DOLPHIN DISSUASIVE DEVICE MITIGATION INSHORE FISHERIES – MIT2019-01

SIMON CHILDERHOUSE, OLIVIA JOHNSON,
LAURA TREMBLAY-BOYER

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BACKGROUND

- Dolphin Dissuasive Devices (DDDs) = pingers
- DDDs are thought to limit interactions between dolphins and fishing nets by emitting high frequency ultrasound signals that either persuade animals to avoid the noise source or increase echolocation to actively search for nets
- Good international evidence for their success in reducing bycatch (sometimes by as much as 100%) in several different fisheries
- DDDs are presently being used in some NZ fisheries (e.g. inshore set net, offshore trawl)
- Anecdotal information that they may be effective in reducing dolphin bycatch in setnet and trawl fisheries
- No clear quantitative data or direct evidence from New Zealand as to the efficacy of DDDs (Stone et al. 2000; Dawson & Lusseau 2005)
- Still unclear as to how reductions work (e.g. behavioural mechanism)

PROJECT SCOPE

The project has the following main objectives:

1. Review of international literature of the types of DDDs used and their influence on bycatch events (summarised in a matrix), leading on to a specific review of New Zealand set-net and trawl fisheries with all protected New Zealand dolphin species, including Hector’s and Māui dolphins (HMDs)
2. Develop a methodology for possible field trials and assessment of DDDs appropriate to an inshore fishery environment (i.e. set-net and trawl) to mitigate bycatch of HMDs
3. Propose recommendations for future research on the use of DDDs in the New Zealand inshore fishery with respect to bycatch mitigation of HMDs.

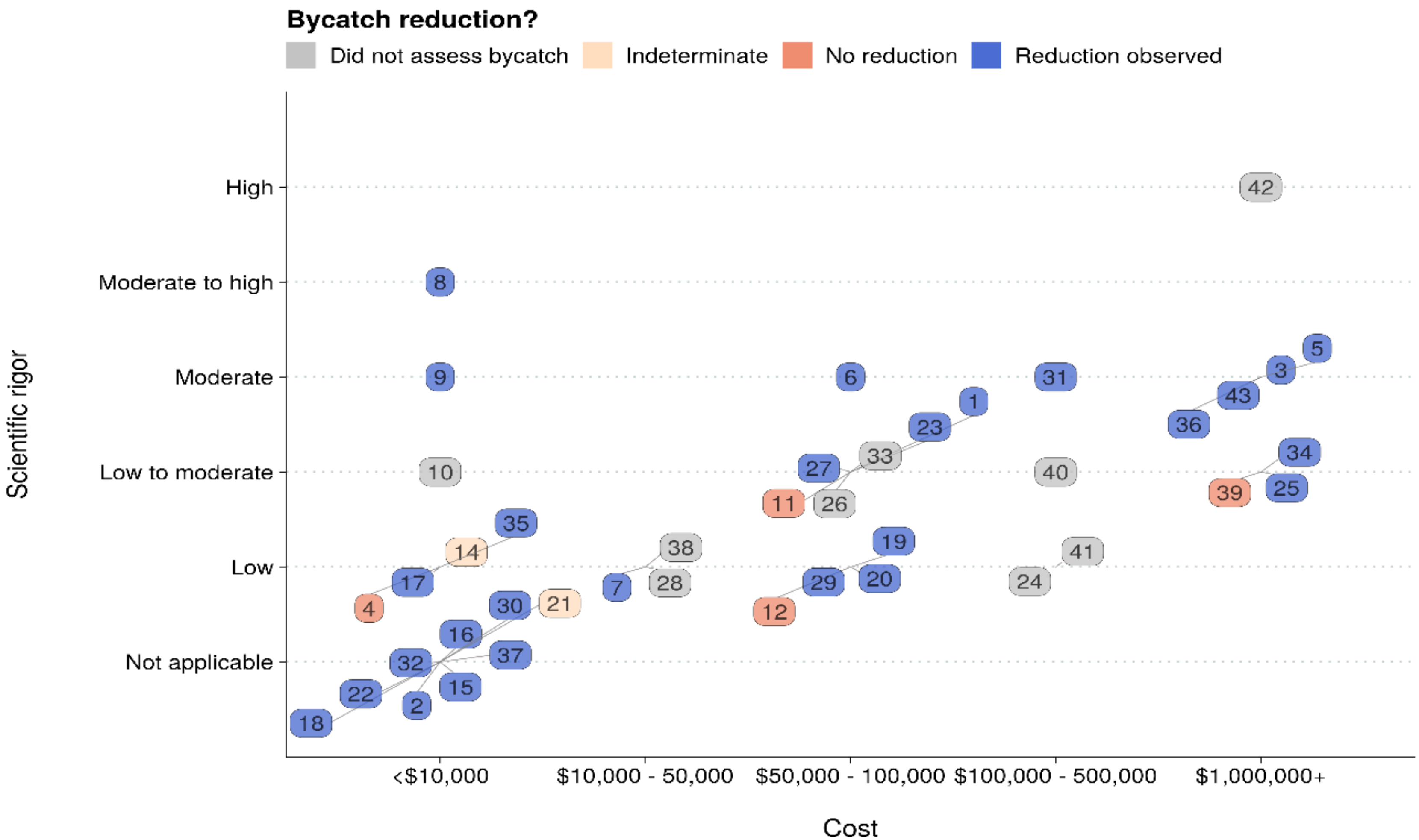
LITERATURE REVIEW METHODS

- Standard literature review using online search engines
- List of all references plus assessments of each available as electronic spreadsheet from CSP.
- Wide range of criteria reviewed including:
  - level of scientific rigor
  - level of proven efficacy (i.e. mm and fish capture rates)
  - region and gear type
  - caveats and uncertainties in methods
  - relevance to NZ inshore fishery methods by gear type
  - relevance to Māui and Hector's dolphins
  - costs and benefits.

LITERATURE REVIEW RESULTS

- Review identified 43 research papers spanning the period 1998 to 2019 relevant to DDDs
- Range of material considered: international scientific literature, government agency commissioned reports, conference proceedings, commercial research and results from industry and scientific trials
- Some useful recent review papers identified (e.g. Dawson et al. 2013, Childerhouse et al. 2013, FAO 2018, Hamilton & Baker 2019)

SUMMARY OF REFERENCES



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EFFICACY OF DDDS IN REDUCING MM BYCATCH

- Summary from Dawson et al. (2013)
  - The greatest success rate appears to be for beaked whales (Carretta et al. 2008) and harbour porpoises (Alfaro Shigueto 2010; Gönener & Bilgin 2009; Northridge et al. 2011; Palka et al. 2008).
  - There have been varying degrees of success for bottlenose, common, striped and franciscana dolphins
  - There has been little or no evidence of success for Hector's (Stone et al. 1997, 2000), Indo-pacific humpback (Berg Soto et al. 2009; Soto et al. 2012) and tucuxi dolphins (Monteiro-Neto et al. 2004) although there have been only limited studies on these species.

- **Conclusion**: DDDs can effectively reduce bycatch in some but not all fisheries and not all mm species

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SUMMARY OF KEY REFERENCES

Reference	Study name (DDD type)	Species	Exhibited avoidance?	Bycatch reduction	Maintained target catch	Level of efficacy	Costs
Barlow and Cameron 2003	Field experiments show that acoustic pingers reduce marine mammal bycatch in the California drift gill net fishery	Dolphins & pinnipeds	Y	77%	Y	Pingers significantly reduced total cetacean and pinniped entanglement in drift gill nets without significantly affecting swordfish or shark catch	$1,000,000+
Bordino et al. 2002	Reducing incidental mortality of Francisana dolphin with acoustic warning devices attached to fishing nets	Franciscana	Y	84%	N	The alarms were effective at reducing the incidental mortality of the Franciscana dolphin in bottom-gillnets in the study area. Sea lion depredation increased.	$1,000,000+
Brotons et al. 2008b	Do pingers reduce interactions between bottlenose dolphins and nets around the Balearic Islands?	Bottlenose dolphins	Y	49%	NA	Shows potential for reducing net interactions, but requires further research	$50,000 - 100,000
Carretta & Barlow 2011	Long-term effectiveness, failure rates, and “dinner bell” properties of acoustic pingers in a gillnet fishery	Dolphins & Pinnipeds	Y	50%	NA	The proportion of sets with cetacean bycatch was significantly lower in sets with ≥30 pingers than in sets without pingers	<$10,000
Carretta et al. 2008	Acoustic pingers eliminate beaked whale bycatch in a gill net fishery	Beaked whales	Y	90%	NA	Beaked whale bycatch dropped 100%, bycatch rates of all cetaceans decreased by only 50% over the same period	<$10,000
Mangel et al 2013	Using pingers to reduce bycatch of small cetaceans in Peru’s small-scale driftnet fishery	Dolphins	Y	37%	Y	Pingers reduced bycatch of small cetaceans in the Peruvian small-scale driftnet fishery	$100,000 - 500,000
Palka et al. 2008	Effect of pingers on harbour porpoise bycatch in the US Northeast gillnet fishery	Harbour porpoises	Y	50%	IND	Support that pingers can reduce harbour porpoise bycatch, even in an operational fishery	$1,000,000+
Waples et al. 2013	A field test of acoustic deterrent devices used to reduce interactions between bottlenose dolphins and a coastal gillnet fishery	Bottlenose dolphins	Y	49%*	Y	SaveWaves were effective in deterring dolphins from gillnets, but observations indicate that they did not eliminate this behaviour entirely	$1,000,000+

POTENTIAL IMPACTS OF DDDs ON MMs

- Range of potential impacts documented
- Habituation (e.g. responses of animals lessen over long-term exposure)
  - No evidence (Carretta & Barlow 2011; Palka et al. 2008)
  - Some evidence (Berggren et al. 2009)
- Habitat exclusion
  - Mixed evidence
  - Likely to be more significant in mm with small, and local home ranges
- Increased noise pollution
  - Potential behavioural modification or exclusion
  - Trade-offs between DDD loudness vs. number (Larsen et al. 2013; Northridge et al. 2011)

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POTENTIAL EFFECTS ON FISHERIES

- Relatively expensive in terms of the cost of initial setup and maintenance
  - Some questions around robustness of some models requiring regular repairs and maintenance
- Estimated cost of implementation in UK fisheries was between $230k-$5m depending on amount of DDD coverage required
- Trials can be expensive especially in fisheries with low bycatch rates
- Concerns around crew safety
- While DDDs can be expensive to use, they may increase access to previously closed or protected areas if they are confirmed as being an effective mitigation tool, in which case they become more cost effective

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DDD USE IN NEW ZEALAND

- Some DDDs have been trialled in New Zealand fisheries (Stone et al. 1997, 2000; Dawson & Lusseau 2005) and had mixed results
- DDDs have been used sporadically in the New Zealand set net fishery (Ramm 2010, 2011); however, low observer presence and lack of compliance prevented conclusions being made on their efficacy in reducing bycatch of protected marine species
- Nonetheless, DDDs are being used under voluntary Codes of Practice by some commercial fishers

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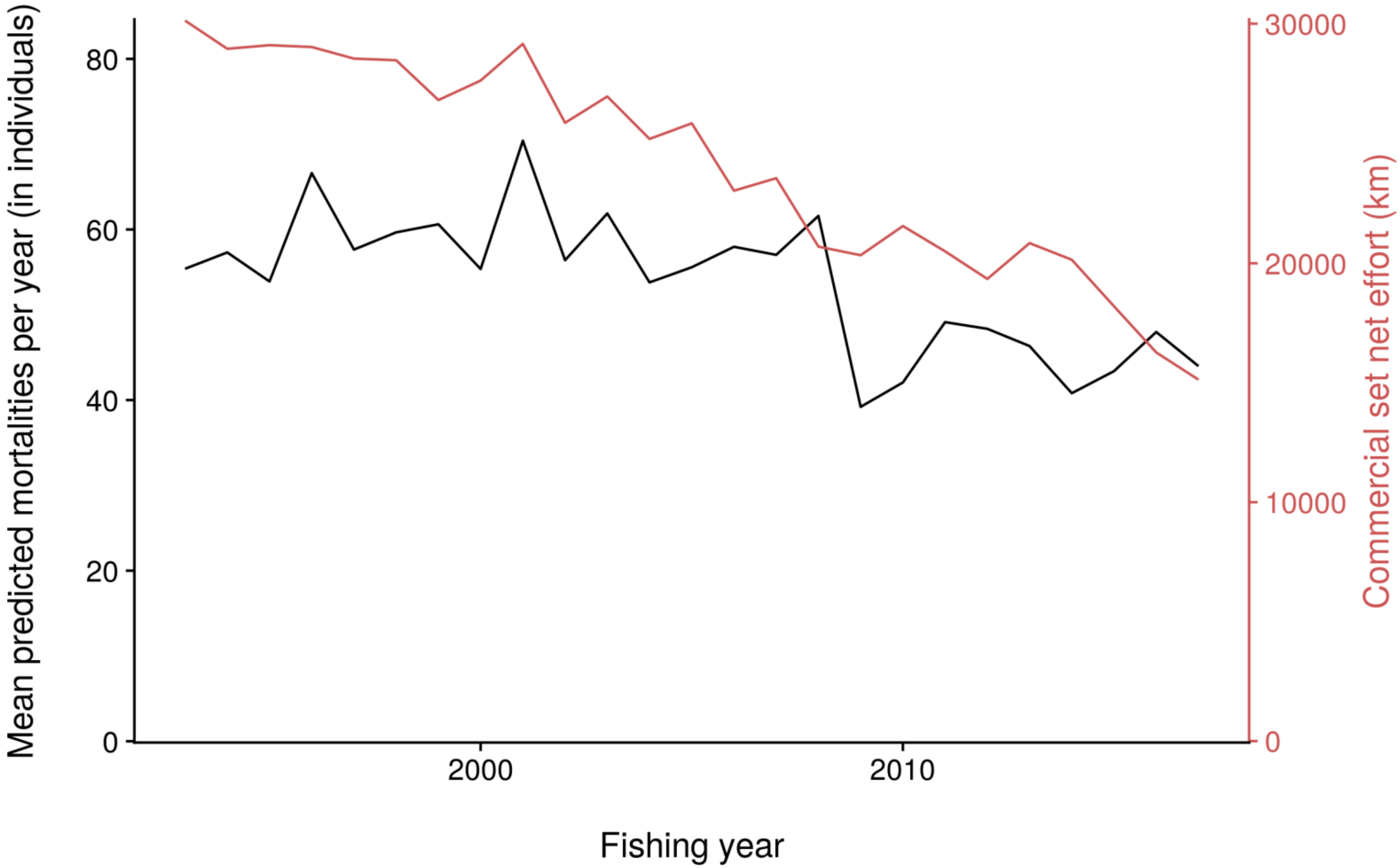
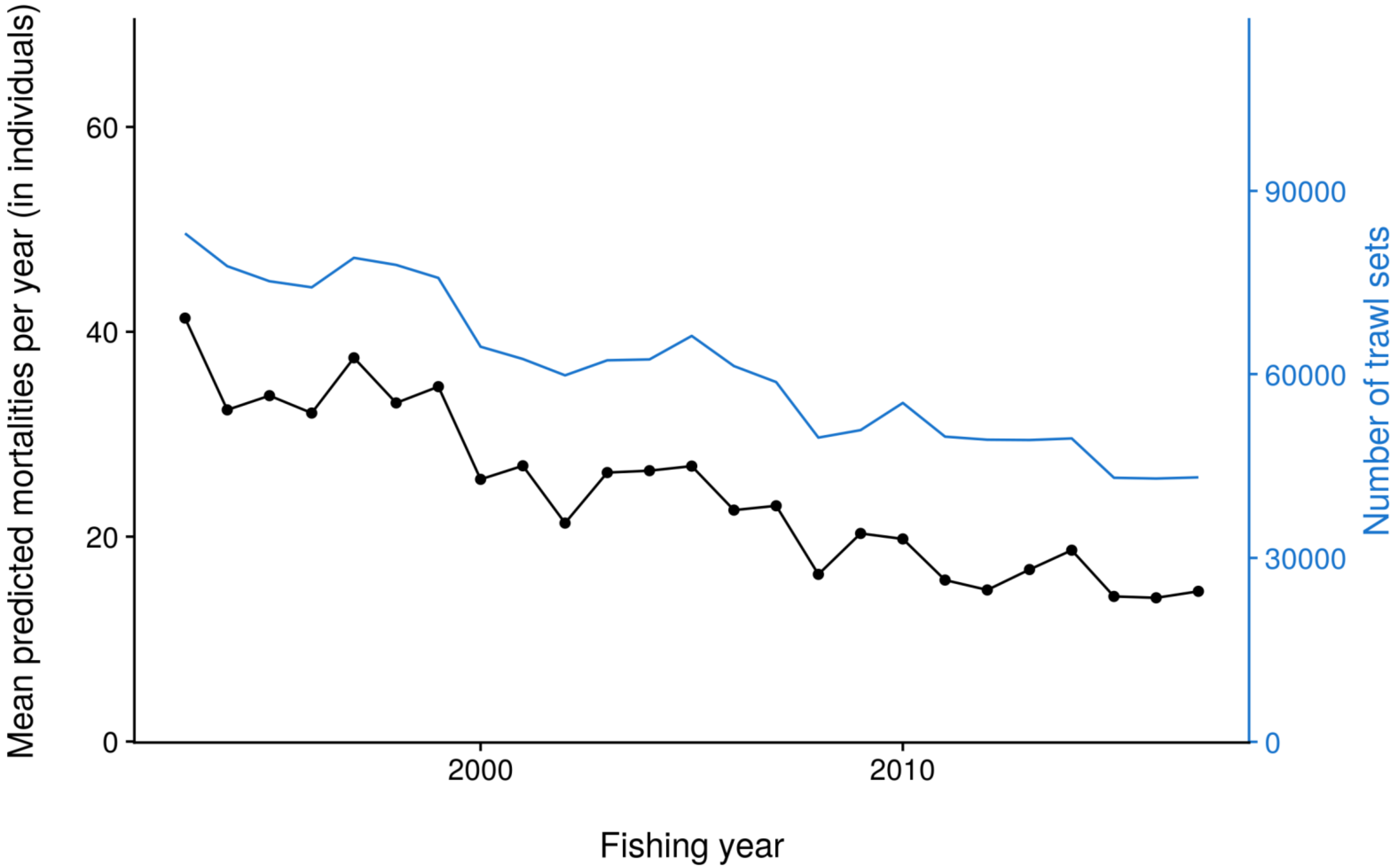
HECTOR'S BYCATCH IN NZ SET NET FISHERIES



Data from Roberts et al. (2019)

HECTOR'S BYCATCH IN NZ TRAWL FISHERIES



Data from Roberts et al. (2019)

CONSIDERATIONS FOR EXPERIMENTAL TRIALS FOR DDDs

- Strong experimental design including use of appropriate controls and double blind experiments
- Use of independent government observers and / or independent scientists to provide robust and accurate monitoring data
- Large sample sizes (e.g. > 25% of all fishing effort)
- Consideration and monitoring of range of potential variables and fixing variables wherever possible
- Formal necropsies of dead individuals for which cause of death was not able to be directly confirmed
- Multi-year and multi-regional studies and consideration of issues such as habituation. In particular, use of long term, existing, robust data sets to establish base line capture rates is particularly useful

EXPERIMENTAL TRIALS FOR DDDs

- Calculation of statistical power for results to aid in accurate interpretation of any significant (and non-significant) results
- Concurrent monitoring of commercial fish catch as an essential part of the trial to demonstrate any impact on catch
- Clear instructions and communication provided to all parties involved in the trials (e.g. fishers, observers, managers) to ensure experimental designs are implemented accurately (e.g. to ensure comparability between vessels, areas, and years) including appropriate training
- Needs to be well-funded. Most of the research that provided a robust fishery level result utilised existing government observer programmes that were estimated as exceeding US$1 million in value.

RECOMMENDATIONS FOR A TRIAL STRUCTURE

Undertake a staged approach:

1. Testing the in-water operation of one or more different types of DDDs
2. Testing simple responses of HDs to active DDDs
3. Exploratory data analysis
4. Pilot trial in fishery
5. Trial in full fishery.

- Staged approach with successive stages building in both complexity and risk
- Stages 1-3 represent no additional risk to HMDs during their implementation and therefore could be progressed immediately

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RECOMMENDATIONS FOR A TRIAL STRUCTURE

- Stages 4-5 include intrinsic risk (i.e. increased bycatch levels, habitat displacement or abandonment) due to expanding into operational fisheries
- This step should not be taken unless the data from Stages 1-3 confirms that the risk of increasing capture rate has been robustly estimated to be negligible and the predicted benefits outweigh the costs
- The design and analysis of such research should include international experts experienced in working with DDDs and fisheries issues.

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CONCLUSIONS

- While achieving variable success rates across marine mammal species, there have been some significant examples of large reductions in bycatch
- There have been some DDD trials with HMD in New Zealand, but these have led to equivocal results but with some indication that HDs avoid active DDDs
- DDDs appear most successful for cetaceans that are neophobic (i.e. fear of anything new) or are easily startled and have large home-ranges. They are, therefore, more likely to be more effective for phocoenids (i.e. porpoises) than coastal delphinids such as HMDs.
- As such, DDDs are less likely to be effective mitigation techniques for HMDs but the possibility exists that they could. The efficacy of DDDs will not be possible to assess without formal trials.

RECOMMENDATIONS

- Based on this review, it is clear that the potential exists that DDDs could be an effective form of mitigation of HMD bycatch in New Zealand fisheries
- Therefore, it is recommended that a staged approach to research is undertaken
- Stage 1 and 2 trials should be undertaken as these trials pose no risk to dolphins and are likely to provide useful data to aid in the evaluation of the efficacy of DDDs for the mitigation of HMD bycatch
- Stage 3 analysis should be undertaken once Stage 1 and 2 are complete
- Move to Stage 4 should not be taken unless the data from Stages 1-3 confirms that the risk of increasing capture rate has been robustly estimated to be negligible and the predicted benefits outweigh the costs

CONCLUSIONS

- Prior to any possible trials, the effectiveness of DDDs must be evaluated against two key considerations:
  - What reductions in bycatch may be achievable without further impact such as habitat displacement or avoidance , and is this likely to meet management goals?
  - What sample sizes would be necessary in order to yield sufficient statistical power to quantify effectiveness?

  While it would be advantageous to undertake this prior to any trials, it may be more usefully done as part of Stage 3 when some data is available.
- If DDDs are implemented, dedicated enforcement and compliance monitoring regimes will be required, as well as high levels of observer coverage to assess long-term effectiveness

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