Appendix Y Draft shark management plan

NIWA
Taihoro Nukurangi

Shark Management Plan

Prepared for Ngāi Tahu Seafood Limited

June 2025

Climate, Freshwater & Ocean Science

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Executive summary

This report is a (draft) Shark Management Plan for the proposed finfish farm to be situated off northern Rakiura/Stewart Island. The purpose of the management plan is to identify and mitigate the potential impacts on sharks.

This management plan is designed to meet the following specific objectives:

- Minimise shark incidents with the finfish farm;
- Determine how the operation of the finfish farm will be managed adaptively to avoid, remedy and mitigate adverse effects on sharks;
- Ensure best practice is adopted to avoid entanglement or entrapment of sharks, having regard to best international practice, ongoing research, and allowing for technological improvement in net design and construction;
- Establish a monitoring programme to assess the effectiveness of the Shark Management Plan;
- Establish reporting and response procedures in the event of protected, threatened, or at-risk shark entrapment, entanglement, injury, or death. Reporting and response procedures for shark species managed under the Quota Management System are also provided.

The Shark Management Plan has been prepared in consultation with the Department of Conservation (DOC), Environment Southland, Ngā tahu ki Murihiku, and the Ministry for Primary Industries (MPI).

1 Introduction

Ngāi Tahu Seafood Limited is proposing to develop an area of 1247 hectares of the coastal marine area 2–6 km off the northern coast of Rakiura/Stewart Island for finfish aquaculture (Figure 1). The finfish farm locations have been selected based on multiple factors, including separation distances between marine farms, distance to the island and to biogenic habitat, and feedback provided through previous consultation. Alternative locations have also been identified if the initial locations do not meet the requirements of the independent review panel (Figure 2).

Four marine farms will be developed in two-stage approach:

- Stage 1 involves a feed discharge of 15,000 tonnes per annum and the establishment of a block of 10 sea pens (arranged in a 5x2 configuration) at each of the four marine farm sites
- Stage 2 would increase the overall feed discharge rise to 25,000 tonnes per annum with the introduction of a second set of 10 sea pens at each of the four marine farm sites. Stage 2 would be subject to environmental monitoring over two production cycles at the Stage 1 feed input.

Each farm will consist of two blocks of ten net pens, the associated mooring and anchoring systems and a feed barge. The proposed finfish farm consists of a series of polar circle type pens that can withstand both the strong currents that run through Te Ara a Kiwa/Foveaux Strait and the wind and wave conditions that can occur at the site. These types of pens are currently used in dynamic exposed coast and open coast areas (e.g., Storm Bay in Tasmania). Sea pens are proposed to be installed in grids of ten pens, each with 168m circumference. Each marine farm would consist of two grids of pens, located at least 300m apart. Net structures are to be suspended in the water column to depths of 17–22m below the sea surface, with a minimum clearance of 5 m from the seabed, net heights will be adjusted accordingly.

The farm stocking is proposed to be on a single year class rotational basis so that one farm will have stock introduced, one will be at grading, one will be at harvest, and the final farm will be fallow (i.e., inactive).

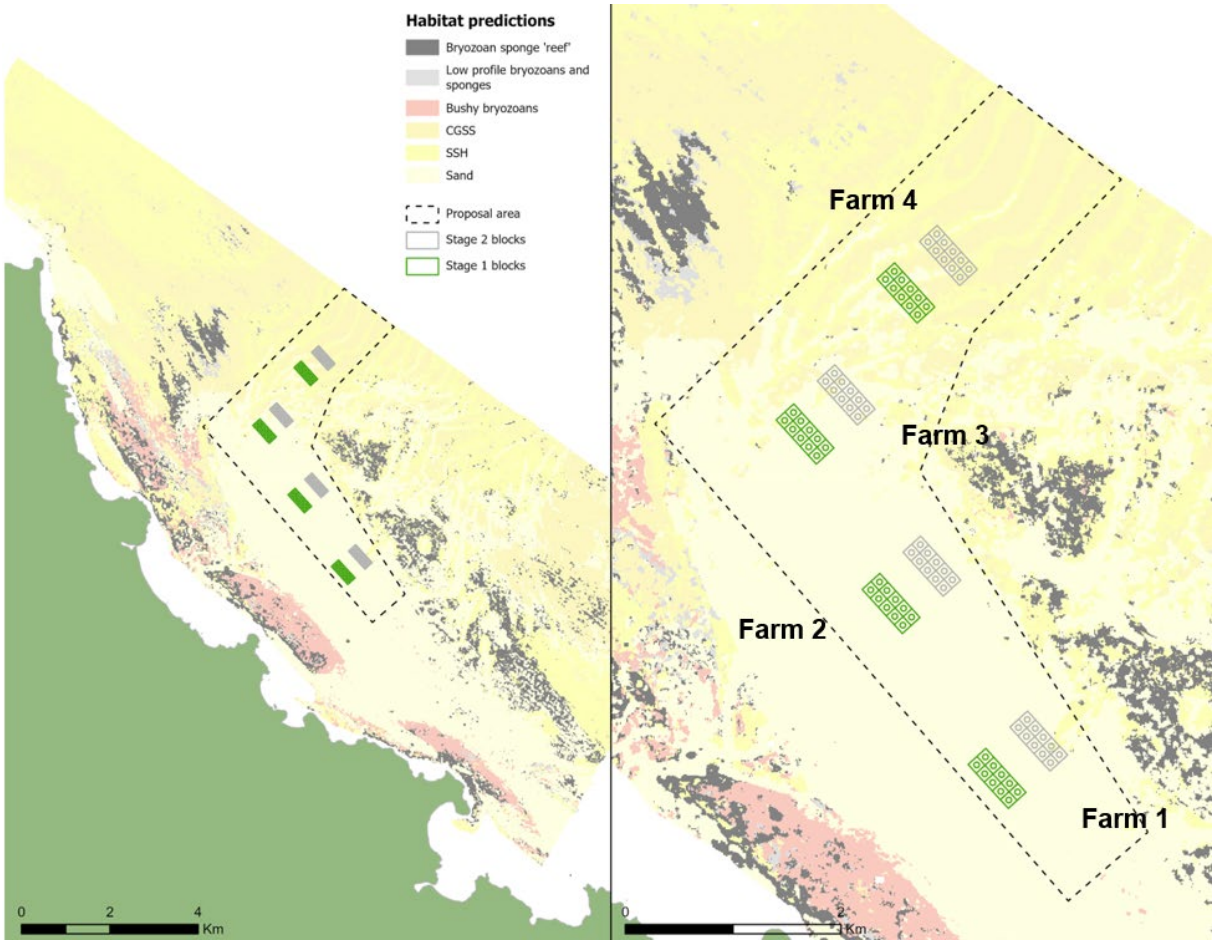

Figure 1: Marine finfish farm layout (green and grey) within proposed site off the northeast coast of Rakiura/Stewart Island.

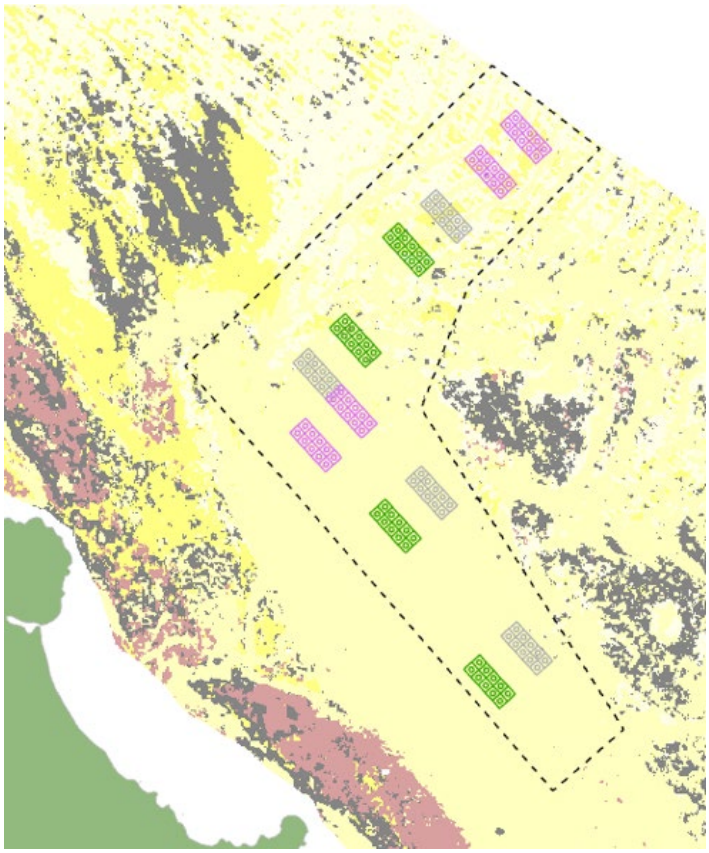

Figure 2: Alternative proposed farm locations (in pink) within proposed site off the northeast coast of Rakiura/Stewart Island.

1.1 Terminology

For clarity, definitions for a number of terms frequently used in this plan are provided below:

TERM	DEFINTION
Mitigation	Any action that alleviates or moderates the severity of an impact caused by something. Actions that mitigate impacts may also minimise those effects.
Incident	Any physical contact an individual (person), boat, or gear has with a shark species that causes, or may cause death, injury, or stress to an animal. This includes entrapment and entanglement.
Incident response	Actions taken immediately following an incident to attend to the shark(s) involved.

1.2 Shark Management Plan Objectives

The purpose of the Shark Management Plan is to identify and mitigate the potential impacts on sharks arising from the establishment of the Hananui Aquaculture salmon farm. This Shark Management Plan has been prepared in consultation with the Department of Conservation (DOC), Environment Southland, Ngā Rūnanga ki Murihiku, and the Ministry for Primary Industries (MPI). All staff and contractors working on the finfish farm must comply with the Shark Management Plan.

This management plan is designed to meet the following specific objectives:

- Minimise shark incidents with the finfish farms;
- Determine how the operation of the finfish farm will be managed adaptively to avoid, remedy, and mitigate adverse effects on sharks;
- Ensure best practice is adopted to avoid entanglement or entrapment of sharks, having regard to best international practice, ongoing research, and allowing for technological improvement in net design and construction;
- Establish reporting and response procedures in the event of protected, threatened, or at-risk shark entrapment, entanglement, or death;
- Establish a monitoring programme to assess the effectiveness of the Shark Management Plan.

If required, the Shark Management Plan will be amended to ensure its Objectives are being met.

1.3 Sharks in Te Ara a Kiwa/Foveaux Strait

At least 21 species of sharks and their relatives (rays and chimaeras, herein referred to as sharks) have been identified from the Te Ara a Kiwa/Foveaux Strait area. Information on species distribution was described from research trawl surveys (largely off Southland, including the Stewart Island shelf in the summer months of 1994, 1995, and 1996; see Hurst and Bagley 1997), directed research studies (see Sections 2.3, 2.5), and public observations reported on iNaturalist (iNaturalist 2025). Species are listed in Appendix 1.

The two shark species most likely to interact directly with the finfish farm are white shark (*Carcharodon carcharias*) and sevengill shark (*Notorynchus cepedianus*) (Francis 2019). Both species are recorded in the area throughout the year but are mostly present in the summer and autumn months. White sharks aggregate at the Titi islands, which are less than 10 km away from the

proposed farm site, to feed on New Zealand fur seals (*Arctocephalus forsteri*), which form large colonies there. The emerging breeding colony of New Zealand sea lions (*Phocarctos hookeri*) at Port Pegasus at the southern tip of Rakiura/Stewart Island may also be attractive to white sharks.

Spiny dogfish (*Squalus acanthias*), school shark (*Galeorhinus galeus*), elephantfish (*Callorhinchus milii*) and carpet shark (*Cephaloscyllium isabellum*) are relatively abundant in the area, with nearly 1290 tonnes (t), 559 t, 518 t, and 75 t of the species, respectively, reported from commercial fisheries operating in Foveaux Strait (statistical area 025) between 2011 and 2020 (Taylor & Dempster 2021). These species, and others are not anticipated to have a direct incident with the finfish farm is low or unlikely because of their small size, are relatively uncommon in the area, or are not known to interact significantly with fish farms elsewhere. Some of these species occupy offshore or deepwater habitats (mostly at depths greater than 200m) and are unlikely to have any incidents with the finfish farm.

Table 1: Shark species known to occur in the Te Ara a Kiwa/Foveaux Strait area.*see Appendix 1 for additional details.

Species	Management category	New Zealand Threat Classification System (NZTCS) status	IUCN Red List of Threatened Species global status*	Likely incident with finfish farm
White shark (*Carcharodon carcharias*)	Protected under Wildlife Act 1953	Threatened (Nationally Endangered)	Vulnerable	Likely; incidents with aquaculture operations reported
Broadnose sevengill shark (*Notorynchus cepedianus*)	None	Not Threatened	Vulnerable	Likely; incidents with aquaculture operations reported
School shark (*Galeorhinus galeus*)	Managed under Quota Management System (QMS)	Not Threatened	Critically Endangered	Possible
Spiny dogfish (*Squalus acanthias*)	Managed under QMS	Not Threatened	Vulnerable	Possible
Blue shark (*Prionace glauca*)	Managed under QMS	Not Threatened	Near Threatened	Possible
Mako (*Isurus oxyrinchus*)	Managed under QMS	Not Threatened	Endangered	Possible
Porbeagle (*Lamna nasus*)	Managed under QMS	Not Threatened	Vulnerable	Possible
Basking shark (*Cetorhinus maximus*)	Protected under Wildlife Act 1953	Threatened (Nationally Vulnerable)	Endangered	Unlikely
Thresher shark (*Alopias vulpinus*)	None	Not Threatened	Vulnerable	Unlikely
Carpet shark (*Cephaloscyllium isabellum*)	None	Not Threatened	Least Concern	Unlikely
Rig (*Mustelus lenticulatus*)	Managed under QMS	Not Threatened	Least Concern	Unlikely
Rough skate (*Zearaja nasuta*)	Managed under QMS	Not Threatened	Least Concern	Unlikely
Smooth skate (*Dipturus innominatus*)	Managed under QMS	Not Threatened	Least Concern	Unlikely
Elephantfish (*Callorhinchus milii*)	Managed under QMS	Not Threatened	Least Concern	Unlikely

1.3.1 Compliance with Wildlife Act 1953

White shark and basking shark are protected under Schedule 7A of the Wildlife Act 1953. It is illegal to hunt, kill, or harm white sharks and basking sharks within New Zealand's Territorial Sea and Exclusive Economic Zone (200 nautical mile limit around New Zealand).

1.3.2 Compliance with the New Zealand Coastal Policy Statement 2010 (NZCPS) Policy 11

The objective of the NZCPS-Policy 11 is to protect indigenous biological diversity in the coastal environment. Policy 11 of the NZCPS lists species and habitats for which adverse effects should be avoided (Policy 11(a)) and areas and habitats where significant adverse effects should be avoided and all other adverse effects should be avoided, remedied or mitigated (Policy 11(b)). Policy 11(a) is applicable to white shark, broadnose sevengill shark, school shark, spiny dogfish, basking shark, mako, porbeagle, and thresher shark which are listed as threatened species under either the New Zealand Threat Classification System (NTZTC) or IUCN Red List of Threatened Species (see Table 1[1]). White shark and basking shark considered threatened by both classification systems.

Policy 11(b)(v) is applicable to white sharks which used Te Ara a Kiwa/Foveaux Strait during their annual migrations. The region may also be used by broadnose sevengill shark as they are suspected to move seasonally between the South Island and Rakiura/Stewart Island, but movements of this species have not been quantified.

2 Potential impacts on sharks

Finfish farms are known to attract large marine predators, including sharks. In some cases, sharks can become resident around finfish farms. The increased presence of sharks near finfish farms may result in serious injury or mortality due to entanglement or entrapment in the nets or farm structures, as well as damage to the nets themselves.

The potential for incidents between sharks and the proposed finfish farm was reviewed and summarised by Francis (2019). Adverse effects from finfish farms on sharks can arise from risk factors such as the physical presence of the aquaculture gear, vessel movements, and fish farming activities. Based on a literature review of the best available scientific data, consultation with experts, as well as documented information on the adverse incidents of marine fauna with marine aquaculture, the adverse effects identified to have an impact on sharks are:

- Entanglement and entrapment (fatal or non-fatal)

Cumulative impacts on sharks caused by multiple effects of finfish farms may arise, however, there are no available data and are not considered at this time. Such information may become available with routine monitoring and reporting (see Section 3.2 for reporting on protected species). Shark incidents with finfish farms can be reduced with adequate planning and management, and good husbandry practices, including the removal of dead stock, avoiding over-feeding, and installing farms in shallow locations (Huveneers et al. 2022). Efforts to minimize the attraction of natural prey species (e.g., fur seals) around the farm may also reduce shark presence (see the Marine Mammal Management Plan). Mitigation and management measures will be applied here to minimise the identified potential impacts.

[1] School shark, spiny dogfish, blue shark, mako, and porbeagle are managed under the Quota Management System (QMS). See Appendix 1 for more details.

2.1 Entanglement and entrapment mitigation

To minimise entanglement and/or entrapment risk, the following will be considered, and where practicable implemented, prior and during farm development.

2.1.1 Farm design and layout

To minimise the risk of shark incidents with any farm structures, nets, or mooring/warp lines, the following management techniques will be adhered to during the design of structures:

- Minimise overlap or crossing of underwater warp lines on farms to or from node plates.
- Ensure mooring lines are generally at the same height/depth in any horizontal plane in the water column with little to no vertical staggering or crossing where practicable.
- If crossing lines are necessary for farm integrity or safety, ensure the overlap occurs as close to the seabed as possible or above the water surface.
- The layout of pens within a farm block has been spaced as close in proximity as is operationally possible, with moorings around the sides, to dissuade larger animals from entering between pens.
- Allow ample spacing between farms (at least 1 km apart[2]) as far as practicable, and while adhering to Biosecurity Management Plan, to prevent channelling or the forcing of animals down long corridors between blocks and/or into another farm block (i.e., dead-end).
- Orientating blocks parallel to Foveaux Strait and animal migration pathways.
- Maintain anchor warps under tension in all tidal conditions.

For further details in regard to farm design and layout, refer to design plans (DSA).

2.1.2 Pen design

Ngāi Tahu Seafood is intending to use a single net system and the following management techniques will be adhered to:

- The use of predator resistant materials in the construction of nets (e.g., semi-rigid or core stiffened nets resistant, or heavy monofilament to provide resistance, to easy tearing, i.e., from chewing).
- Nets must have a mesh size that minimises a predator's ability to penetrate the net with their head, fins, or tail(less than 40 mm half mesh; e.g., knot to knot unstretched), and
- Extend any above surface nets, at least 2 m if fixed and rigid and 3 m if flexible, above the sea surface (e.g., jump fences) around pens.

[2] Based on current salmon farm spacings around New Zealand and in regard to the potential whale species in this region.

- Each net would also have a ‘false’ bottom separated from the outer net to catch dead fish or a mortality collection system that would hold/contain them away from access to marine species swimming underneath the nets.

Sharks have also been shown to be attracted to electromagnetic fields (EMFs) generated by power cables (Gill & Taylor 2001). To mitigate potential incidents (i.e., bites), EMFs can be reduced by shielding any power cables. Ngāi Tahu Seafood Limited will consider the possibility of trialling electromagnetic barrier deterrents (e.g., Ocean Guardian Shark Shield) around the finfish farm as a means of shark mitigation. As this technology is rapidly developing, Ngāi Tahu Seafood Limited will explore available options when the farm is established.

2.2 Operational Best Management Practices (BMPs)

The increased availability of food with the presence of finfish stock, dead or moribund stock, harvesting activities, and the provision of feed into the sea pens may attract sharks into the area. These activities may lead to increased visitation rates, increased duration of visits, and/or alterations to the natural feeding behaviours of sharks if sharks begin foraging on accessible finfish stock. In Australia, dead fish have been consistently identified as the prime shark attractant to fish farms. The inclusion of electromagnetic deterrents near the bottom of the nets where mortalities will accumulate before removal may also be a potential shark mitigation tool (see Section 2.1.1).

The net pens will be maintained to a high standard so they are effective at excluding sharks and other marine predators. To minimise such impacts, the following maintenance and inspection activities will be undertaken.

Daily maintenance schedules including:

- Standard maintenance surface inspections and replacement schedules as part of normal operational activities to ensure:
  - no shark is entangled in or has entered the farm;
  - attention to any unusual fish stock behaviour that may suggest a marine species has entered a net pen;
  - nets/pens and lines are well maintained (e.g., holes repaired as soon as feasible) and kept taut;
  - tensioning systems of all pen nets (no billowing) are regularly checked and maintained;
  - no unsupervised un-tensioned and/or loose ropes and lines on farms at all times;
  - immediate inspections of all nets after any significant storm events, once it is practicably safe.
- Standard below water net inspections will be undertaken:
  - during feeding via the feed cameras;
  - via net scoring assessments;
  - via net cleaning, and/or

- by divers operating in the pens during the course of their normal work

Fortnightly / monthly[3] maintenance schedules including:

- All net structures at farms will have been subject to detailed sub-surface visual inspection during net cleaning to check for holes and damage.

Nets and structures must be checked and inspected immediately following any significant storm to ensure that no shark has become entangled or entrapped or damage occurred that may allow this to happen.

Minimising potential for loss of farm debris that could entangle or otherwise be a hazard for an animal through a waste management plan that will include, for example:

- Collecting or retrieving waste, and retaining it in secure storage (especially in higher wind conditions);
- Mitigating the loss of debris through service vessel scuppers;
- Maintaining farm infrastructure regularly, to minimise breakages or loss of equipment overboard;
- all wastes must be disposed of at an approved solid waste facility onshore.

Before undertaking major operational installations, removals and/or maintenance of structures:

- Consider the monitoring data as to whether sharks are likely to be in the area and review the management procedures accordingly;
- Minimise the period of time that outer nets (as part of dual net system) are opened for repair/removal and extra vigilance must be maintained by farm staff/divers during these situations.

3 Monitoring and Incident Reporting

3.1 Monitoring

Ngāi Tahu Seafood will keep marine fauna logs and report all shark incidents and the nature of these incidents (e.g., species, type and frequency of incident, location, and likely cause of the incident, noted behaviours). Observed (visual identification of the shark) and non-observed incidents (shark not seen but suspected to have been in proximity to the finfish farm, i.e., bite mark in net) will be reported. Collection of this information will help inform on the effect of the finfish farm, specifically if the number of sharks observed in the area increases or decreases over time after the finfish farm is established, and if particular individuals become habituated or attracted to the farm.

Staff should provide as many details as possible about a shark incident, including:

- Date and time;
- Location;

[3] Duration to be confirmed once operations start and net fouling scores are being collected.

- Species;
- Size and sex (where possible);
- Shark condition (dead or alive);
- Injuries incurred;
- If observed, behaviour prior to the incident;
- Type of incident (e.g., entanglement, entrapment);
- If the incident was an entanglement, what part of the shark was entangled (e.g., jaws, fin, whole body)
- Location within the farm structure/s;
- Operational context (e.g., condition of the net, was the net stocked with fish, was the net being fixed/cleaned/maintained);
- Other possible contributing factors;
- Incident response (i.e., remediation action taken after an incident to mitigate further incidents).

If possible, distinguishing features should be noted and photographs taken of individual sharks involved in incidents with the marine farm. This information could be used to assist in identifying "problematic" individuals. Profile photographs (see Appendix 2 for examples) are most helpful for species and individual identification. Photographs of the gills and dorsal fin are also useful to identify individuals. Images captured from any underwater camera operations may be useful for individual shark identification.

3.2 Reporting

An annual summary report of all shark incidents with the finfish farm will be prepared. Annual summary reports will be sent to:

- **Environment Southland**
  - **Phone: 03 211 5115 or 0800 76 88 45 (after hours)**
  - **Email: service@es.govt.nz**

Any incident (see Section 1.1) with a protected shark must be reported on a 'Protected Shark Incident Report'. Staff should provide as many details as possible as outlined in Section 3.1. Reporting to DOC must occur within 24 hours of the incident:

- **The Department of Conservation**
  - **Phone: 03 219 0002 (DOC Rakiura/Stewart Island) or 0800 DOC HOT (0800 362 468) (after hours)**
  - **Email: stewartisland@doc.govt.nz**
  - **DOC Marine Species Team:sharks@doc.govt.nz**

4 Shark incident response

In the event that a shark incident occurs, staff will notify Ngāi Tahu Seafood Limited regional management. If a protected species (white shark, basking shark) is involved, DOC must also be contacted. Ngāi Tahu Seafood Limited regional management will advise on how best to respond to shark incidents on a case by case basis, noting that human safety is a first order priority. In no instance should a person enter the water with an entangled or entrapped live shark. All reasonable efforts will be made to disentangle or release the shark alive.

All sharks should be treated with caution. For all species, sharks should never be handled by the tail, and preferably, avoid the abdomen region. Never lift a shark using a hook, or by the gills, or tail as this can cause serious injury to the shark. Where practicable noting that human safety is a first order priority, staff will follow release practices for sharks in accordance with DOC's Protected Species Handling Guide (2019) (see Appendix 3).

In the event that all reasonable actions have been attempted to remove the shark, or the condition of the shark deteriorates rapidly, or the shark begins to display more aggressive behaviour, action may be taken to destroy the shark. If the shark is a protected species, destruction will require approval from DOC first (see Section 3.2 for contact details) or have to be carried out by a DOC officer. Sample collection of dead sharks may be requested (see Section 4.4). If the species is managed under the QMS, incidents resulting in the death of the shark will be applied to current quota allocations held by Ngāi Tahu Seafood Limited (see Appendix 1).

4.1 Guidelines for releasing live entangled sharks

In the event that a shark becomes entangled in the net itself, or other pen structures, staff should refer to the protocols established for releasing entangled marine mammals. See Appendix 3 of the Marine Mammal Management Plan.

4.2 Guidelines for releasing live entrapped sharks

In the event that a shark enters the finfish pen (entrapment), the location of where the shark has entered should first be identified.

4.2.1 QMS species release

If the entrapped live shark is a species managed under the QMS (e.g., school shark, spiny dogfish, see Table 1) and is small in size (<2m in length), attempts will be made by experienced staff to capture the shark by hook and line and guide the hooked shark outside of the pen for release. Barbless (or crimped barb) circle hooks should be used to minimize foul hooking and allow for easier removal. If hooks cannot be removed from the shark before release, all fishing gear attached to the shark will be kept to a minimum (use of non-stainless steel hooks, cut trailing line gear as close to hook as possible).

4.2.2 Non-QMS species release

If the entrapped live shark is a species not managed under the QMS (e.g., broadnose sevengill shark) and is small in size (<2m in length), all reasonable attempts to release the shark should follow the guidelines for QMS species release (Section 4.2.1). If the entrapped live shark is large in size (> 2m in length), all reasonable attempts to release the shark should follow the guidelines for protected species release (Section 4.2.3).

4.2.3 Protected species live release

If the entrapped live shark is a protected species (white shark, basking shark), the following guidelines should be used to release the shark. In the unlikely event a basking shark becomes entrapped, staff should refer to the protocols established for releasing large marine mammals.

With the use of a single net system:

- If possible, lower the top net (approximately 3 m for a large white shark (Murray-Jones 2004) and use a crowder net to guide the shark out over the submerged section of the netting; or
- Cut a section of the netting in an attempt to release the shark:
  - Use a pruning hook to place a vertical cut in the net;
  - Pull apart the sides of the vertical cut using a boat hook on either side creating a hole for the shark to swim through. Alternatively, ropes could be attached to each side of the cut and lateral pressure applied on the ropes to create an opening;
  - Use a crowder net to guide the shark to the opening;
  - Repair or replace the damaged section of the net as soon as possible once the shark has been released and no further shark sightings have occurred.

These techniques have been used successfully to release entrapped white sharks (4.5 m in length) from tuna cages without loss of tuna stock (Murray-Jones 2004). It took 1.5 hours for one of these releases to be completed. Ngāi Tahu Seafood Limited is also exploring the possibility of including escape panels in the net development, which could be used in the event that a shark enters the finfish farm.

4.3 Dead sharks

If a dead shark is found entangled or entrapped in the net, the species should be identified, and an incident report will be completed (see Appendix 2 for species identification). The reason for entanglement or entrapment will be investigated and remedied. If the shark is a protected species, DOC must be notified (see Section 3.2). If the species is managed under the QMS, the weight of the shark will be applied to current quota allocations (see Appendix 1).

4.4 Disposal of dead protected shark

If a protected shark mortality occurs or a dead protected shark is discovered in or around the finfish farm, DOC will be notified. Before disposal, mortalities must be recorded on a 'Protected Shark Incident Report' and reported to DOC (see Section 3 on reporting).

A necropsy and/or biological sampling may be requested by DOC prior to disposal. Any arrangements for sample collection or transport will be discussed and agreed upon with the DOC Marine Species Team (sharks@doc.govt.nz). Where possible, samples should be collected for the Protected Species Tissue Archive at the Auckland Museum.

Permission for disposal must be granted. When permission to dispose of the shark has been granted, the shark will be disposed of at sea.

There are agreed protocols between the Department of Conservation and Ngāi Tahu that provide a process for Ngāi Tahu to access cultural materials in the takiwā of Ngāi Tahu whānui and provide a process to enable Ngāi Tahu input into the management of cultural materials held by the Department of Conservation (Ngāi Tahu/Department of Conservation, 2007). These protocols are also likely to have some influence on the disposal of dead marine wildlife found in connection with the Hananui Aquaculture Project.

5 Preventing incidents between sharks and farm staff

Finfish farms may encourage large sharks to aggregate in the area, particularly during the summer months when white sharks are known to migrate to the area and the abundance of broadnose sevengill sharks is highest (Francis et al. 2015; Lewis et al. 2021). The risk of a shark interaction with staff is expected to be low, but white shark and broadnose sevengill shark are potentially dangerous and there is a risk of unprovoked attacks. In Australia, broadnose sevengill sharks are commonly reported to interact with salmon farms in Tasmania, and divers reported possible aggressive behaviour (Keane & Semmens 2016). There is at least one recorded instance of a sevengill shark becoming entrapped in a salmon farm off Chile (Bustamante et al. 2020). The animal was released alive.

The following policies have been put in place to reduce the likelihood of sharks being attracted to the finfish farms and ensure staff safety:

- Staff are not permitted to intentionally feed, touch, or swim with sharks;
- Staff are not permitted to recreationally fish off the farm;
- Any activities which require staff to be in the water outside of the pens should be minimised. NTS will implement Diver Safety Management Systems (undertaken separate to this management plan) which will include dive plans that address risks such as the presence of marine predators;
- Dead and moribund stock must be removed as soon as reasonably practical (see Section 2.1.2) from the net pens, stored in enclosed containers until disposed of and disposed of appropriately.

5.1 Staff training

Farm staff will receive the following training related to shark incidents occurring during operations at the finfish farm:

- Shark identification training, with particular focus on protected, threatened, and at-risk species;
- Entangled and entrapped shark removal.

Ngāi Tahu Seafood Limited will develop appropriate training modules in association with people with relevant experience in managing shark incidents and/or shark handling experience.

6 Adaptive Management Strategy

The Shark Management Plan is designed to identify, monitor, and mitigate shark incidents. The Plan will be reviewed and revised where necessary following the completion of Stage 1, and then again at

the end of the five-year period after the implementation of Stage 2 to ensure appropriate efforts are implemented to minimise impact on sharks.

7 Acknowledgements

Thanks to David Thompson (NIWA) for reviewing the initial draft document.

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Murray-Jones, S. (2004). Workshop on shark interactions with aquaculture. Proceedings of the Shark Interactions with Aquaculture Workshop and discussion paper on great white sharks. *Australian Government FRDC report*, 2002/040: 78.

Taylor, P., Dempster, T. (2021) A *discussion on the effects of salmon farming on the wild fish fauna of an area in Foveaux Strait and management options for avoiding, remedying, and mitigating any adverse effects including proposed methods for monitoring and investigating the impact of deploying a sea pen salmon farm in the area.* Report prepared for Ngāi Tahu Seafood Resources. 87 p

9 Appendix 1: The status of QMS species

School shark, spiny dogfish, mako, and porbeagle are globally distributed species and thus, the IUCN Red List assessments for these species reflect their global population status. New Zealand population trend data from fisheries assessments were reviewed within these global assessments using a decision support tool, Just Another Red List Assessment (JARA). JARA employs a Bayesian population state–space model to average relative abundance indices and provides quantitative support for the final status outcome of a Red List assessment.

For school shark, JARA estimated the highest probability of a 30–49% population reduction over three generation lengths (the time period threshold used to assess population reduction) from the New Zealand data. Under the IUCN Categories and Criteria, school shark would be assessed as Vulnerable in New Zealand waters. For spiny dogfish, JARA estimated the highest probability of no major reductions in population over three generation lengths in New Zealand. This suggests that spiny dogfish would be assessed as Least Concern in New Zealand waters. For spiny dogfish and mako, JARA estimated the highest probability of no major reductions in population over three generation lengths in New Zealand. This suggests that these species would be assessed as Least Concern in New Zealand waters.

While the outcomes of the global IUCN Red List assessments are concerning, particularly for school shark, these global statuses may not be reflective of the regional population statuses around New Zealand. This is indicated by the contrasting New Zealand Threat Classification System (NZTCS) statuses which assessed all species as Not Threatened in New Zealand waters. The global Red List assessments were reviewed and published in 2020 (see below). Following IUCN guidelines, the assessments will be reviewed again in approximately 10 years' time.

School shark, spiny dogfish, mako, and porbeagle are managed under the Quota Management System (QMS). Ngāi Tahu Seafood Limited holds Annual Catch Entitlements (ACE) for all of these species. In the event that an incident with these species results in the shark's death, these sharks will be weighed and incidents will be offset by current quota allocations.

For more details on the IUCN Red List assessments for these species,

School shark:

Walker, T.I., Rigby, C.L., Pacoureau, N., Ellis, J., Kulka, D.W., Chiaramonte, G.E. & Herman, K. 2020. *Galeorhinus galeus*. The IUCN Red List of Threatened Species 2020: e.T39352A2907336. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T39352A2907336.en

Porbeagle:

Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Lamna nasus*. *The IUCN Red List of Threatened Species* 2019: e.T11200A500969. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T11200A500969.en

Mako:

Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Isurus*

oxyrinchus. *The IUCN Red List of Threatened Species* 2019: e.T39341A2903170. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T39341A2903170.en

Spiny dogfish:

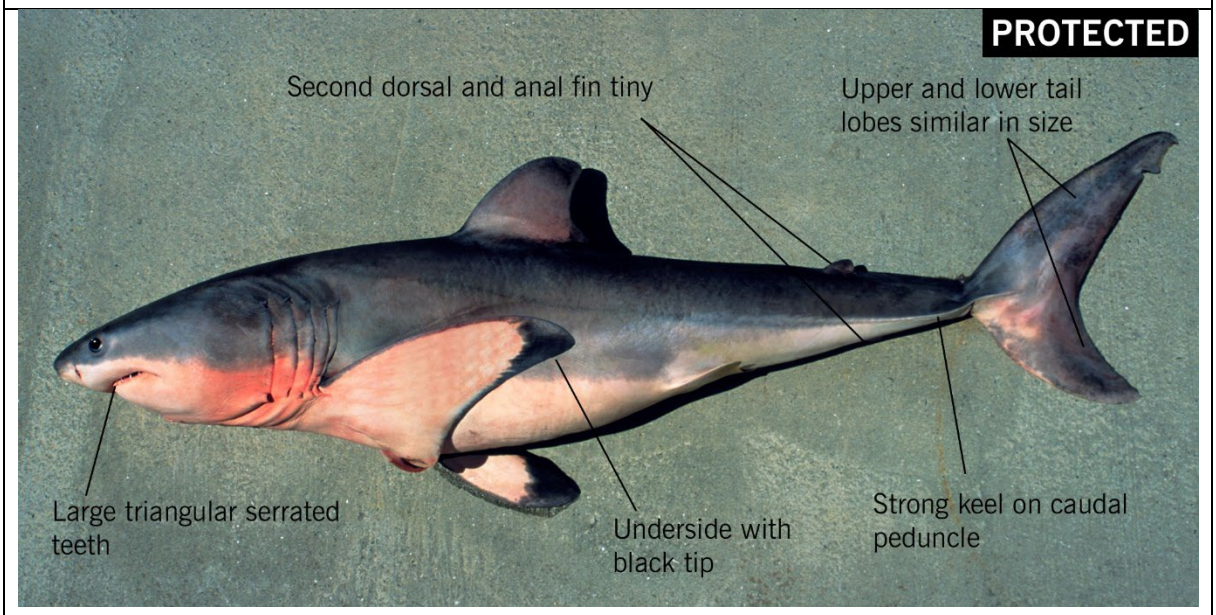
Finucci, B., Cheok, J., Chiaramonte, G.E., Cotton, C.F., Dulvy, N.K., Kulka, D.W., Neat, F.C., Pacoureau, N., Rigby, C.L., Tanaka, S. & Walker, T.I. 2020. *Squalus acanthias*. The IUCN Red List of Threatened Species 2020: e.T91209505A124551959. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T91209505A124551959.en

10 Appendix 2: Species Identification Guide

For a complete guide of species regularly observed in New Zealand waters:

AEBR 333 New Zealand fishes. A field guide to common species caught by bottom, midwater, and surface fishing for New Zealand fishers

White shark (*Carcharodon carcharias*)



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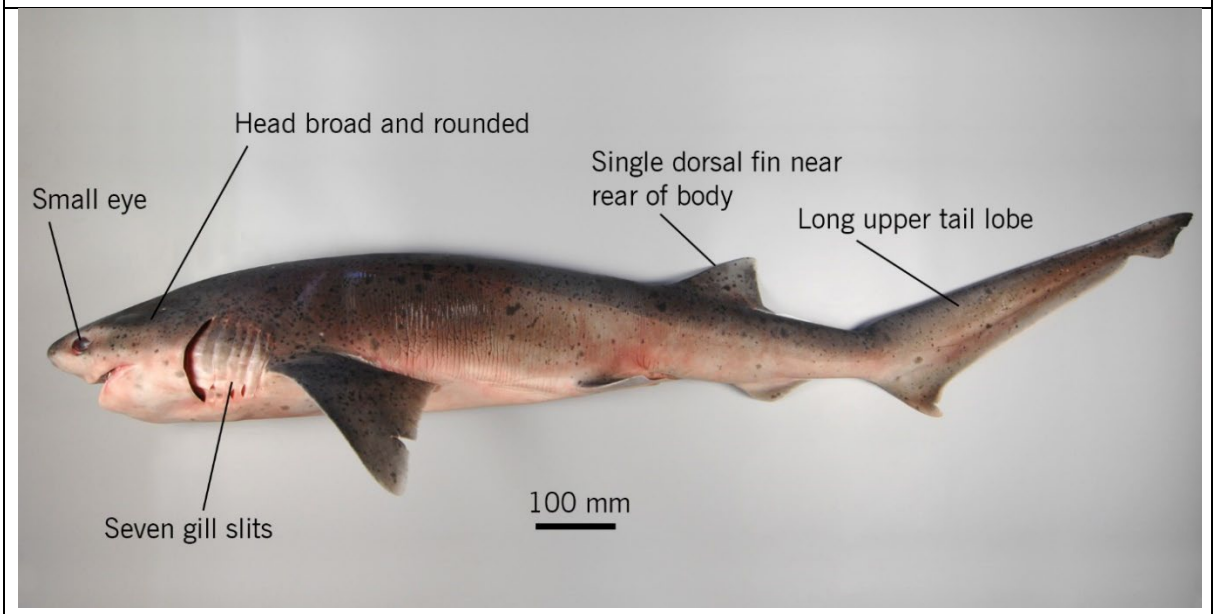
Broadnose sevengill shark (*Notorynchus cepedianus*)



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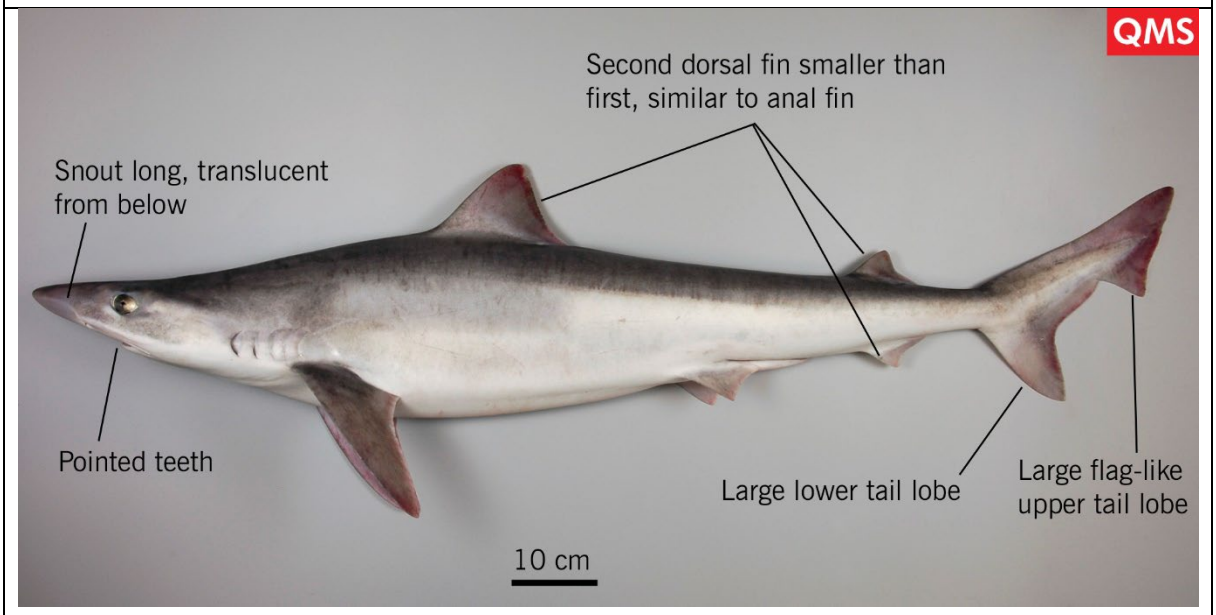
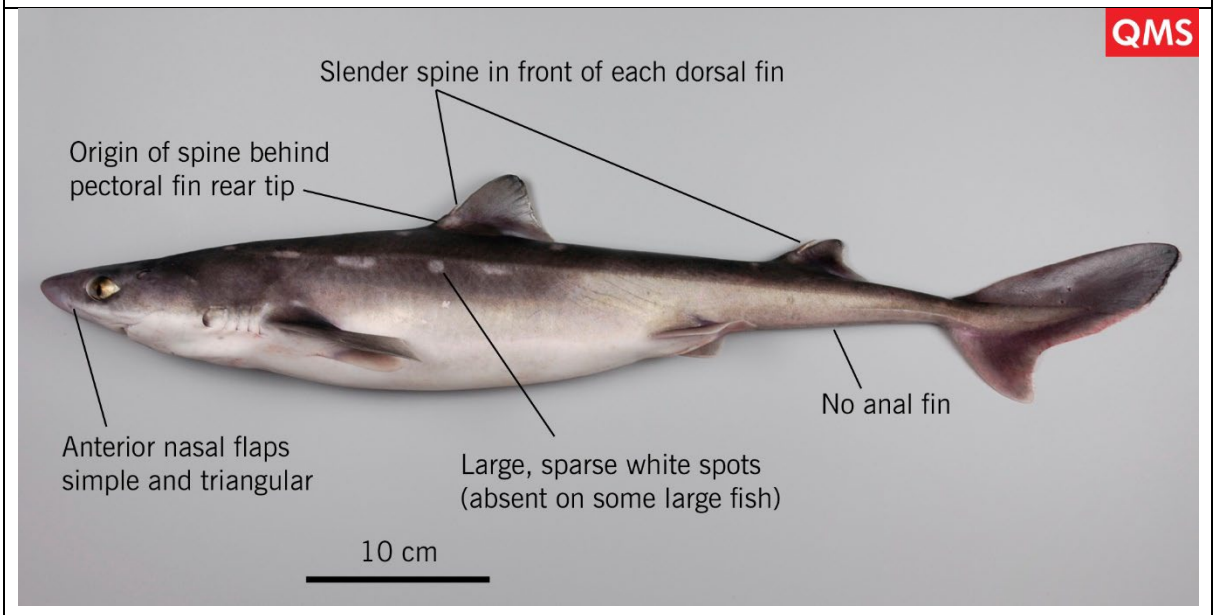
School shark (*Galeorhinus galeus*)



© NIWA

Spiny dogfish (*Squalus acanthias*)



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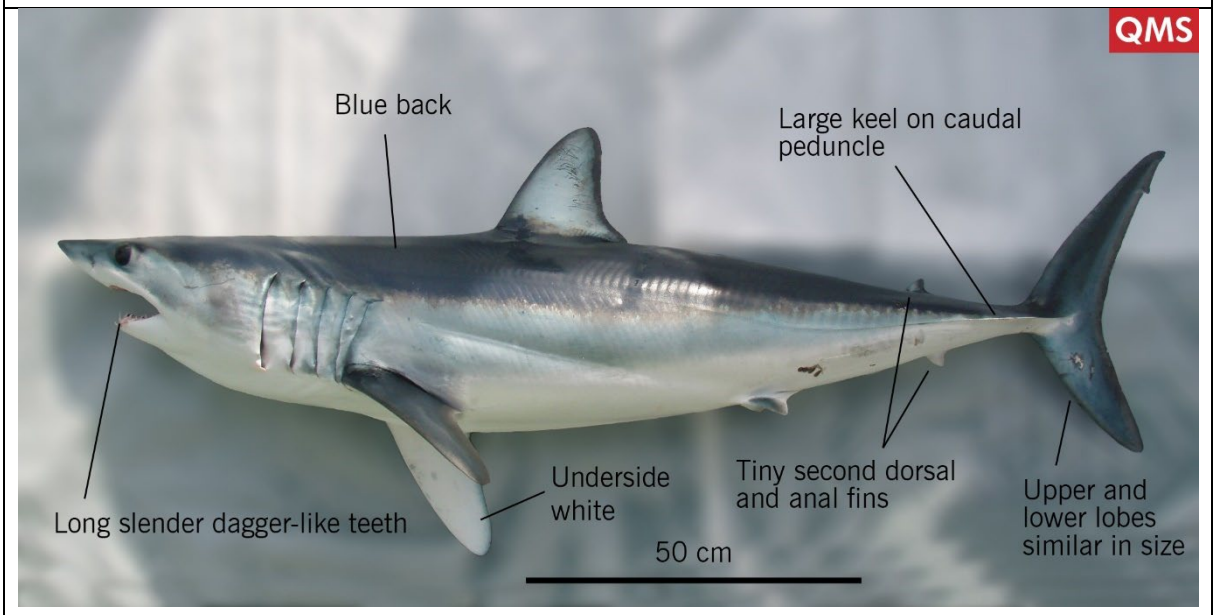
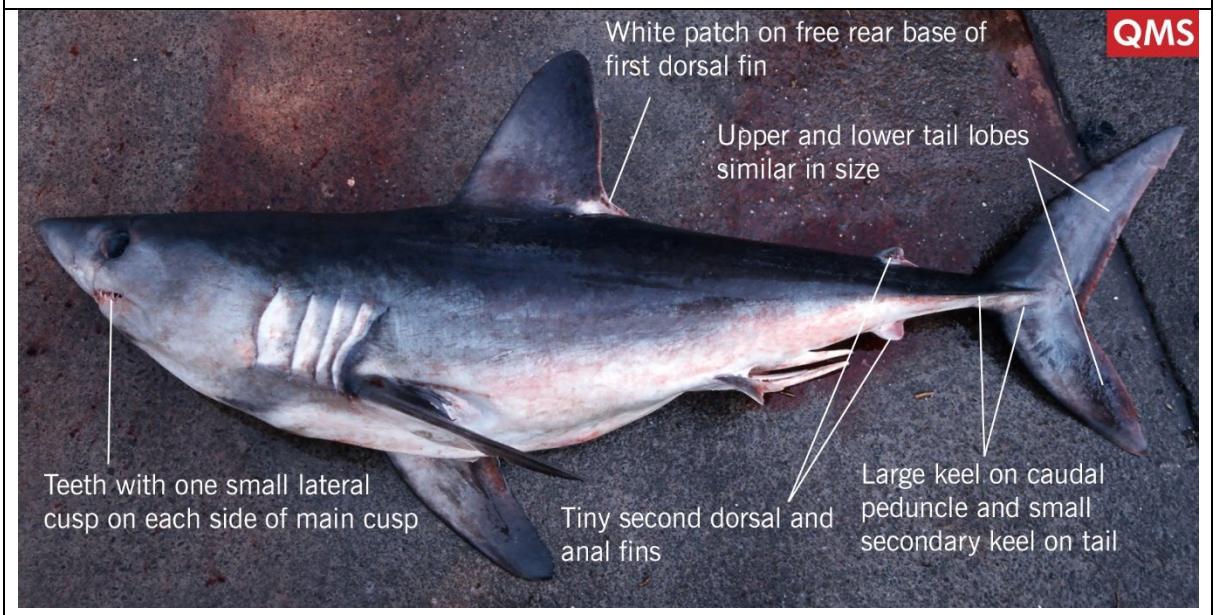
Mako (*Isurus oxyrinchus*)



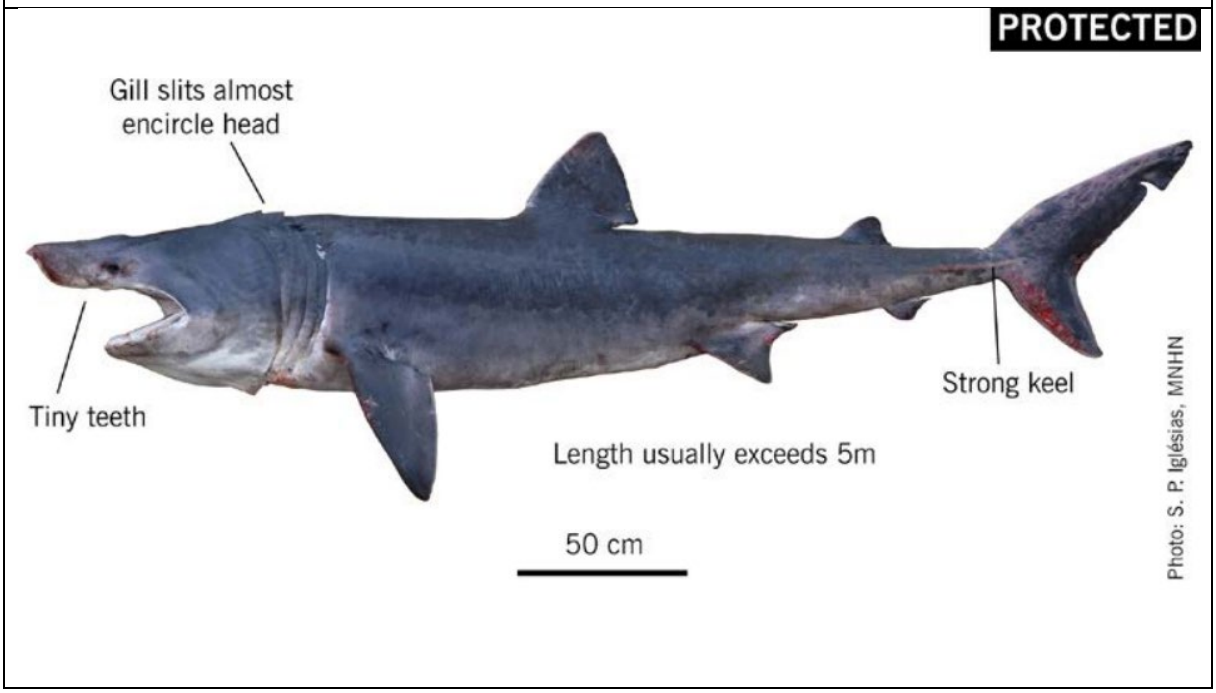
© NIWA

Porbeagle (*Lamna nasus*)



© NIWA

Basking shark (*Cetorhinus maximus*)



11 Appendix 3: Department of Conservation Safe Handling and Release Guide

The full guide can be found here: [protected-species-handling-guide-20192.pdf]

Sharks

pg 8

THINK FIRST: Safety Around Sharks

Treat all sharks as if they are alive, as even sharks which appear to be dead may suddenly lash out and cause injury.

Potential injuries from sharks include being struck, tripped or bitten.

Where possible, avoid working around the jaws of sharks. Put a solid object between a sharks jaws to prevent bites.

There are five protected species of shark in New Zealand waters, they can be accidentally captured in a range of fisheries.

When possible, release the shark from fishing gear without bringing it on deck. This minimises the risk of internal organ damage for the animal.

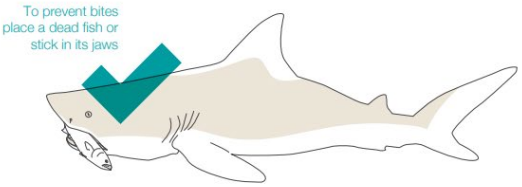
If sharks are landed on deck

- If it is large and active, let it tire before approaching.
- Treat all sharks as if they are alive.
- Once it is safe to do so, try to return the shark to sea head first and the right way up.
- 1-2 people may be required to handle a shark depending on the size.
- Always attempt to keep the shark in a horizontal position and on their side to reduce the risk of internal damage.

Treating sharks on deck

For line fisheries:

- Hold the shark firmly behind the head and around the tail using gloves and/or a wet towel, and then try to remove the hook.
- If the hook cannot be removed easily the line should be cut as close to the mouth as possible.
- To calm a shark down turn it over onto its back or place a wet towel over its eyes.
- If release needs to be delayed, place a deck hose in the shark's mouth so that water flows through the shark's gills.

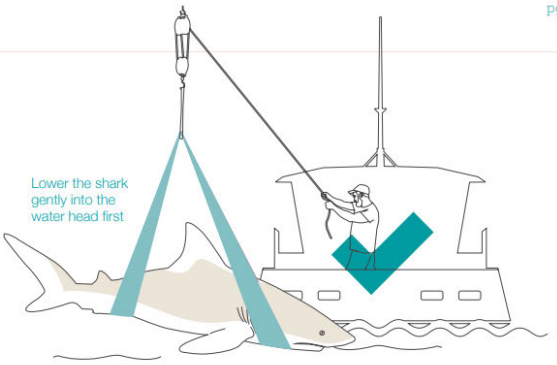


Sharks

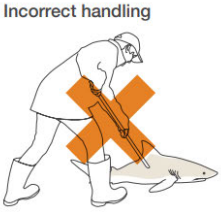
pg 9

Returning sharks to the water

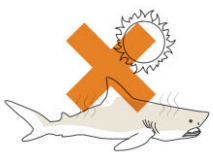
- Lower the shark gently into the water head first and release it. Do not throw it.
- It may be necessary to face the shark into the current and swim it for a few minutes to aid in recovery before it swims away.
- Small sharks can be released by one person.
- Large sharks may require two people to lift and hold the shark.
- Very large sharks may need to be lifted with the use of wide slings.
- Do not use thin wires or cables.
- Do not release sharks with ropes still attached.



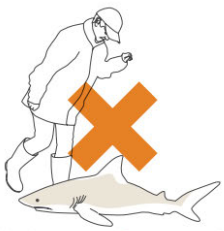
Incorrect handling



Do not use gaffs or sharp objects in direct contact with the shark. A gaff should be used only to control the line.

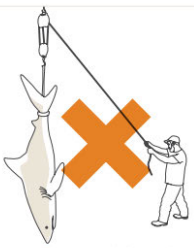


Do not leave the shark exposed to sunlight for extended periods of time.



Do not kick, hit, throw or push the shark harshly, or expose it to other physical trauma.

Do not cut off fins or other body parts to remove sharks entangled in gear.



Do not pick up the shark by the tail, head or the gill slits.