers in the area during the summer months (J Hartl pers. obs. 2024).

Between August 2006–December 2010, 544 Brown Stingrays were caught in the area using longlines (Dale 2011). Vertebral samples were collected for 203 of these individuals that measured between 35–133 cm disc width (DW). Of these, 13 measured 35–45 cm DW, and according to growth band readings, were neonates or YOY that were captured in May and June (Dale 2011; Dale et al. 2011). These sizes are similar to the reported size-at-birth for this species (35 cm DW; Last et al. 2016). In addition, 159 were classified as juveniles measuring <95 cm DW (Dale 2011). Stable isotope analysis (bulk and amino acids) and stomach content analysis of 156 juvenile Brown Stingrays revealed long-term foraging fidelity and high residency to the bay for small individuals (35–55 cm DW) with a shift to foraging in offshore areas when reaching sexual maturity (Dale et al. 2011).

SUB-CRITERION C2 – FEEDING AREAS

Kāne'ohe Bay is an important feeding area for one ray species.

Between 2004–2024, 96 Reef Manta Rays were identified around the island of O'ahu using photographic identification (photo-ID). In total, 456 sightings of these individuals have been confirmed via photo ID, with 80% of sightings recorded since dedicated researcher surveys began in 2021 (n = 366; O'ahu Manta Project unpubl. data 2024).

Between 2021–2024, 83 sightings of Reef Manta Rays were recorded in Kāne'ohe Bay (22.7% of the total sightings around the island; O'ahu Manta Project unpubl. data 2024). During this time, 46 dedicated researcher surveys were conducted, and feeding was observed during 78% of surveys. Observations are mostly of surface feeding, with group size ranging from 1–10 individuals, with an average of 3–4 individuals per sighting. In addition to sightings confirmed via photo-ID, there are numerous anecdotal reports each year of Reef Manta Rays observed feeding in the area, with the species confirmed from a vessel via photographs, but without individual identification (O'ahu Manta Project unpubl. data 2024). For example, during 2022 and 2023, 84 additional sightings were recorded from anecdotal sources in the area.

Using a combination of dedicated research surveys and citizen science contributions, 36 individuals were recorded in the area, highlighting the small resident population (O'ahu Manta Project unpubl. data 2024). No records of inter-island connectivity have been documented, despite collaboration between manta ray research projects using genetics and photo-ID techniques (Deakos et al. 2011, Whitney et al. 2023, C Nevels pers. obs. 2024). Of the 30 individuals identified in the area since dedicated surveys began in 2021, 14 were confirmed as adults and the others of unknown maturity, although notably larger in size than at other aggregation sites in O'ahu. There are also opportunistic reports of courtship behaviour from Kāne'ohe Bay. Other areas around O'ahu have higher frequencies of juveniles observed suggesting there is some degree of habitat segregation between age classes, however, more information is needed to confirm whether this area is also important for reproduction.

Acknowledgments

Julia Hartl (Hawai'i Institute of Marine Biology), Corey R Nevels (Hawai'i Institute of Marine Biology; O'ahu Manta Project; Hawaii Association for Marine Education and Research), Yannis Papastamatiou (Florida International University), Asia O Armstrong (IUCN SSC Shark Specialist Group – ISRA Project), and Emiliano García-Rodríguez (IUCN SSC Shark Specialist Group – ISRA Project) contributed and consolidated information included in this factsheet. We thank all participants of the 2024 ISRA Region 10 – New Zealand and Pacific Islands workshop for their contributions to this process.

This factsheet has undergone review by the ISRA Independent Review Panel prior to its publication.

This project was funded by the Shark Conservation Fund, a philanthropic collaborative pooling expertise and resources to meet the threats facing the world's sharks and rays. The Shark Conservation Fund is a project of Rockefeller Philanthropy Advisors.

Suggested citation

IUCN SSC Shark Specialist Group. 2024. Kāne'ohe Bay ISRA Factsheet. Dubai: IUCN SSC Shark Specialist Group.

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												
Sphyrna lewini	Scalloped Hammerhead	CR	0–1,043	X		X						
RAYS												
Bathytoshia lata	Brown Stingray	VU	0–800	X		X						
Mobula alfredi	Reef Manta Ray	VU	0–711	X			X					

SUPPORTING SPECIES

Scientific Name	Common Name	IUCN Red List Category
SHARKS		
Carcharhinus galapagensis	Galapagos Shark	LC
Carcharhinus limbatus	Blacktip Shark	VU
Carcharhinus melanopterus	Blacktip Reef Shark	VU
Carcharhinus plumbeus	Sandbar Shark	EN
Triaenodon obesus	Whitetip Reef Shark	VU
RAYS		
Aetobatus ocellatus	Spotted Eagle Ray	EN

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.

REFERENCES

Bush A. 2003. Diet and diel feeding periodicity of juvenile scalloped hammerhead sharks, *Sphyrna lewini*, in Kāne'ohe Bay, Ō'ahu, Hawai'i. *Environmental Biology of Fishes* 67: 1–11. https://doi.org/10.1023/A:1024438706814

Bush A, Holland K. 2002. Food limitation in a nursery area: Estimates of daily ration in juvenile scalloped hammerheads, Sphyrna *lewini* (Griffith and Smith, 1834) in Kāne'ohe Bay, Ō'ahu, Hawai'i. *Journal of Experimental Marine Biology and Ecology* 278: 157–178. https://doi.org/10.1023/A:1024438706814

Clarke T. 1971. The ecology of the scalloped hammerhead shark, *Sphyrna lewini*, in Hawaii. *Pacific Science* 25: 133–134.

Dale JJ. 2011. Life history, foraging ecology, metabolic rates and bioenergetics of the brown stingray, Dasyatis lata. Unpublished PhD Thesis, University of Hawai'I, Honolulu.

Dale JJ, Wallsgrove NJ, Popp BN, Holland KN. 2011. Nursery habitat use and foraging ecology of the brown stingray *Dasyatis lata* determined from stomach contents, bulk and amino acid stable isotopes. *Marine Ecology Progress Series* 433: 221–236. https://doi.org/10.3354/meps09171

Deakos MH, Baker JD, Bejder L. 2011. Characteristics of a manta ray *Manta alfredi* population off Maui, Hawaii, and implications for management. *Marine Ecology Progress Series* 429: 245–260. https://doi.org/10.3354/meps09085

Duncan K, Holland K. 2006. Habitat use, growth rates and dispersal patterns of juvenile scalloped hammerhead sharks *Sphyrna lewini* in a nursery habitat. *Marine Ecology Progress Series* 312: 211–221. https://doi.org/10.3354/meps312211

Ebert DA, Dando M, Fowler S. 2021. *Sharks of the world: A complete guide.* Princeton: Princeton University Press.

Holland KN, Wetherbee BM, Peterson JD, Lowe CG. 1993. Movements and distribution of Hammerhead Shark pups on their natal grounds. *American Society of Ichthyologists and Herpetologists* 1993: 495–502. https://doi.org/10.2307/1447150

Hunter CL, Evans CW. 1995. Coral reefs in Kaneohe Bay, Hawaii: Two centuries of western influence and two decades of data. *Bulletin of Marine Science* 57: 501–515.

Jabado RW, Chartrain E, De Bruyne G, Derrick D, Dia M, Diop M, Doherty P, Finucci B, Leurs GHL, Metcalfe K et al. 2021. *Bathytoshia lata. The IUCN Red List of Threatened Species 2021*: e.T104071039A104072486. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T104071039A104072486.en

Last PR, White WT, de Carvalho MR, Séret B, Stehmann MFW, Naylor GJP. 2016. *Rays of the world.* Clayton South: CSIRO Publishing.

Lowe CG. 2001. Metabolic rates of juvenile scalloped hammerhead sharks (*Sphyrna lewini*). *Marine Biology* 139: 447–453. https://doi.org/10.1007/s002270100585

Lowe CG. 2002. Bioenergetics of free-ranging juvenile scalloped *S. lewini*. *Journal of Experimental Marine Biology and Ecology* 278: 141–156. https://doi.org/10.1016/S0022-0981(02)00331-3

Marshall A, Barreto R, Carlson J, Fernando D, Fordham S, Francis MP, Herman K, Jabado RW, Liu KM, Pacoureau N et al. 2022. *Mobula alfredi* (amended version of 2019 assessment). *The IUCN Red List of Threatened Species* 2022: e.T195459A214395983. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T195459A214395983.en

RAMSAR 2024. Kawainui and Hamakua Marsh Complex. Available at: https://rsis.ramsar.org/ris/1460 Accessed August 2024.

Rigby CL, Dulvy NK, Barreto R, Carlson J, Fernando D, Fordham S, Francis MP, Herman K, Jabado RW, Liu KM et al. 2019. *Sphyrna lewini. The IUCN Red List of Threatened Species 2019*: e.T39385A2918526

Ringuet S, Mackenzie FT. 2005. Controls on nutrient and phytoplankton dynamics during normal flow and storm runoff conditions, southern Kaneohe Bay, Hawaii. *Estuaries* 28: 327–337. https://doi.org/10.1007/BF02693916

Tanaka K, Guidry MW, Gruber N. 2013. Ecosystem Responses of the Subtropical Kaneohe Bay, Hawaii, to Climate Change: A Nitrogen Cycle Modeling Approach. *Aquatic Geochemistry* 19: 569–590. https://doi.org/10.1007/s10498-013-9209-4

Whitney JL, Coleman RR, Deakos MH. 2023. Genomic evidence indicates small island-resident populations and sex-biased behaviors of Hawaiian reef Manta Rays. *BMC ecology and evolution* 23(1): 31. https://doi.org/10.1186/s12862-023-02130-0