

Management plan for leopard seals in New Zealand waters

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LeopardSeals.org

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1.0 Purpose of the Leopard Seal Management Plan

The Leopard Seal Management Plan (LSMP) has been developed to enable Leopardseals.org (LS.org), the Department of Conservation (DOC), Iwi, and various community stakeholders (including boat clubs/marinas) to:

1. Categorise leopard seal behaviours to enable better management of this species in New Zealand.
2. Establish and define pre-emptive management strategies (and actions) to help stakeholders minimise incidents and avoid emergency situations from developing between humans and leopard seals.
3. Establish and define reactive management actions for events involving leopard seals in New Zealand, thereby providing a coordinated response from all of the stakeholders.
4. Outline intervention activities which can be used for leopard seal disruptions.
5. Provide contact details for all stakeholders to enable effective and efficient communication between organisations in response to leopard seal management in New Zealand.

For the purposes of the LSMP, there is some emphasis on the presence of leopard seals within the Auckland region, however the main aim of this document is applicable to all regions within New Zealand.

2.0 Leopard seals co-habitation in New Zealand

Leopard seals were formally known as a 'Vagrant' species in New Zealand (Hupman et al. 2020). However, after sightings were collected and collated by LeopardSeals.org, analysis showed that the species was found in all regions of NZ and year-round (Hupman et al. 2020). At that point, DOC reclassified this species as a 'Resident' (Baker et al. 2019).

Considering leopard seals are widespread around NZ, they often come into contact with humans and domestic animals which may cause wildlife-human conflict. Such conflicts may include leopard seals approaching out of curiosity or a desire for them to haul out to rest. Additionally, there may be damage to property, as has been documented when dinghy's have been punctured and fenders have been removed. Such conflicts have led to negative perceptions of leopard seals by some humans.

Conversely, human-wildlife conflict occurs where leopard seals are at risk from humans and domestic animals. Such conflicts may include humans making threats of physical harm, close encounters resulting in disturbance and/or harassment and physical harm (including beating and shooting leopard seals). Harassment by dogs has also been documented. Despite the threats/harm posed to leopard seals, our records reflect that their behaviour has not changed towards humans or domestic animals.

One particular leopard seal in Auckland has been the centrepiece of such conflicts. This individual, a female known as HLNZ-001 (nicknamed "*Owha*") is typically found in urban environments including marinas, resulting in frequent encounters with humans and domestic animals. This co-habitation has led to mixed opinions on how she should be managed. *Inter alia* these have resulted in requests/threats for her to be harmed, permanently removed and/or killed. Threats have also included baiting her with fish that has been laced with hooks and actions have included a gunshot wound to the face. Equally, there have been positive reactions to her presence (such as public viewing, dedicated citizen scientists documenting her presence) and strong support for her being protected and nurtured in the marine environment.

Co-existence with leopard seals around New Zealand will require all stakeholders to actively participate in effective management. This will include, education, adjustment of perceptions, increased leopard seal protection, mitigation of property damage and an increased willingness to cohabitate with this 'Resident' species which is part of our cultural and biodiversity heritage.

3.0 Leopard seal behaviour

Table 1 includes an ethogram to describe a full suite of leopard seal behaviours.

*Table 1: Behaviour ethogram for leopard seals. *These are all normal and natural behaviours that leopard seals use to assess the intentions of human(s) and domesticated animal(s); ** May occur due to a leopard seal being unprovoked (shown in the absence of disturbance or harassment) or provoked (shown due to disturbance or harassment); ***At the time of publication this behaviour has not been documented.*

Behaviour Category	Location	Specific behaviour	Definition	Leopard seal example
Biological	In water	Hunting	Pursuing and consuming prey items including seaweed, fish, birds or seals.	Leopard seal swimming after and catching fish.
		Snorting	Exhaling air in a loud manner. This sounds like a deep breath, and is similar to a dolphin or whale exhaling, but typically has a 'sharper' snort. Often associated with surfacing after holding breath for a prolonged period under water. Not directed at any humans(s) or animal(s).	Leopard seal taking deep breath after surfacing from underwater.
		Swimming	Moving through the water. Not directed at any humans(s) or animal(s).	Leopard seal swimming along the beach or through a marina.
	On land	Hauling out	Propelling itself out of the water and onto land/pontoons. Often associated with pre haul-out 'checks' (raising of the head and torso above the waterline to observe a possible haul-out zone) before final propulsion from the water onto land/pontoons.	Leopard seal hauled out on beach or marina pontoon.
		Moving	Moving with chest/belly and hips/tail in contact with ground where the seal shortens and lengthens its body to propel itself forward. Appears similar to movement of a caterpillar. Not aiming at or in the consistent direction of human(s) or domesticated animal(s). Not directed at any humans(s) or animal(s).	Leopard seal moving towards the water on a beach.
		Resting	Laying on its side, belly or back with the head resting on the ground. Eyes may be open or closed. May involve intermittent movements including stretching, yawning, rolling, waving of fore flipper(s) and/or slight body repositioning.	Leopard seal laying on a beach or pontoon.

Behaviour Category	Location	Specific behaviour	Definition	Leopard seal example
		Yawning	Opening of the mouth, often to its fullest extent, and closing shortly after. Head may remain on ground, although it may also be lifted. Eyes are often closed. Not directed at any humans(s) or animal(s).	Leopard seal opening and closing mouth.
Curious / investigative / playful / social	In water / on land	Blowing bubbles	Expelling air from the nostrils and/or mouth underwater to produce bubbles. May or may not be in the direction of a human(s).	Leopard seal blowing bubbles underwater either while fully submerged or from the side of a pontoon.
		Nudging	Making contact with an object, vessel, human(s) or domesticated animal(s) however the object is not displaced. Mouth is closed. Contact is made in a non-aggressive manner.	Leopard seal making a brief contact with a fender hanging over the side of a boat, in which the seal put its nose against it and bumps the fender against the boat.
		Pushing	Making contact with an object, vessel, human(s) or domesticated animal(s) and the object is displaced. Mouth is closed.	Leopard seal leans on the edge of a dinghy so it is pushed to the extent that it begins to be filled with water.
		Mouthing	Making contact with an object, vessel, human(s) or domesticated animal(s) and the object is displaced. Mouth is open and wrapped around the object, vessel or body part of a human(s) or domesticated animal(s). The seal does not bite down with enough pressure to result in damage or injury. Contact is made in a non-aggressive manner. Note: This behaviour has been observed in other pinnipeds but to our knowledge (at time of publication) it has not been observed in leopard seals.	Leopard seal wrapping mouth around a fender but not puncturing the fender.
		Observing	Observation made by watching (tracking) and/or lifting of the head vertically above the water's/grounds surface. Performed in the direction of an object of interest including vessels, human(s) and domesticated animal(s). Often performed several times from various vantage points and may be associated with 'following' and/or 'spy-hopping'.	Leopard seal in the water, lifting its head to observe a dog on a pontoon or human(s) on the beach

Behaviour Category	Location	Specific behaviour	Definition	Leopard seal example
	In water	Spy hopping	Observation made by lifting of the head and upper torso (shoulders) vertically above water's surface. Performed in the direction of an object of interest including vessels, human(s) and domesticated animal(s). Often performed several times from various vantage points and may be associated with 'following' and/or 'observing'.	Leopard seal in the water, lifting its head and upper torso to observe a dog on a pontoon.
		Following	Movement through the water behind or alongside a vessel, human(s) or domesticated animal(s) as they move. May be accompanied by 'observing' and/or 'spy-hopping'.	Leopard seal swimming beside kayaker.
Defensive / warning*	In water	Avoiding	Swimming away from a perceived threat. If in response to a vessel, human(s) or domesticated animal(s) this behaviour indicates disturbance (or harassment) has occurred.**	Leopard seal moves along a pontoon to position itself away from a human who is within a 5m distance.
		Lunging	Rapid propulsion in the direction of, or towards, an object, vessel, human(s) or domesticated animal(s) with intent to protect itself from harm and/or death. No physical contact made. **	Leopard seal lunges towards person on pontoon who hoses it in the eyes with a hose.
	On land	Avoiding	Movement away from a perceived threat. If nearby the water, this often results in the seal returning to the water if possible.**	Leopard seal leaves a pontoon and returns to the water after a human approaches in close proximity.
		Gaping	Opening of the mouth, often to its fullest extent, in a fast manner, and keeping it open acting as a warning/threat display. Head is lifted off the ground. Eyes are typically open. Usually aimed in the direction of a perceived threat and may include 'head jabbing' in the direction of threat.**	Leopard seal opens mouth as a human approaches it in close proximity.
		Head jabbing	Quick movements of the head back and forth (usually with the mouth closed but may be in combination with gaping) and neck often extending to its maximum length, produced when threatened. Body of the seal tends to remain in position.**	Leopard seal moves head back and forwards quickly as a human approaches in close proximity.
		Hissing	A sibilant sound vocal warning noise (similar to the sound produced by a hissing cat) produced when threatened. May or may not be	Leopard seal hisses as a human approaches in close proximity.

Behaviour Category	Location	Specific behaviour	Definition	Leopard seal example
			accompanied by other defensive behaviours.**	
		Wicking	A deep throaty vocal warning noise ('clonking' like sound) produced when threatened. Head is usually tilted back and raised well off the ground, neck fully extended and often seen in combination with gaping.**	Leopard seal makes deep throaty noise as a human approaches in close proximity.
	On land	Charging	Rapid movement towards an object, vessel, human(s) or domesticated animal(s) with intent to protect itself from harm and/or death. No physical contact made.**	Leopard seal makes a sudden movement towards a human as a human approaches in close proximity.
Aggression / Attack***	In water/ on land	Biting / attacking	Making contact with an object, vessel, human(s) or domesticated animal(s) and the object is displaced. Mouth is open and wrapped around a body part of a human(s) or domesticated animal(s). The seal bites down with enough pressure to result in injury or death. Contact is made in an aggressive manner. If in response to a vessel/vehicle, human(s) or domesticated animal(s) this behaviour indicates disturbance (or harassment). It likely showed a range of behaviours (from the Defensive and Warning categories) and these have been ignored and it becomes aggressive as a last resort to protect itself. **	Leopard seal bites a human that approaches in close proximity.

4.0 Pre-emptive leopard seal management

Several pre-emptive actions can be implemented to help minimise incidents and avoid emergency situations from developing between humans and leopard seals. Below a range of actions is outlined noting who, if they are currently being completed, is responsible for conducting them.

4.1 Providing education

The aim is to educate members of the public about leopard seals. It is important that people are made aware of the behaviours displayed by leopard seals under various circumstances and the safety measures people should employ when they encounter a leopard seal (to keep both themselves and others safe). The role of education should include the aspect of informing people of the current legislation in place protecting leopard seals from disturbance or harassment. Strategies and actions that may be used or implemented in order to achieve these aims are described in table 2 below.

Table 2: Education actions for leopard seal management.

Action	Responsibility	Currently conducted?
Provide members of the public with a brochure that explains leopard seal occurrence in and around New Zealand. Include reference to their ongoing presence in urban areas such as Auckland. Include specific information on Owha, her known habits (playing with dinghies and fenders etc.) and any current advice on how people can best protect their private property from damage. It is imperative that this documentation include general safety guidelines and measures that everyone should adhere to in order to minimise incidents and avoid emergency situations from developing. Contact information for the various stakeholders i.e. 0800 DOC HOT (e.g. similar to the seal deal brochure) and 0800 LEOPARD should be included.	DOC	No
Provide boat clubs/ferry terminals/marinas etc. with the aforementioned brochure, which will also explain what measures boat owners can take to prevent damage and human/wildlife conflicts from occurring (i.e. bringing their dinghy's and fenders out of the water when they are not being used) and who to call if and when an issue does arise.	DOC	No
Provide incoming international crews/vessels (e.g. liveaboard yachts, regatta crews) with the aforementioned brochure to ensure that they are not only aware of potential mitigation actions, but also the laws and relevant contact details.	DOC	No
Conduct public presentations every 6 months in the Auckland region to help inform members of the public about the leopard seals that do occur in the region, their known behaviours, current legislation, safety guidelines and how people can best keep themselves and leopard seals safe.	LS.org	Yes (since 2017)
Conduct meetings every 6 months with Auckland boat clubs/marinas etc. to inform and update patrons about leopard seals in the region, how they are being managed, debrief any incidents that have occurred, provide tips or best practice knowledge on how to keep themselves and leopard seals safe and minimise any disturbance	DOC	No

Action	Responsibility	Currently conducted?
issues. Meetings such as this (or via video-conferencing facilities) are preferred over passive options such as emails, as it gives the stakeholders an opportunity to share their opinions and feedback on the effectiveness of management strategies. A question and answer session could be held after the meeting to answer any pressing concerns. Similar private meetings and education events with concerned stakeholder groups would also be useful. Conducting a survey before and after these meetings will also help to ascertain how effective they are as an educational tool and the resulting feelings towards leopard seals and the actions being taken toward their management		
Attend leopard seal sightings to manage the event, set up cordons and, inform members of the public about leopard seals in the region, their known behaviours and how people can best keep themselves and leopard seals safe.	DOC	Yes – in some regions
Install warning signs at frequently used haul-out sites around hotspots for leopard seal presence informing members of the public about leopard seals, the hazards and potential for damage, their behaviours, current legislation and guidelines on how people can keep themselves and leopard seals safe. Include contact information for the various stakeholders. i.e. 0800 DOC HOT and 0800 LEOPARD	DOC	Yes – some, however these are often removed and rarely maintained
Respond to all concerns about leopard seals including non-incidents, incidents and emergencies promptly and efficiently.	DOC	Yes – some
	LS.org	Yes – most
Publish media releases to assist in leopard seal management. Examples include requesting leopard seal sighting reports, providing caution during busy periods (e.g. summer months or during key Auckland events), notifying members of the public about legislation protecting leopard seals and publishing material about breaches of the Marine Mammal Protection Act.	DOC	Yes – some
	LS.org	Yes – some
LS.org and DOC develop a social media campaign to raise public awareness about leopard seals being present around the country and with particular emphasis in the Auckland region	DOC	No
	LS.org	No

4.2 Attending leopard seal sightings

The aim is to attend leopard seal sightings whenever they occur in public locations in order to manage any events which occur. This includes but is not limited to crowd control, ensuring people remain 20m away from the leopard seal and setting up safety cordons. It also includes informing and educating members of the public about leopard seals and how they can best keep themselves and leopard seals safe. Strategies and actions that may be used or implemented in order to achieve this aim are described in table 3 below.

Table 3: Actions for leopard seal management during seal sightings.

Action	Responsibility	Currently conducted?
Attend leopard seal sightings to manage the event, set up cordons and, inform members of the public about leopard seals in the region, their known behaviours and how people can best keep themselves and leopard seals safe. Typically, night-time reports are not responded to due to the reduced level of public exposure. However, if an event were to occur in a public area at night (e.g. onto a pontoon in the Viaduct Harbour during a sailing regatta event) attendance should be considered.	DOC	No currently conducted by LS.org volunteers
Record and document specific information about the leopard seals sighted, their occurrence, behaviours witnessed and individual identity (photo-identification) as well as collecting scientific (e.g. scat) samples where possible to assist with further research efforts.	LS.org	Yes
Attend leopard seal sightings during key public events occurring in the Auckland region (i.e. Westhaven Marina Day, events at the Viaduct Harbour etc.) to manage the event, set up cordons and, inform members of the public about leopard seals in the region, their known behaviours and how people can best keep themselves and leopard seals safe.	DOC	No currently conducted by LS.org volunteers

4.3 Monitoring leopard seal movements

The aim is to document leopard seal movements around New Zealand in order to establish areas most frequently visited by the animals and target pre-emptive management strategies and actions accordingly, while also ensuring that impacted organisations can be made aware of a seal's whereabouts or pre-warned of an animal's impending arrival. Strategies and actions that may be used or implemented in order to achieve this aim are described in table 4 below.

Table 4: Strategies and actions for monitoring leopard seal movements.

Action	Responsibility	Currently conducted?
Broadcast in real time all leopard seals sightings reported in New Zealand (between management stakeholders DOC/LS.org) via a dedicated group on a platform such as Facebook Messenger LOG.	DOC	No - not all
	LS.org	Limited to a small group
Collect scientific data on leopard seal sightings within New Zealand and record this information in the New Zealand Leopard Seal Sightings Database (NZLSD).	LS.org	Yes
Alert all Auckland boat clubs and marinas etc. when a leopard seal is reported heading towards, has arrived in, or is known to be active in, the Auckland region (i.e. when Owha is reported travelling South from Northland and back towards Auckland) so that they are able to pre-warn patrons and thereby manage/minimise the potential risks and/or possible incidents before they end up occurring.	DOC	No
	LS.org	Limited; made by individuals to various management team members

Action	Responsibility	Currently conducted?
Identify key public events occurring in the Auckland region (i.e. Westhaven Marina Day, events at the Viaduct Harbour etc.) and develop a management plan for each event with respect to potential human/wildlife conflicts and human/leopard seal safety (e.g. if a leopard seal is likely to be active in the region at the time of the event or people will be swimming when a leopard seal is known to be in the region at the time of the event).	DOC	Yes – by LS.org
Initiate a more comprehensive monitoring team for Westhaven Marina to allow a 7 day a week presence in this region to monitor the movements of Owha and also reduce the possibility of any events occurring. Since 2017 LS.org and Project Jonah have suggested this idea to DOC and are happy to run such a team, considering their previous experience in running this for both leopard and fur seals in the Auckland region. LS.org strongly recommends this idea be reinvestigated as a longer-term option to allow comprehensive monitoring & eliminate any events from occurring.	DOC	No

4.4 Providing enrichment

The aim is to provide enrichment to leopard seals in the regions where they are consistently interacting with and/or damaging property. The theory behind this is that it will minimise human/wildlife conflicts by offering ‘sacrificial’ objects and thereby lowering the likelihood of private property being taken or damaged. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 5 below.

Table 5: Enrichment actions for leopard seals.

Action	Responsibility	Currently conducted?
Investigate other possible forms of enrichment and/or deterrents used both nationally and internationally by zoological or ecological organisations (e.g. Taronga Zoo or the Kea Conservation Trust) to manage human/wildlife conflicts and look to apply applicable methods to the management of leopard seals in New Zealand.	DOC	No
	LS.org	Yes
DOC to source or provide old, used or discarded dinghy’s, buoys and/or fenders and other appropriate items such as inner tubes from tyres or tyres and place these items in and around known problem areas around Auckland where property damage has proven to be ongoing issue. By providing this enrichment it is anticipated that it will lower the likelihood of property being taken or damaged.	DOC*	No

* LS.org has offered to do this but has been declined by DOC. Members of the LS.org team have been involved with research into enrichment of this type for captive marine mammals for decades.

4.5 Providing training

The aim is to provide all employees (including volunteers) with the appropriate training and skill set required to adequately manage a leopard seal event, their own health and safety around a leopard seal and members of the public. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 6 below.

Table 6: Employee training actions for leopard seal management.

Action	Responsibility	Currently conducted?
Train all employees who may be required to work in close proximity to a leopard seal in First Aid.	DOC	Yes
	LS.org	Yes
Train all DOC/Marina employees that could be required to use the DOC leopard seal disturbance permit to accurately identify a leopard seal (species and individual), interpret their behaviours, recognise their warning signs and threat displays and be familiar with the most effective and appropriate way of managing each set of circumstances as and when they may eventuate during a leopard seal event.	DOC	No
Train all LS.org employees to accurately identify a leopard seal (species and individual), interpret their behaviours, recognise their warning signs and threat displays and be familiar with the most effective and appropriate way of managing each set of circumstances as and when they may eventuate during a leopard seal event. This is of particular importance given that LS.org volunteers are often in attendance at leopard seal sightings without any DOC staff present (and at times with crowds of people).	LS.org	Yes
Ensure that all DOC employees and LS.org volunteers complete DOC Safety Officer Training to enable them to manage unruly/abusive /threatening people during a human/leopard seal event.	DOC	Yes
	LS.org	Most volunteers

4.6 Providing equipment

The aim is for all employees conducting leopard seal management in the Auckland region to have the appropriate (and adequate) equipment required in order to complete their roles safely and effectively. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 7 below.

Table 7: Strategies and actions for supplying employees with equipment.

Action	Responsibility	Currently conducted?
Create and make available a leopard seal field kit which includes warning signs, flyers, cones (or similar), appropriate PPE (i.e. high-visibility vests) etc. for all employees or volunteers attending a leopard seal sighting.	DOC	No
	LS.org	Yes*

*Each volunteer has their own kit with most if not all the items (cones, for example are sometimes unavailable for some volunteers).

4.7 Communicating between stakeholders

The aim is to increase communication and information sharing between all stakeholders involved with leopard seal management around the country. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 8 below.

Table 8: Strategies and actions for stakeholder communication.

Action	Responsibility	Currently conducted?
A meeting with Westhaven Marina should be initiated by DOC but involve LS.org in an effort to keep at least one floating pontoon available at dead man's corner. This platform is vital for monitoring of leopard seals' marina usage, behavior and management initiatives to be trialed (i.e. inflatable dinghy's/fenders on the pontoon). This pontoon was previously removed from dead man's corner and the number of haul outs on other pontoons and piers within the marina dramatically increased. To help protect members of the public and Owha, it is vital that this pontoon remains available and accessible to her in an effort to discourage Owha from hauling out on any public areas around the marina.	DOC	No
A meeting with Westhaven Marina should be initiated by DOC but involve LS.org to discuss the future developments at the marina and the potential impacts this may have on any leopard seals within the region. It is unknown if the development activities will act as a deterrent or attractant to leopard seals (i.e. disturbance could displace the seal from the marina or the seal may be attracted to the noise as was previously observed by divers in the marina and swimmers in the Viaduct). DOC and LS.org need to be involved in the monitoring of leopard seals during the development process to document behavioral changes of the seals. This may require the use of trail cams within the marina. Such monitoring will allow researchers to determine how the development activities effect the seal.	DOC	No
	LS.org	Yes
Form a Leopard Seal Management Group (LSMG), comprised of interested stakeholders who are involved in, or affected by, leopard seal management in the Auckland region (e.g. involving DOC, LS.org, Iwi, Auckland Zoo, marinas, boat clubs etc.) and conduct 6 monthly meetings. Such meetings could inform and update all stakeholders about leopard seals in the region, how they are being managed, debrief any incidents that have occurred, provide tips or best practice knowledge on how to keep themselves and leopard seals safe and minimise any disturbance issues. Meetings such as this (or via video-conferencing facilities) are preferred over passive options such as emails, as it gives the stakeholders an opportunity to share their opinions and feedback on the effectiveness of management strategies.	DOC	No
Include additional key stakeholders into event matrices (e.g. Iwi).	DOC	No

Action	Responsibility	Currently conducted?
Finalise the LSMP and allow all stakeholders (e.g. DOC, LS.org, marinas and iwi) to comment on the plan.	DOC	Limited consultations held
	LS.org	Limited consultations held
Finalise the LSMP to establish clear communication protocols between all of the stakeholders involved in leopard seal management within New Zealand.	DOC/ LS.org	No
A joint meeting should be held with each Iwi in the Auckland region, with both LS.org and DOC present, to discuss leopard seal management in the region, any concerns they have and how they would like to be involved as partners. Where possible, Iwi liaison and involvement should be incorporated into all sections and actions set out in the LSMP.	DOC/ LS.org	Limited consultations held

4.8 Communicating between DOC and LS.org

The aim is to increase communication and information sharing between DOC and LS.org. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 9 below.

Table 9: Strategies and actions for communication between DOC and LS.org.

Action	Responsibility	Currently conducted?
Update SOPs and duty ranger manuals to include information on how to report leopard seal sightings to LS.org and the NZLSD.	DOC	Not that LS.org is aware of
Finalise the LSMP to establish clear communication protocols between DOC and LS.org.	DOC	No
	LS.org	Second round of edits for LSMP completed & submitted to DOC
Expand event response matrices to include both in and outside of office hours. For example, if a DOC employee or duty ranger is not available, then it must be determined what tasks can or cannot be completed by an alternate stakeholder.	DOC	No
	LS.org	No
Develop a reporting method for LS.org to report urgent disturbances/ harassment of leopard seals directly to DOC compliance team, to allow urgent follow up by DOC team members.	DOC/LS.org	No
Develop a reporting method for DOC to report to LS.org when members of the public contact 0800 DOC HOT with concerns over welfare of leopard seals.	DOC/LS.org	No

4.9 Dealing with conflict/property damage

The aim is to report, document, review, debrief and ultimately minimise human/leopard seal conflicts. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 10 below.

Table 10: Strategies and actions on dealing with human/ wildlife conflict.

Action	Responsibility	Currently conducted?
Develop an online submission form for registering property damage, a conflict, incident or event involving a leopard seal. Information obtained is to be collated, stored in a database and reported back to members of the LSMG.	DOC	No*
	LS.org	LS.org**
Discuss with the DOC compliance team member what constitutes 'harassment' and 'disturbance' under the Marine Mammal Protection Act. These terms are not defined in the Act and yet it is crucial to understand what they mean to monitor conflicts that arise. For instance, is the use of a hose, air horn etc. to deter a leopard seal from a public pontoon considered as disturbance or harassment under the Act?	DOC	No

* Although a database may exist, events are rarely reported back to LS.org.

** LS.org maintains a database of incidences and reports these to DOC via the Auckland Leopard Seal Facebook Messenger group.

4.10 Investigating incidents and emergencies & improving responses to such events

The aim is to investigate all reported incidents and emergencies to ensure that the circumstances of each event (or incident) are fully understood. Any breaches of the Marine Mammal Protection Act should be enforced to ensure that leopard seals continue to receive the protecting they are entitled to under the law. When incidents and emergencies do occur, appropriate follow up should identify areas for improvement for future events. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 11 below.

Table 11: Actions for investigation of incidents and emergencies.

Action	Responsibility	Currently conducted?
Investigate all (reported) incidents (as differentiated from 'sightings') involving a leopard seal and debrief the outcomes with LS.org and/or other applicable stakeholders.	DOC	No - not the debrief/ reporting
Record any and all threats received against a leopard seal in a 'threat database' so that subsequent incidents or emergencies can be linked back to potential contacts.	DOC	No
Record the management actions completed when an incident or emergency occurs including the protocols followed, how quickly was	DOC	No

Action	Responsibility	Currently conducted?
the incident or emergency attended too, and what improvements could be made in the future to streamline the management actions currently in place.		
Develop better communication between DOC and LS.org to make each organisation aware as quickly as possible of any threats that may be made. Police should also be immediately alerted when a threat involving a firearm is made.	DOC/LS.org	No
Establish a protocol for dealing with incidents and emergencies in an effective manner and involve national and international experts in the management of such events.	DOC	No
	LS.org	Yes

4.11 Understanding compliance

The aim is to understand how the Marine Mammal Protection Act can be used to protect leopard seals and what rights organisations such as DOC and LS.org have in response to harassment and disturbance to these animals.

Table 12: Strategies and actions on understanding compliance.

Action	Responsibility	Currently conducted?
Discuss with the DOC compliance team the best way to deal with threats made to harm leopard seals (i.e. shooting leopard seals). A protocol needs to be developed to formally warn members of the public that taking such actions will be in breach of the Marine Mammal Protection Act and an official database needs to be established to log offenders so any repeat threats or actual harm can be dealt with effectively.	DOC	No
Discuss with the DOC compliance team what constitutes 'harassment' and 'disturbance' under the Marine Mammal Protection Act. These terms are not defined in the Act and yet it is crucial to understand what they mean to monitor conflicts that arise. For instance, is the use of a hose, air horn etc. to deter a leopard seal from a public pontoon considered as disturbance or harassment under the Act?	DOC	No

4.12 Trialling deterrents & developing intervention matrices

The aim is to use deterrents and/or interventions to discourage leopard seals from entering public places where they may trigger human/leopard seal conflicts. Various deterrent methods are described within the DOC permit to disturb leopard seals in the Auckland region. LS.org notes that deterrents are yet to be trialled to determine which methods are the most effective, yet least invasive. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 13 below.

Table 13: Strategies and actions on development of deterrents for leopard seals.

Action	Responsibility	Currently conducted?
DOC and LS.org to work collaboratively on developing a leopard seal deterrent trial to remove leopard seals from Populated areas (in particular suburban areas) and look to integrate the most effective/least invasive measures into the current LSMP.	DOC/LS.org	No
Develop flow charts which describe actions required for all intervention activities between key stakeholders (i.e. DOC, LS.org, Iwi, zoos etc.).	DOC/LS.org	No
<p>DOC and LS.org work collaboratively to complete a leopard seal deterrent trial and report on the results of what were the most effective/least invasive measures used and incorporate these into the current LSMP.</p> <p>Further guidelines should be developed as to how different deterrent activities are tested and implemented. It is imperative that the use of these activities does not create negative associations for leopard seals with humans. It is also important to review the use of these deterrent activities in the wider context of all leopard seals and other native wildlife within NZ. For example while Westhaven Marina is a public place where we may decide to use deterrent activities, we need to consider what messaging this will give to the wider NZ public about removal of leopard seals and other native wildlife from other public areas – considering DOC maintains a ‘minimum intervention’ policy.</p> <p>Note that the use of any deterrent activities should be recorded (either by video or trail cameras) and then reviewed to allow DOC and LS.org to; a) make improvements to the activity, b) assess the behavioral response of the leopard seal to the activity, in particular to assess if seals become habituated to repeated activities, c) determine the effectiveness of the activity and if it should be continued as a deterrent method, and d) thoroughly document the activity being conducted to develop deterrents of leopard seals in other public areas within NZ. The deterrent trials should only be trialed after health and safety training has been conducted on safe approach distances and emergency responses if leopard seals show any signs of aggression.</p>	DOC/LS.org	No
A short-term study should be initiated to investigate potential mitigation options to manage and deter leopard seals from marinas. LS.org proposes a six-month study to be conducted to complete a thorough examination of what options have been used worldwide to deter pinnipeds from public areas and how to manage interactions between leopard seals and humans in Auckland.	DOC	No

4.13 Review of DOC leopard seal disturbance permit

In 2019, Panuku Development Limited (Westhaven Marina) and Empire Capital (other marinas in Auckland), both applied to DOC for permits to remove leopard seals from specific locations when they were disrupting members of the public or in emergency situations. This permit states that DOC

employees are able to conduct activities to remove leopard seals from specific areas, however when DOC employees are unavailable, employees of the marinas are able to conduct the activities to remove leopard seals (as long as they have undergone DOC training). Both the Westhaven Marina permit and the Empire Capital permit were granted without consulting species-specific experts such as LS.org. There are currently a number of flaws identified by LS.org within these permits - and in 2019 DOC agreed that these flaws need to be addressed as soon as possible. The aim herein is to address the current flaws in these permits by revising the current permit conditions. Strategies and actions that may be used or implemented in order to achieve this aim are described in Table 14 below.

Table 14: Strategies and actions on review of current DOC permits.

Action	Responsibility	Currently conducted?
DOC to review LS.org comments on the Westhaven Marina and Empire Capital permits.	DOC	No
DOC and LS.org to liaise with each other and the DOC Permit team in order to revise permit conditions.	DOC/LS.org	No
Look at expanding current permit conditions to allow trained experts (i.e. LS.org) to assist in leopard seal disturbance mitigation. This may prove to be beneficial to DOC when DOC staff are unable to attend leopard seal incidents or emergencies.	DOC	No

5.0 Reactive leopard seal management

When an interaction occurs between a leopard seal and a human, the situation may need retroactive leopard seal management. Below we outline a number of events that may occur, the various response levels each event may trigger, and the required response from the different stakeholders/organisations.

5.1 Event definitions

In Table 15 we outline the types of events which can occur and if they are based on the point of view (POV) of the leopard seal (LS) or human (H)/ domesticated animal (A). We outline the definitions of each type of event and where there are multiple POV's (i.e. LS, H or A), we provide a definition for each. We provide an example for each category, but recognise that there will be other scenarios which will fall into each category (and some which may not fit into these event definitions at all).

Table 15: Possible event types (and definitions) which have an impact on leopard seal management.

Event type	Definition	Example
Question (H POV)	General question about a leopard seal that does not concern conflicts between humans/domesticated pets or the seal.	Where leopard seals are found presently in the Auckland region.
Sighting (H POV)	Sighting report of a leopard seal that was not the cause of any conflict between humans/domesticated pets or the seal	A leopard seal observed laying on a pontoon at Westhaven Marina.
Close encounter (LS, H, A POV)	An encounter between a LS/H/A, within a physical distance of 1 m.	A leopard seal approaches a diver underwater and comes within a physical distance of 1 m of the human.
Perceived conflict (H POV)	A conflict which is perceived (rather than actual) between a human and a leopard seal	A leopard seal which hauls out from the water onto a pontoon, and there is a human nearby who is startled and scared by the leopard seals presence.
Disruption requiring intervention (H POV)	Any disruption to day-to day human activities caused by a leopard seal which thereby is deemed by DOC to require intervention.	A leopard seal hauled out on a public fuel jetty preventing humans from accessing the fuel pumps. DOC deems that the seal needs to be removed from the fuel jetty.
Disruption requiring intervention (LS POV)	Any disruption to leopard seal behaviours caused by a human/animal which thereby is deemed by DOC to require intervention.	A leopard seal is feeding in the water and a boat uses a hose to remove the leopard seal from the area.
Property damage (H POV)	Damage to any human property caused by a leopard seal. Damage may be superficial (damage that does not impact the use/effectiveness of the item), repairable (damage that impacts the use/effectiveness of the item, but it can	Superficial: Teeth marks in a non-inflatable fender and still able to be used.

Event type	Definition	Example
	be repaired) or not fit for purpose (damage that impacts the use/effectiveness of the item and therefore it is no longer fit for purpose as the item can't be repaired or cost to repair is prohibitive).	Repairable: Small hole on side of dinghy that can be repaired. Not fit for purpose: Large hole on side of inflatable dinghy that can not be repaired.
Threat (LS POV)	A verbal or written threat made about a leopard seal by a human to disturb, harass, injure or kill a leopard seal.	A human threatening to shoot a leopard seal which has caused property damage.
Natural or indirect injury (LS POV)	Any injury to a leopard seal that was either from natural causes or was from an indirect action of a human or domesticated animal.	A leopard seal with a scar from another leopard seal or a fishhook through its mouth.
Disturbance (LS POV)	Either an unintentional or intentional action to a leopard seal by a human or domesticated animal that causes the leopard seal to change its normal behaviour(s) (includes expression of warning, defensive, and displacement behaviours). Note: this could escalate into other higher-level events described below.	Unintentional: A human walking past a leopard seal on a pontoon in close proximity, not realising the leopard seal was there, causing the leopard seal to move from the pontoon into the water. Intentional: A human walking towards a leopard seal on a beach in close proximity making loud noises, knowing the leopard seal was there, causing the leopard seal to move into the water.
Harassment (LS POV)	An Intentional action to a leopard seal by a human or domesticated animal that causes the leopard seal to change its normal behaviour(s) (includes expression warning, defensive, and displacement behaviours). Note: this could escalate into other higher-level events described below.	A human walking towards a leopard seal on a pontoon in close proximity using a hose directed at the animal's face, knowing the leopard seal was there, causing the leopard seal to move from the pontoon into the water.
Harassment (H/A POV)	An Intentional action to a human or domesticated animal by a leopard seal that causes the human to change its normal behaviour(s) (includes protection of themselves against harassment by the seal). Note: this could escalate into other higher-level events described below.	A leopard seal swimming through the water and encountering a diver, whereby it starts to bite their leg repeatedly.
Direct injury / attack (LS POV)	Any action from a human or domesticated animal towards a leopard seal which causes physical injury or death.	A human shooting a leopard seal or a leopard seal bitten by a dog

Event type	Definition	Example
Direct injury / attack (H/A POV)	Any action from a leopard seal towards a human or domesticated animal which causes physical injury or death.	A leopard seal biting a human, dragging them underwater and drowning them.

5.2 Response levels

Depending on the severity of the event and the possible/likely outcomes, different response levels can be assigned as follows:

- Non-incident – Any interaction involving a leopard seal and a vessel, human(s) or domesticated animal(s) that does not result in a negative outcome for either party.
- Incident – Any interaction involving a leopard seal and a vessel, human(s) or domesticated animal(s) that results in a negative outcome for one or more of the parties (i.e. damage, loss, aggravation or injury).
- Emergency – Any interaction involving a leopard seal and a vessel, human(s) or domesticated animal(s) that results in an attack or serious (i.e. life threatening or changing) injury to one or more of the parties (i.e. a serious bite, gunshot).

5.3 Event response matrix

Below we define the types of events which can occur and if they are based on the point of view (POV) of the leopard seal (LS) or human (H)/ domesticated animal (A). We outline the response level associated with each event and the required response from different stakeholders including DOC, LS.org, iwi and boat clubs/marinas (referred to below as marina). The table below endeavours to cover all non-incidents, incidents and emergency situations that may occur. However, there may be incidents or events that fall outside the scope of the table and these should be worked through collaboratively by stakeholders, with common sense and the below matrix as a guide. In addition, these matrices should be expanded on to include office and non-office hours so that a plan can be prepared between stakeholders for both scenarios.

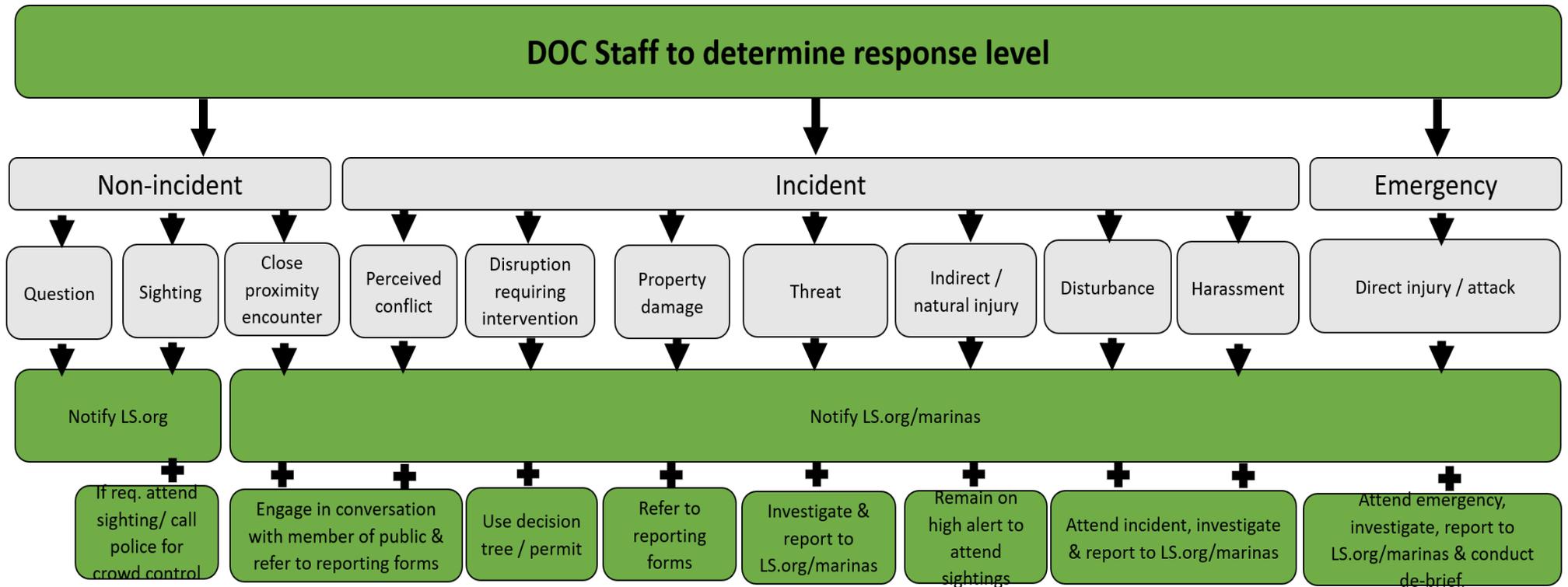
Type of Event	Response Level	DOC response	LS.org response	Iwi response	Marinas response
Question (H POV)	Non-incident	Pass question to LS.org.	Answer leopard seal question.	Pass question to LS.org.	Pass question to LS.org.
Sighting (H POV)	Non-incident	<p>Notify LS.org of sighting.</p> <p>If required (i.e. people within 20 m of leopard seal or crowd of >20 people), attend the sighting & complete crowd control.</p> <p>If required (i.e. unruly people or crowd of >100 people), request police assistance.</p>	<p>Notify DOC/marinas of sighting.</p> <p>Record sighting of leopard seal in NZLSD.</p> <p>If required (i.e. people within 20 m of leopard seal or crowd of >20 people), request DOC's assistance to attend the sighting & complete crowd control.</p> <p>If required (i.e. unruly people or crowd of >100 people), request police assistance.</p>	Notify LS.org of sighting.	<p>Notify LS.org of sighting.</p> <p>If required (i.e. people within 20 m of leopard seal or crowd of >20 people), request DOC's assistance to attend the sighting & complete crowd control.</p> <p>If required (i.e. unruly people or crowd of >100 people), request police assistance.</p>
Close proximity encounter (LS/H/A POV)	Non-incident	<p>Notify LS.org/marinas.</p> <p>Engage in conversation with member of the public.</p>	<p>Notify DOC/marinas.</p> <p>Engage in conversation with member of the public.</p>	Notify DOC/LS.org.	Notify DOC/LS.org.
Perceived conflict (H POV)	Incident	<p>Refer member of the public to conflict/damage reporting forms.</p>	<p>Refer member of the public to conflict/damage reporting forms.</p>		
Disruption requiring intervention (LS POV)	Incident	<p>Notify LS.org/marinas.</p> <p>Use of intervention decision tree to determine the level of intervention required.</p>	<p>Notify DOC/marinas.</p>	Notify DOC/LS.org.	<p>Notify LS.org/DOC.</p> <p>Use of intervention decision tree to determine the level of intervention required.</p>

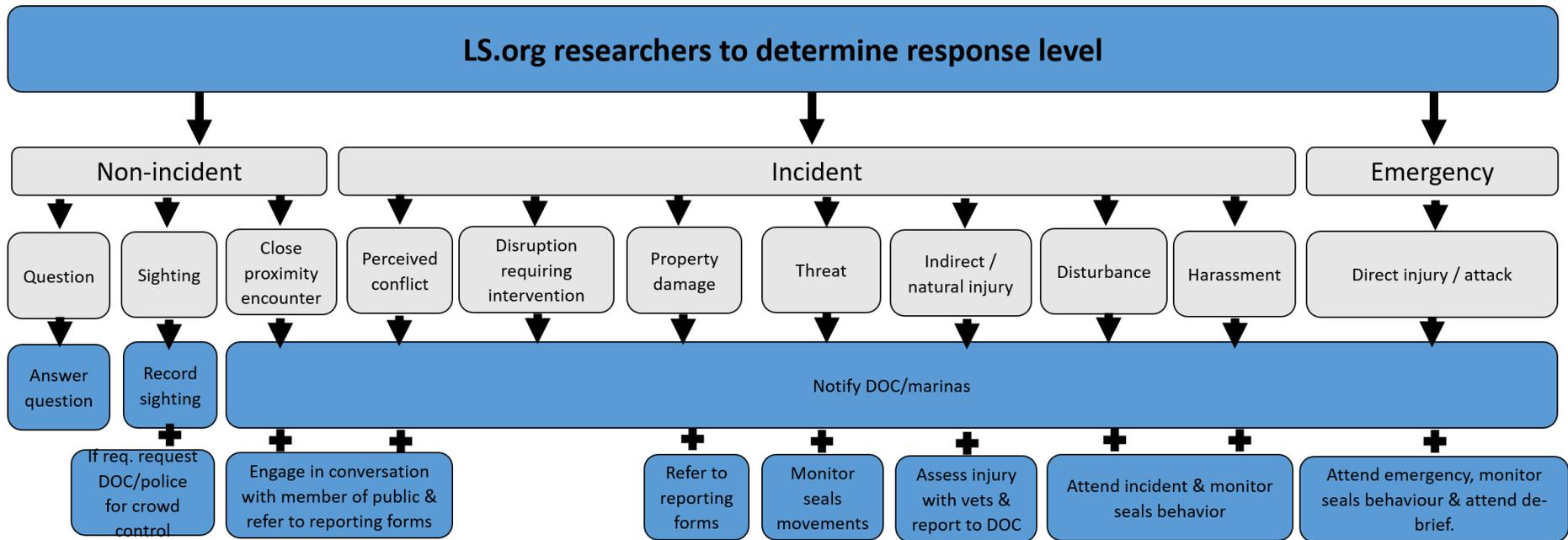
Type of Event	Response Level	DOC response	LS.org response	Iwi response	Marinas response
		Utilise DOC leopard seal disturbance permit as required.			Utilise DOC leopard seal disturbance permit as required.
Disruption requiring intervention (H POV)	Incident	Notify LS.org/marinas. Use of intervention decision tree to determine the level of intervention required. Utilise DOC leopard seal disturbance permit as required.	Notify DOC/marinas.	Notify DOC/LS.org.	Notify LS.org/DOC. Use of intervention decision tree to determine the level of intervention required. Utilise DOC leopard seal disturbance permit as required.
Property damage (H POV)	Incident	Notify LS.org/marinas. Engage in conversation with member of the public. Refer member of the public to conflict/damage reporting forms.	Notify DOC/marinas. Engage in conversation with member of the public. Refer member of the public to conflict/damage reporting forms.	Notify DOC/LS.org.	Notify DOC/LS.org.
Threat (LS POV)	Incident	Notify LS.org/marinas. Record threat in database. Complete investigation to determine if any follow up actions or prosecution is required.	Notify DOC/marinas. Record threat in database. Monitor leopard seal movements. Receive report from findings of DOC investigation.	Notify DOC/LS.org.	Notify DOC/LS.org.

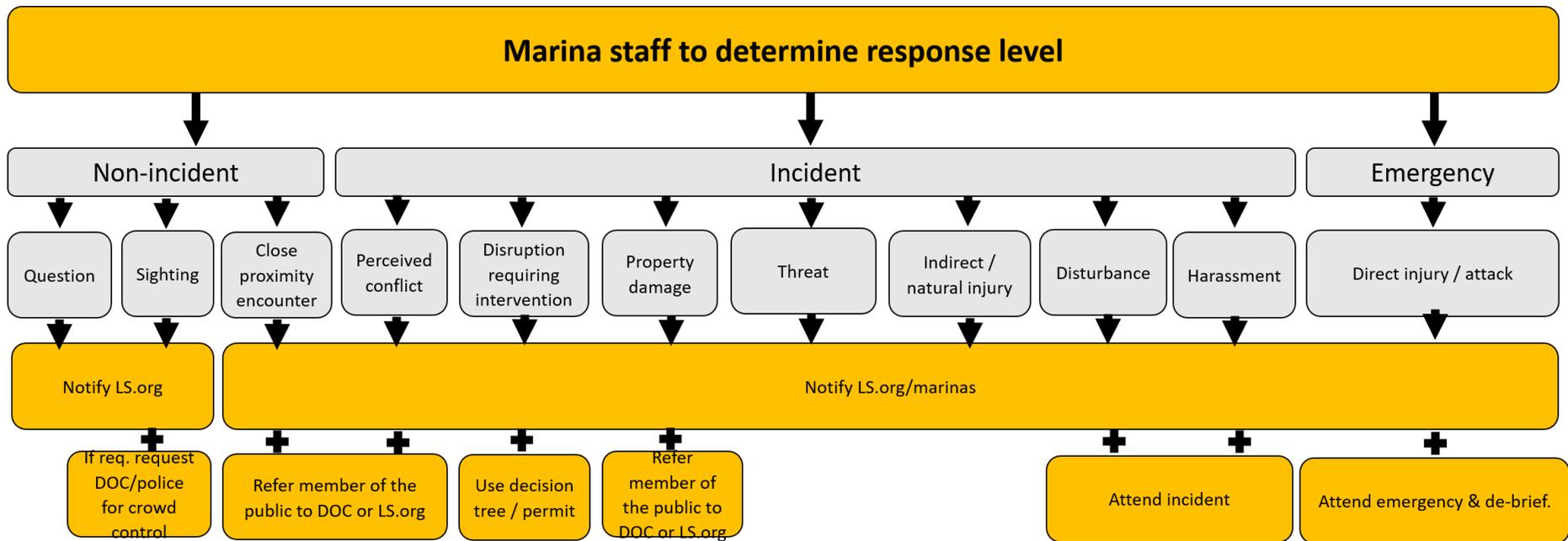
Type of Event	Response Level	DOC response	LS.org response	Iwi response	Marinas response
		Report the findings of the investigation to LS.org and marinas.			
Indirect/natural injury (LS POV)	Incident	<p>Notify LS.org.</p> <p>Receive report from findings of injury assessment from LS.org.</p> <p>Remain on high alert to attend to sightings, considering the injury may change leopard seal behaviour.</p>	<p>Notify DOC.</p> <p>Assess the injury with the assistance of Veterinarians and report the outcome to DOC.</p> <p>Remain on high alert to attend to sightings, considering the injury may change leopard seal behaviour.</p>	Notify DOC/LS.org.	Notify LS.org/DOC.
Disturbance (LS POV)	Incident	Notify LS.org/marinas.	Notify DOC/iwi/ marinas.	Notify DOC/LS.org.	Notify LS.org/DOC.
Harassment (LS/H/A POV)	Incident	<p>Attend the incident (if current).</p> <p>Complete investigation to determine if any follow up actions or prosecution is required.</p> <p>Report the findings of the investigation to LS.org and marinas.</p>	<p>Attend the incident (if current).</p> <p>Monitor leopard seals behaviour.</p> <p>Receive report from findings of DOC investigation.</p>		<p>Attend the incident (if current).</p> <p>Receive report from findings of DOC investigation.</p>

Type of Event	Response Level	DOC response	LS.org response	Iwi response	Marinas response
Direct injury / attack (LS/H/A POV)	Emergency	<p>Notify LS.org/marinas.</p> <p>Attend the emergency (if current).</p> <p>Complete investigation to determine if any follow up actions or prosecution is required.</p> <p>Report the findings of the investigation to LS.org and marinas.</p> <p>Host a debrief with LS.org and marinas.</p>	<p>Notify DOC/iwi/ marinas.</p> <p>Attend the emergency (if current).</p> <p>Monitor leopard seals behaviour.</p> <p>Receive report from findings of DOC investigation.</p> <p>Attend debrief.</p>	<p>Notify DOC/LS.org.</p> <p>Receive report from findings of DOC investigation.</p> <p>Attend debrief.</p>	<p>Notify LS.org/DOC.</p> <p>Attend the emergency (if current).</p> <p>Receive report from findings of DOC investigation.</p> <p>Attend debrief.</p>

Below we provide an event/incident flow chart for DOC, LS.org and Marina staff. Local Iwi will need to be consulted in each region to develop their own event/incident flow chart.







6.0 Intervention activities

When an incident or emergency occurs between a leopard seal and a human/domesticated animal (and vice versa) several intervention methods can be conducted to appropriately and effectively manage the situation.

6.1 Impact levels

Each intervention method can be categorised into one of the following impact levels:

- **Minimal Impact** – The method is unlikely to cause current behavioural change, disturbance, harassment, injury or death to a leopard seal or cause the leopard seal to change its behaviour towards humans/domesticated animals in the future.
- **Moderate Impact** – The method is unlikely to cause current behavioural change, disturbance, harassment, injury or death to a leopard seal, however persistent or continued use of this method may cause the leopard seal to change its behaviour towards humans/domesticated animals in the future.
- **Major Impact** – The method is likely to cause current behavioural change, disturbance, harassment, injury or death to a leopard seal. If not resulting in death, persistent or continued use of this intervention method may cause the leopard seal to change its behaviour towards humans/domesticated animals in the future.

6.2 Intervention methods - minimal and moderate impact levels

Below we outline the minimal and moderate intervention methods which could be used when an incident or emergency occurs between a leopard seal and a human/domesticated animal. Intervention methods should be used/implemented in the order listed below (i.e. first the implementer will try '1. Visual stimuli'. If the outcome is unsatisfactory the implementor can then move on to '2. Audio stimuli' etc.).

Intervention method	Detail	Impact level
1. Visual stimuli deterrent	Use thick brightly coloured tape ribbons tied approximately 1-1.5m above the ground at a distance of 5-10m from the seal. It must be noted that this may not work if the seal is sleeping. In this situation a combination of audio (see intervention activity 2) and visual stimulus could be used. Stimuli should be tried for a 10-minute period.	Minimal
2. Audio stimuli deterrent	Use of whistles or airhorn (from a distance) intermittently or an audio recording played from a speaker. Stimuli should be tried for a 10-minute period. Stimuli should be no louder than 120 Db (threshold based on noise levels which damage hearing for other pinnipeds).	Minimal
3. Distant physical stimuli deterrent	A saltwater or freshwater hose should be set up with the nozzle 10m from the seal and laying on the ground while pointed toward the posterior (rear) of the seal. Water should run along the ground towards	Minimal

Intervention method	Detail	Impact level
	the seal. The water volume may be increased over time until the implementation is completed. Or an oscillating sprinkler (on a light pressure setting) could also be used 5-10m from the seal to simulate rain.	
4. Close physical stimuli deterrent	A saltwater or freshwater hose, handled by the implementor, should be aimed at the ground approximately 10m from the seal. The water pressure should be set as low as possible (but may be increased incrementally until it causes the water to splash slightly off the ground. As time passes the distance between the seal and point of contact (where the water hits the ground) may be decreased at a rate of 1 meter per minute (but never closer than 1m away from the seal). The intervention should be aimed at the posterior (rear) end of the seal and water from the hose should never be aimed forward of the fore-flippers.	Moderate

Leopard seal removal

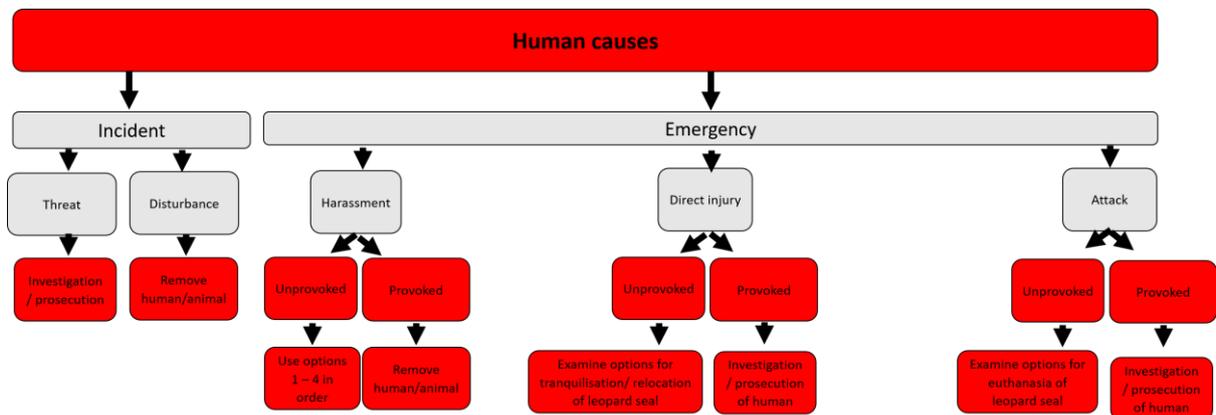
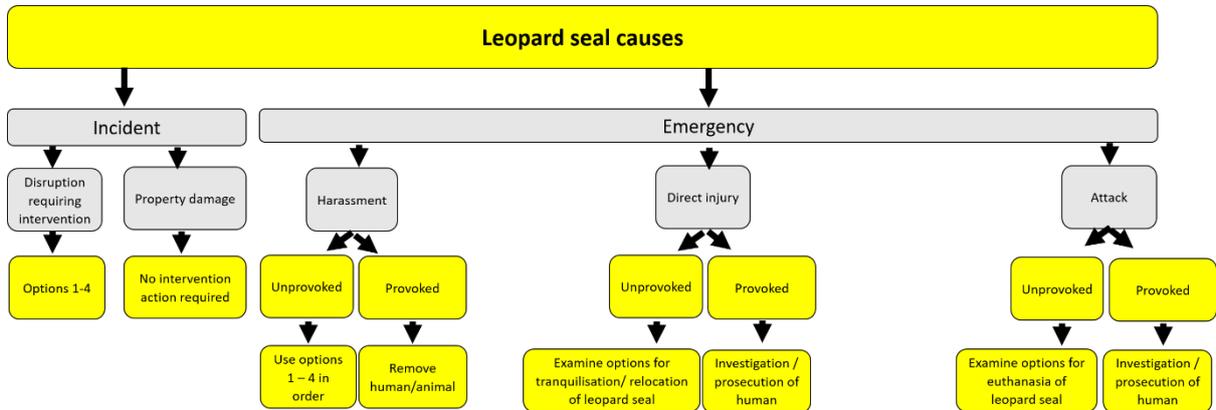
Currently, DOC have issued a permit to Panuku Development Limited (Westhaven Marina) to remove a leopard seal from an area if it is: (1) disrupting normal day to day activities of humans and (2) in the event of an emergency. Currently this permit can only be used by DOC employees, however DOC can instruct DOC trained members of Westhaven Marina staff to conduct removal activities if DOC is unable to attend. Currently LS.org is unable to conduct removal activities at any Marinas in Auckland. In addition to the Panuku Development Limited permit, Empire Capital (Bayswater and other marinas in the Auckland region) have also applied for an identical permit. The status of this permit is not known. The marina removal permits can currently be used by DOC or trained Westhaven Marina employees to conduct intervention methods 1-4.

6.3 Intervention methods - major impact level

Intervention methods which are for major impacts include tranquilisation, relocation and/or euthanasia. As these methods carry extreme risk/death to a leopard seal, any discussion or implementation of these methods would require:

- Extensive consultation between DOC, LS.org, Iwi and other experts to determine, under which circumstances major level intervention activities should be used.
- Development of pre-discussed and stakeholder agreed upon matrices which outline when such intervention methods should be used.
- These methods to be a last resort option, if all other minimum and medium level intervention methods have been exhausted or proven to be inappropriate.
- Strong evidence that the leopard seal displayed unprovoked aggression or an attack towards a human or domesticated animal.
- DOC and appropriate animal ethics approval.

Below is an example of matrices which could be used; however this requires further development between DOC, LS.org, Iwi and additional stakeholders.



7.0 Acknowledgements

Thank you to those who have contributed to various iterations of this management plan, especially Tineke Joustra and Rick Bout for their extensive edits. We recognise their efforts and desire to see better protection for leopard seals around New Zealand.

8.0 References

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