

# **Entanglement of Cetaceans in Pot/Trap Lines and Set Nets and a Review of Potential Mitigation**

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# Worldwide Context

- Conservation issue worldwide.
- Can be major anthropogenic cause of injury and death.
- Effect of entanglement: individual whale vs population.
- Varying levels of population resilience to entanglement.
- Underreporting of entanglements is a major issue.
  - ▶ Entanglement rates should be considered conservative – suggestion that actual rates may be 10 x reported.

# New Zealand Context

- DOC maintains databases.
- Humpback, southern right and killer whales most frequent large whales to be entangled in fishing gear.
- Commercial pot/trap lines and set net: fisheries that most frequently entangle large whales.
- The annual number of reported entanglements is low compared to other countries.
- But, DOC have observed changes in the entanglement data (location and species) and want to know if this warrants implementation of mitigation measures, and if so, what these could be.

# Scope of Project

- Data from available sources.
- Characterise nature and extent of cetacean interactions with commercial pot/trap lines and set nets.
  - ▶ Focus on large whale species (especially humpback, southern right and killer whales).
- Make recommendations on whether the current level of risk of entanglement warrants development or implementation of mitigation.
- Identify and assess current domestic and international mitigation techniques for cetacean entanglement in pot/trap lines and set nets.
- Make recommendations as to their applicability to NZ fisheries.

# Methods

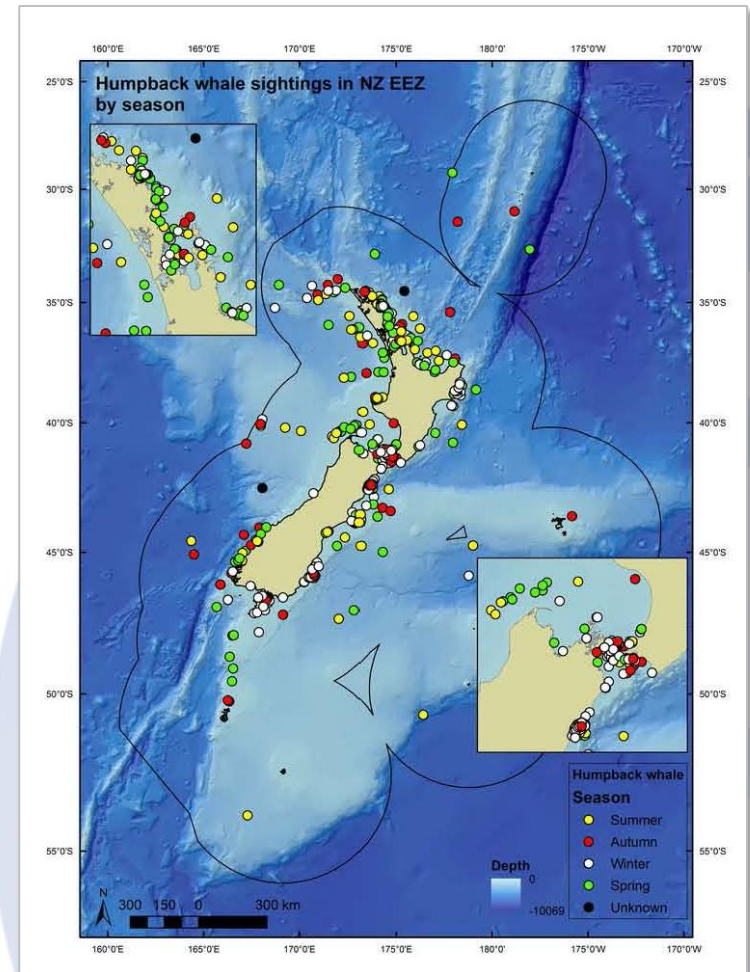
- Liaised with DOC, MPI, fishing industry and relevant experts to compile data from available sources relating to:
  - ▶ The current status of pot/trap line and set net fisheries in NZ
    - MPI fisheries web site, NABIS, and commercial fishing industry representatives (set net and rock lobster).
  - ▶ Cetacean abundance/distribution/trends in NZ waters
    - Scientific literature, commissioned reports and grey literature, and researchers.
  - ▶ Documented entanglement events
    - DOC databases, MPI COD and WAREHOU databases, online searches, researchers, DOC disentanglement team personnel.
  - ▶ Mitigation techniques
    - Scientific literature, government agency commissioned reports, conference proceedings, researchers, commercial research and results from industry and scientific trials.

# Experts Consulted

- Alysia Barnes (Ministry for Primary Industries)
- Chevy Allen (Whale Watch Kaikoura and member of the New Zealand disentanglement team)
- Daryl Sykes (New Zealand Rock Lobster Industry Council)
- Doug Coughran (Department of Parks and Wildlife, Western Australia)
- Hannah Hendricks (Department of Conservation)
- Jason How (Western Australian Fisheries and Marine Research Laboratories)
- Jooke Robbins (Center for Coastal Studies, Massachusetts, USA)
- Katie Clemens-Seely (Department of Conservation)
- Mike Morrissey (Department of Conservation and South Island Coordinator of the New Zealand disentanglement team)
- Mike Noad (Cetacean Ecology and Acoustics Laboratory, University of Queensland)
- Nadine Bott (Researcher)
- Paul Berentson (Ministry for Primary Industries)
- Roger Williams (Whale Watch Kaikoura and member of the New Zealand disentanglement team)
- Russell Leaper (Chair of IWC Committee on Anthropogenic impacts on whales, UK)
- Tom Clark (Fisheries Inshore New Zealand Ltd)

# Humpback Whales in NZ

- Considered ‘Migrant’ under the NZ TCS.
  - ▶ Migrate north (May-Aug).
  - ▶ Migrate south (Sep-Dec).
  - ▶ May take different routes.
  - ▶ Cook Strait.
- Part of Oceania breeding stock: ‘Endangered’ (IUCN).
- No previous significant trend in population recovery, but perhaps now increasing.
- Population?

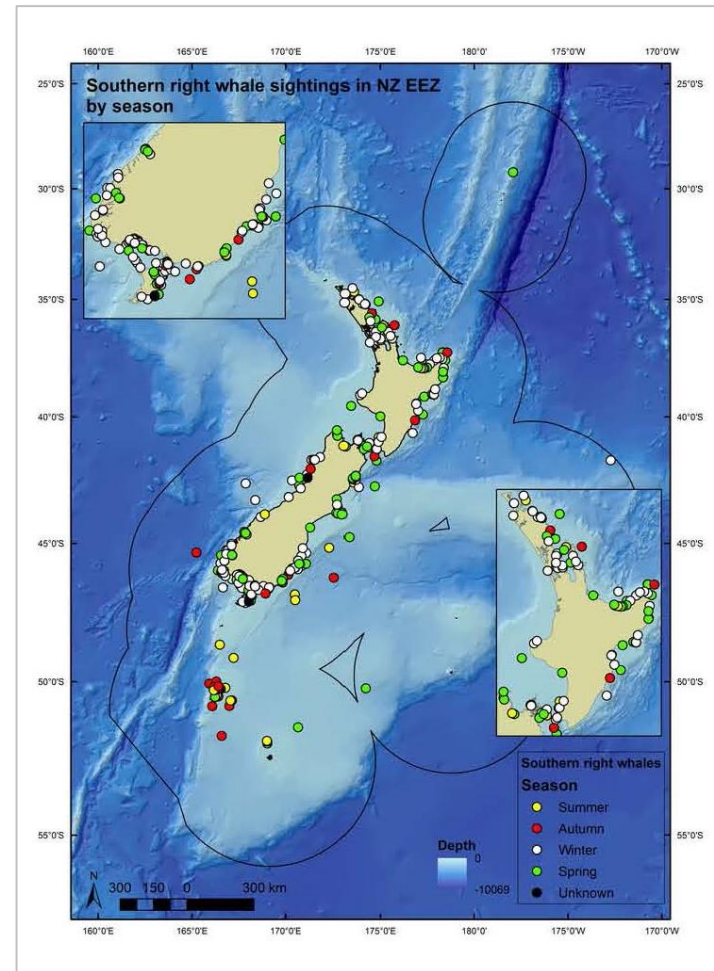


Source: Berkenbusch et al. 2013 (distribution 1970-2013)



# Southern Right Whales in NZ

- Wintering grounds in subantarctic and (increasingly) mainland NZ.
- Most sightings along the coast occur in winter and spring, with calving occurring in winter.
- Whales appear to move offshore to feeding areas in summer.
- Slowly increasing in numbers (2,169 between 1995-2009, with rates of increase estimated at 5% for females and 7% for males in the subantarctic population).
- 'Nationally Vulnerable' under the NZ TCS.

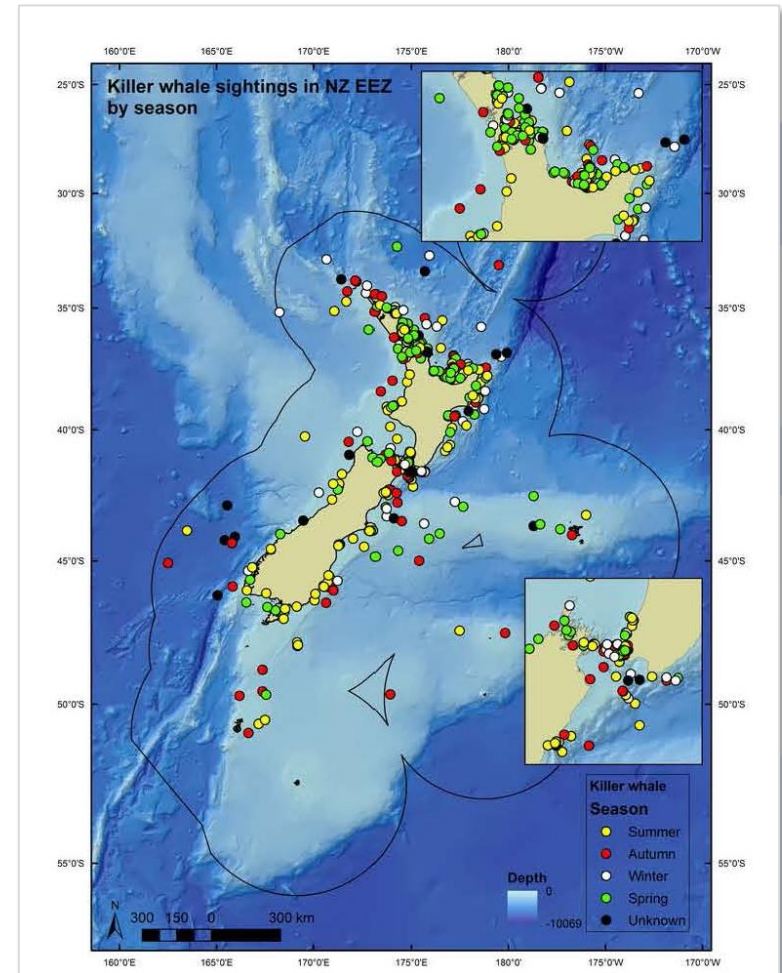


Source: Berkenbusch et al. 2013 (distribution 1970-2013)



# Killer Whales in NZ

- 2006 photo-ID catalogue included 132 animals.
- 'Nationally Critical' under the NZ TCS.
- Regularly sighted along NZ mainland, Chatham Islands, and in offshore and subantarctic waters.
- Potentially three subpopulations: North Island; South Island; one that moves between.
- Some individual killer whales are resighted irregularly, with years between resights, whereas others are resighted regularly.
- Regularly resighted animals may live permanently or semi-permanently close to NZ coastline.

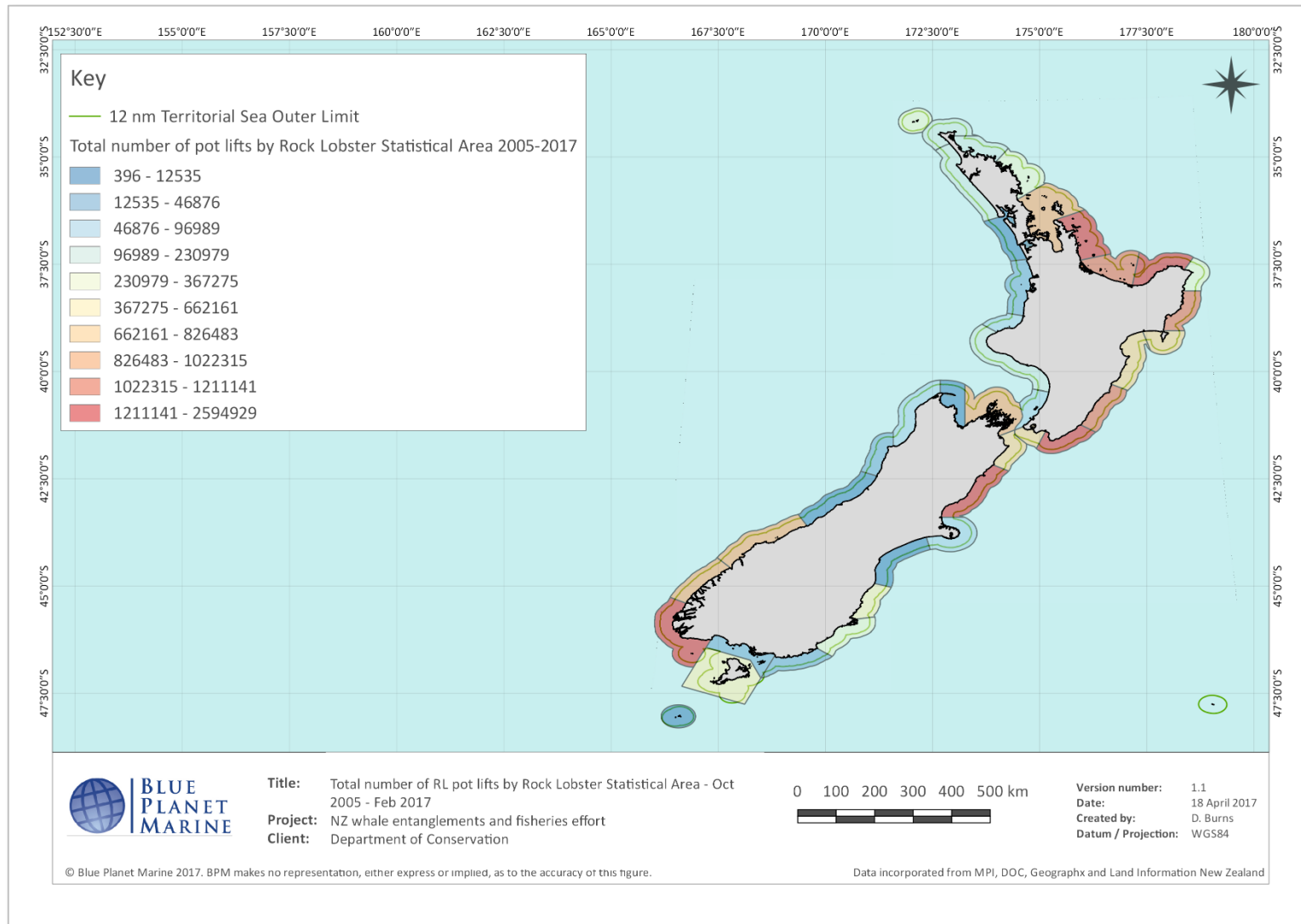


Source: Berkenbusch et al. 2013 (distribution 1970-2013)

# NZ Commercial Pot/Trap Line Fisheries

- Many fisheries use pots, only rock lobster potting has documented large whale entanglements.
- Pots lowered to the seafloor, where they sit unanchored. A line (rope) extends from the pot to the sea surface connected to a buoy.
- The time of day when pots are set varies among fishers and areas, and they are generally hauled and baited in 24-hour cycles, dependent on weather.

# Rock Lobster Fisheries Effort



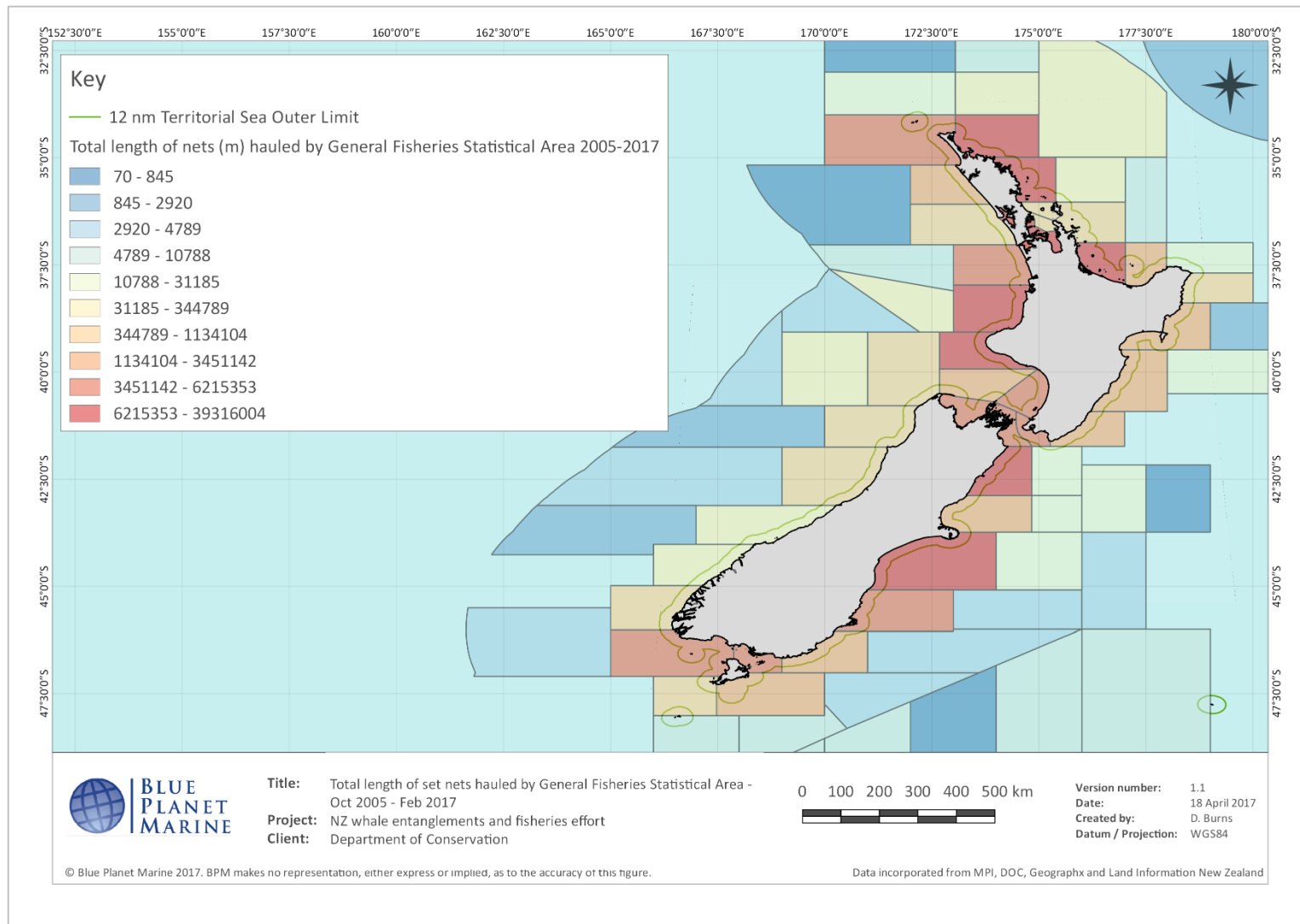
# NZ Rock Lobster Fishery Mitigation

- No currently enforced, mandated whale entanglement mitigation practices.
- NZRLIC recommendations (Whalesafe Identification Guide).
- Same as used in Western Australia by the West Coast Rock Lobster Managed Fishery in their 'Code of Practice for Reducing Whale Entanglements' and include:
  - ▶ Remaining vigilant between May, June and July;
  - ▶ Avoiding excessive slack in pot ropes;
  - ▶ Avoiding setting pots in clusters;
  - ▶ Not leaving pots in the water if not fishing;
  - ▶ Regularly checking pots;
  - ▶ Reporting entanglements as soon as possible;
  - ▶ Collecting any abandoned/lost or cut pot lines, rope or fishing gear;
  - ▶ Investigating new technologies that may reduce entanglements; and
  - ▶ Adopting a cooperative approach to avoiding entanglements and responding to entanglements when they occur.

# NZ Commercial Set Net Fisheries

- Many forms of net fishing, only set netting has documented large whale entanglements.
- Set nets: floats at the top and weights at the bottom, creating a vertical wall of net into which fish swim and become entangled. Nets held in place by anchors/ground weights.
- Target numerous pelagic, demersal and benthic fish species.
- By regulation, may set up to 3 km of net per day.
  - ▶ Target species/habitat/bathymetry affects net set up.
- By law can remain set for max. 18 hours at a time (some exemptions to 24 hours).
  - ▶ Actual time varies from ~20 min (net is actively worked in a harbour) to 24 hours (at sea). During these times nets are not necessarily attended.

# Set Net Fisheries Effort





# NZ Set Net Fishery Mitigation

- Indirect management measures in place.
  - ▶ Type 1 Marine Protected Areas (marine reserves = area closures).
  - ▶ Type 2 Marine Protected Areas (some MPAs prohibit set net fishing).
  - ▶ Other marine protection tools (e.g. marine mammal sanctuaries).
- Some fishers include gaps between nets.

# Large Whale Entanglements in NZ

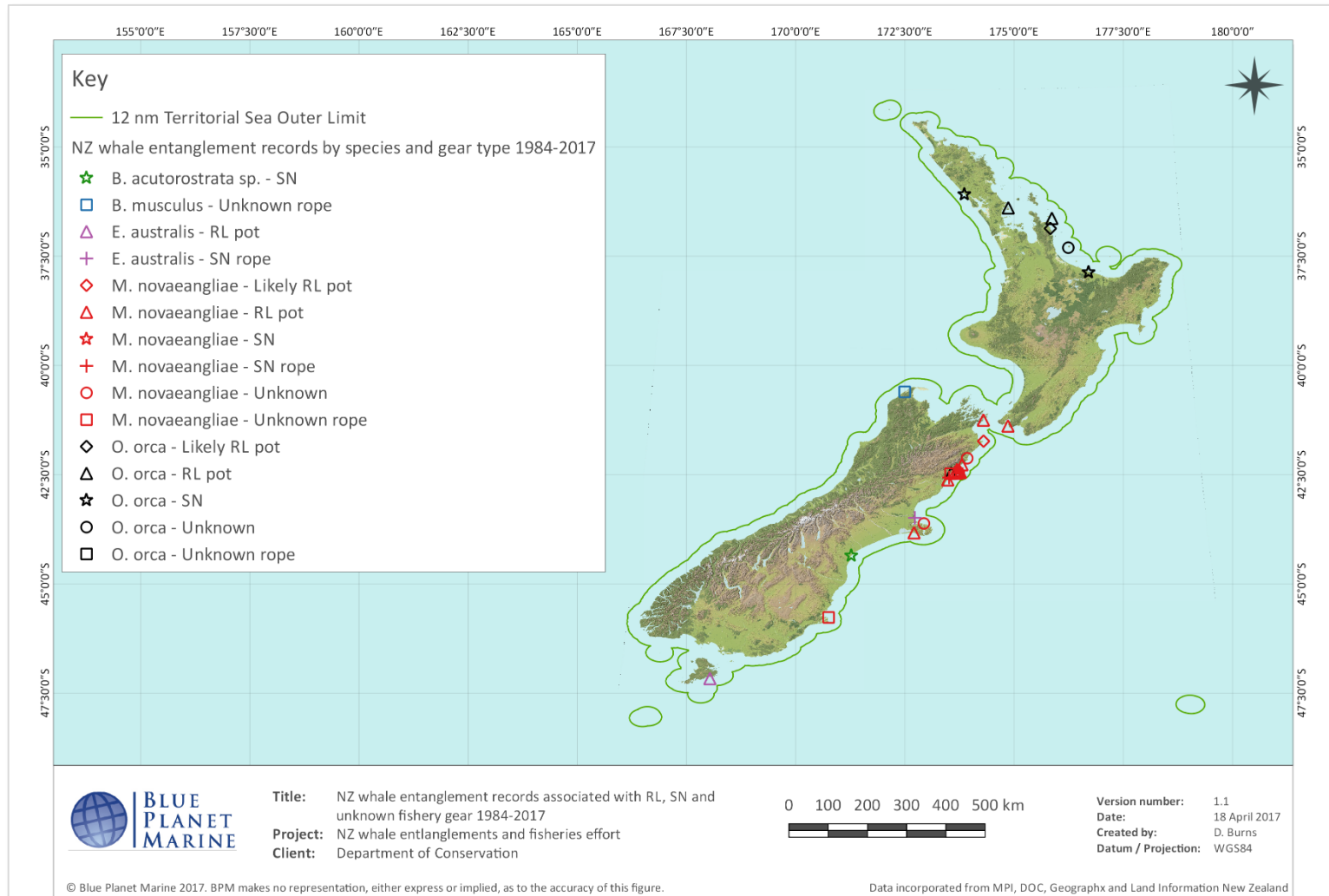
- 44 documented entanglement events in NZ waters involving large whale species between 1984 and 2017.
  - ▶ 36 from DOC databases.
  - ▶ 1 from fisheries observer data (COD).
  - ▶ 1 in a recent email to BPM from DOC.
  - ▶ 6 found in online media.
- We believe this is an underrepresentation of actual entanglements:
  - ▶ DOC database includes no entanglements between 1985-1991.
  - ▶ Reports of entanglements back to 1970s.
  - ▶ Outside of MPI fisheries processes, no formal requirement for reporting.
- 5 entanglements excluded from analyses.
- 39 documented entanglements of large whale species in commercial pot/trap lines, set net fisheries or unknown fisheries gear since 1984.

# Large Whale Entanglements in NZ

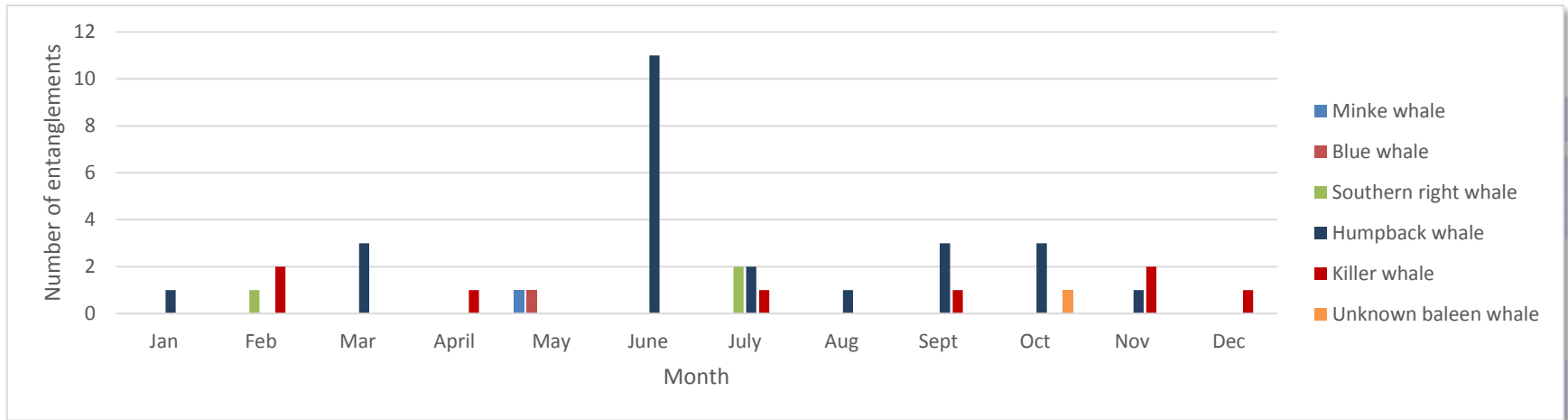
	Likely RL pot	RL pot	SN	SN rope	Unknown gear type	Unknown rope	Grand Total
Minke whale	0%	0%	2.6% (1)	0%	0%	0%	2.6% (1)
Blue whale	0%	0%	0%	0%	0%	2.6% (1)	2.6% (1)
Southern right whale	0%	5.1% (2)	0%	2.6% (1)	0%	0%	7.7% (3)
Humpback whale	7.7% (3)	35.9% (14)	5.1% (2)	2.6% (1)	7.7% (3)	5.1% (2)	64.1% (25)
Killer whale	2.6% (1)	10.3% (4)	5.1% (2)	0%	2.6% (1)	0%	20.5% (8)
Unknown baleen whale	0%	0%	2.6% (1)	0%	0%	0%	2.6% (1)
<b>Grand Total</b>	<b>10.3% (4)</b>	<b>51.3% (20)</b>	<b>15.4% (6)</b>	<b>5.1% (2)</b>	<b>10.3% (4)</b>	<b>7.7% (3)</b>	<b>100% (39)</b>

- Reported entanglement rate from 1991-2017 is 1.4 whales/year.
- 62% of entanglements involved rock lobster gear and ‘likely’ rock lobster gear.
- Set nets accounted for 15% of entanglements and a further 5% attributed to set net ropes specifically.
- Humpback whales were involved in 64% of entanglements, and 21% involved killer whales, with 3 records (8%) of southern right whale entanglements.

# Documented Entanglements - Location

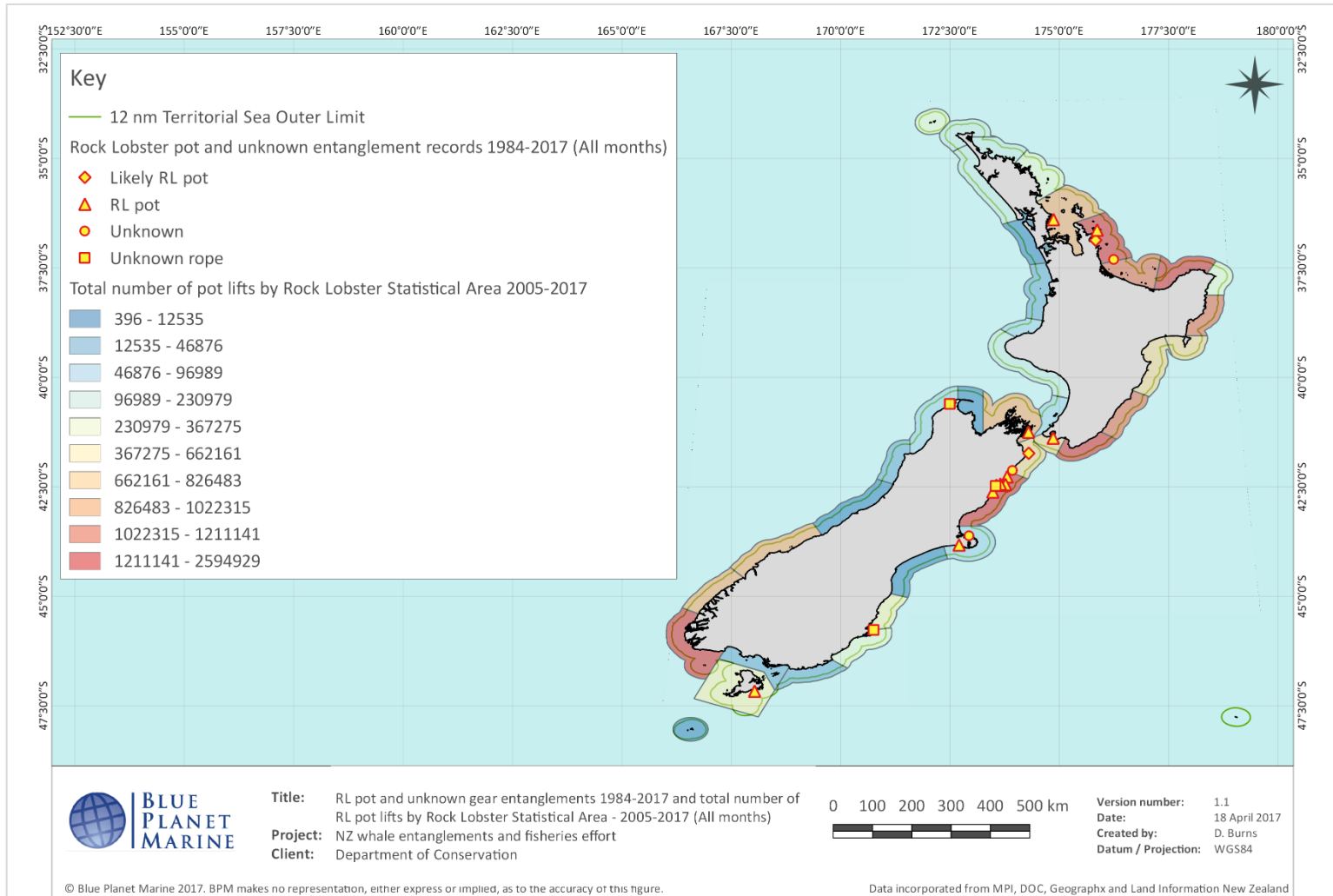


# Documented Entanglements – Over Time



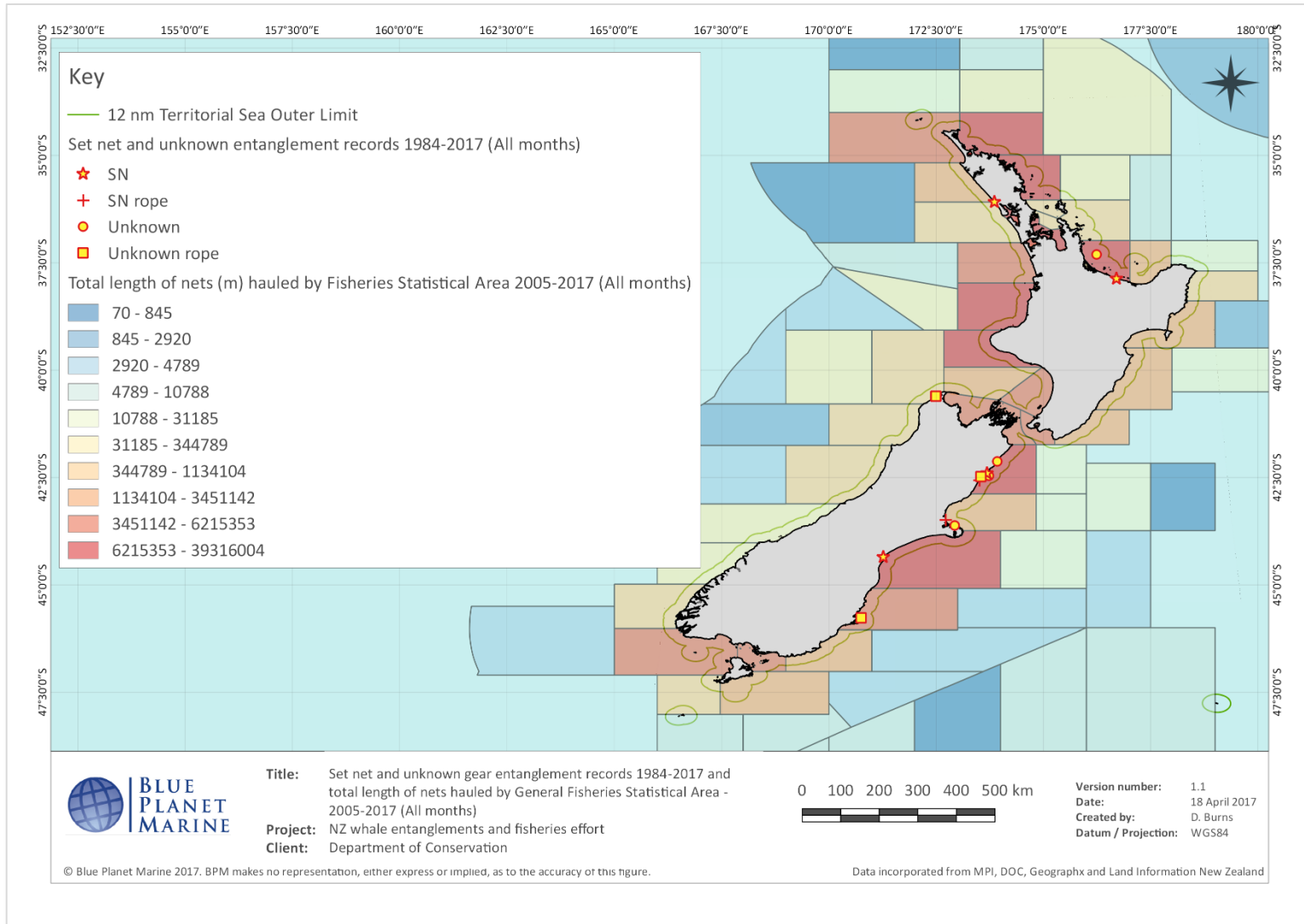
- Since 1991, 0 to 4 whales entangled/year.
- Almost one third (11 of 39) of all documented entanglements occurred in June, all humpbacks.
- Of these 11 entanglements, most in Kaikoura region, most entangled in rock lobster fishing gear, and none known to have caused the death of the whale.
- There may be some evidence that large whales are being caught in more regions, but doesn't appear that a greater number of species are being caught.

# Documented Entanglements – Rock Lobster Fishing Effort



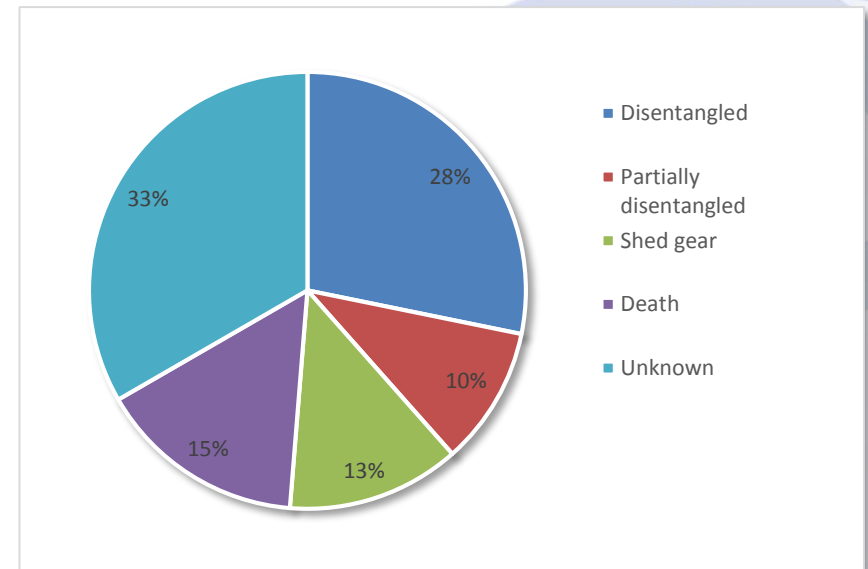


# Documented Entanglements – Set Net Fishing Effort



# Outcome of Entanglement - Individuals

- Whales were fully disentangled (with intervention) in 28% of all documented entanglement events, with 10% partially disentangled (with intervention).
- 13% of whales shed gear on their own (without intervention).
- 15% of entanglements were linked to the death of the individual, either directly or indirectly.
- The fate of 33% of entangled whales remained unknown.



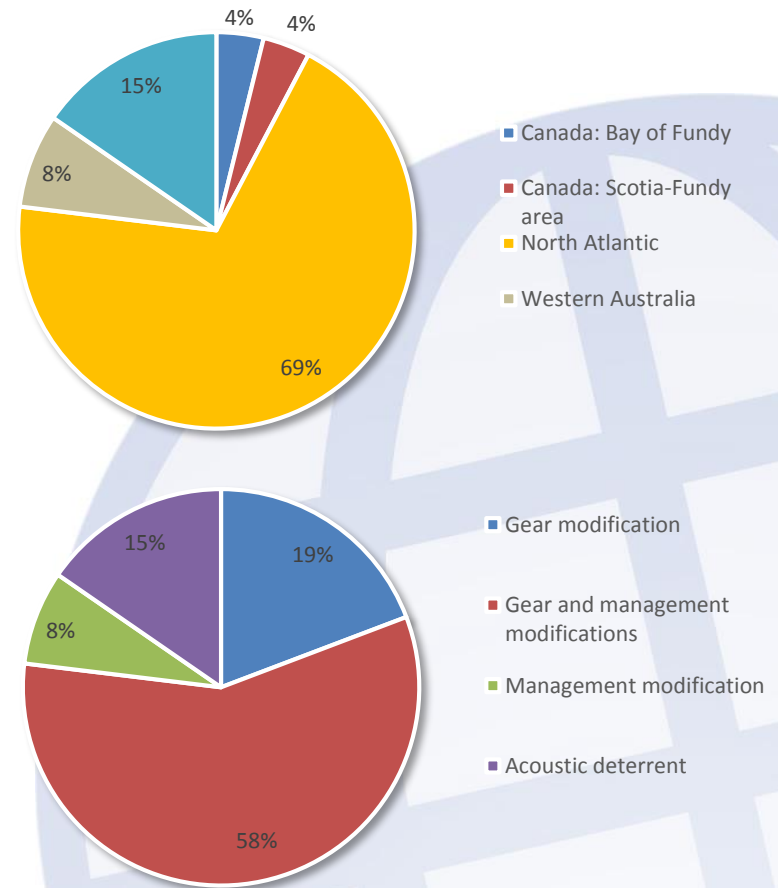
# Risk Analysis

- Simple risk analysis undertaken of large whale entanglements for selected pressure (risk) groups in NZ.
- This was used to evaluate the current degree of severity of entanglements, the likelihood of entanglements occurring, and then determine the level of risk.
- Likelihood of an entanglement event occurring – Unlikely (not expected, but there is a slight possibility it may occur at some time).

Pressure (Risk) Group	Consequence	Risk
Individual whale	<b>Medium</b> – Extreme	Medium
Whale populations	HB and SR whales – Low Killer whales - Medium	Low Medium
Commercial fisheries	Low	Low
Whale-watching operators	Negligible	Low
DOC	Low	Low

# Entanglement Literature Review

- 84 papers and reports relevant to large whale entanglement.
- 26 specifically relevant to the development, testing and implementation of mitigation techniques.
- Mitigation categories:
  - ▶ Acoustic deterrents
  - ▶ Gear modifications
  - ▶ Management modifications



# Mitigation Techniques – Gear Modifications

Gear Modification	Detail	Fisheries	Country	Effective
Weak links	Weak links between parts of fishing gear designed to break under particular level of pressure	Pots/traps, anchored set nets	USA - Atlantic coast	Apparently not, mainly due to placement of weak link
Rope strength	Reduced Breaking Strength ropes – vertical lines	Pots/traps, anchored set nets	USA - Atlantic coast	Uncertain – too early to tell
Reduction of slack (vertical) rope	Negatively buoyant groundline and vertical lines	Pots/traps, anchored set nets	USA - Atlantic coast	Apparently not
Seasonal reduction of rope at water surface	Rope negatively buoyant at top 1/3 of pot line, restrictions on max length of pot line compared to water depth	Rock lobster pots/traps	Australia - WA	Anecdotally successful in reducing entanglements
Rope-less fishing (remote releases)	Eliminate need for slack rope in water while pots in place – acoustic, anode or timer releases	Pots/traps	Australia – WA, NSW USA - Atlantic Coast	Trials only, results pending. Expensive and some resistance in uptake by fishers
Coloured rope	Ropes (and nets) of a certain colour are potentially more visible to whales	Pots/traps, anchored set nets	USA - Atlantic	Lab trials only on right whales. Some evidence but requires further research in situ

# Mitigation Techniques – Acoustic Deterrents

- Aim is to change the behaviour of bycatch species around fishing traps/pots or nets.
- Pingers – common technique to deter small cetaceans – varying success.
- Few studies on large whales.
- East coast of Australia (humpback whales) – inconsistent results between studies and northern/southern migrating whales.
- Chance of habituation to acoustic deterrents.
- Increase noise pollution.
- Relatively expensive.



# Mitigation Techniques – Management Response

Management	Detail	Fisheries	Country	Effective
Reduction of vertical lines in water column	Restricting number of vertical lines in water by prohibiting single trap/pots and requiring fishermen to increase number of traps per trawl	Pots/traps	USA – Atlantic coast	Uncertain – too early to tell, but anecdotally not
Spatial or temporal closures	Closing fisheries at certain times of the year or in particular locations	Pots/traps	Australia (WA) USA – New England	WA – temporal expansion of WA RL fishery corresponded with increased humpback entanglements. USA – no decrease in crude whale entanglement numbers in western North Atlantic region. Need to fully understand species' use of an area for these tools to be effective.
Disentanglement	Team of trained personnel track and follow whale and attempt to free it of fishing gear (usually by keggering or telemetry buoys)	Pots/traps, anchored set nets	Australia, Canada, South Africa, Mexico, NZ, USA	Approximately 30% of reported entanglements successfully disentangled  Reactive rather than proactive Uncertainty around survival Stop-gap solution

# Conclusions

- Entanglement occurs worldwide – significance varies with species and location
- Uncertainty in reporting + conservation effects.
- ~1.4 large whales/year (1991-2017) entangled in NZ commercial set net and pot/trap fisheries. This is a conservative value.
- Rock lobster fishery greatest number of entanglements.
- Risk of entanglement to an individual whale is Medium.
- Risk of entanglement to humpback and southern right whale populations in NZ is considered Low.
- Risk to killer whales is considered Medium.
- Increasing whale populations or in fisheries effort will likely lead to increased rate of entanglement (and risk to stakeholders).
- Risk to stakeholders is considered Low, and is currently focussed on public perception/relations.

# Conclusions

- No mitigation techniques yet scientifically proven to work for large whales in commercial set net and pot/trap fisheries.
- In theory, spatial and temporal closures/restrictions should lead to the greatest reduction in entanglement rate, BUT
  - ▶ In order to be effective overall, the location and/or timing of spatial and temporal closures require sound knowledge of a species' use of an area (and wider area) and other demographic data.
  - ▶ Closures/restrictions will likely have significant effects on fisheries.

# Conclusions

- We are not advocating for fishery area closures, but if considered, seasonal closures of some fisheries during the humpback whale northern migration period would likely make the most difference. The financial cost to fisheries and the NZ economy, however, would be significant.
- Seasonal, mandatory gear modifications, or seasonal effort restrictions would be a more measured approach in NZ, and one that the fisheries may be more open to, considering many such measures are already recommended by the NZRLIC.
  - ▶ These must be based on good knowledge of entanglement, including what part of the gear is most frequently involved in entanglement, when this most frequently happens, when etc.
- Mitigation measures proposed in NZ will have the best chance of success if relevant stakeholders are engaged and involved from the outset.
- Mitigation methods must be financially viable either in outright costs to fishers, or through government subsidies.
- Disentanglement efforts are highly effective in NZ, and will continue to be a vital mitigation measure until effective preventative measures are developed.

# Recommendations

- Reduce risk in practical, cost-effective terms until effective mitigation measures are developed:
  - ▶ Minimise slack rope
  - ▶ Conduct observations of the use of NZRLC's 'OceanSnap' application and if/how this consequently results in fishers moving/removing gear in instances when whales are sighted.
  - ▶ Develop or purchase entanglement buoys similar to those used in WA.
  - ▶ Conduct public education campaigns about the NZ disentanglement network and increased funding or training for DOC HOTLINE.
  - ▶ Train additional personnel (within and outside of DOC) as part of the NZ disentanglement network.
  - ▶ Conduct advocacy campaign that targets fishers around the Kaikoura region and along the south east coast of the South Island during the months of May-August.
- Data recording and quality
  - ▶ Audit DOC databases to ensure they include all known entanglements.
  - ▶ Enhance data reporting protocols for entanglement events (e.g. more information about fishing gear).
  - ▶ Conduct scar-based studies to quantify the extent of the entanglement problem for whales migrating past NZ.
  - ▶ Determine sex via DNA analysis to inform impact on particular demographics.
  - ▶ Monitor (or assist with), the global development of fisheries gear modifications focused on lowering the rate of whale interactions with fisheries.