Characterisation of marine mammal interactions with fisheries & bycatch mitigation

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Project INT2019 - 03

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Background

- Incidental captures of marine mammals documented in New Zealand across commercial fisheries.
- Some New Zealand marine mammal species are endemic and threatened.
- Observer programme started in 1992–93: provides an independent record of captures, but coverage varies across fishing fleets.
- A number of mitigation approaches have been put in place in New Zealand over the last 20 years.
- Implementation of new measures is ongoing, similar to mitigation efforts in fisheries elsewhere.

Objectives

Project INT2019-03

Overall objectives –

1. “to characterise the nature and extent of marine mammal captures in New Zealand commercial fisheries”.

2. “to identify and assess the current mitigation techniques for reducing incidental marine mammal captures domestically and internationally and to make recommendations as to their applicability and suitability” in New Zealand.

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Objective 1:

Characterisation of marine mammal captures in New Zealand commercial fisheries.

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Methods

Analysis of interactions

Interaction: physical contact between an individual and fishing gear, or a modification in behaviour caused by fishing operations.

Capture: an individual that is caught in fishing operations, so that it cannot escape the fishing gear without external assistance.

Mortality: a capture in fishing gear that resulted in mortality.

* Individuals that climbed onboard the vessel or that were decomposed when caught were not considered captures.

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Methods

Data sources

- Fisheries observer records: Captures of protected species reported by observers onboard fishing vessels.
- Fisher-reported captures: Captures of protected species reported by fishers on the non-fish/protected species catch return form (NFPSCR) available since 2008–09.
- Bycatch estimates: Model-based estimates from observed captures predicting bycatch for the total effort of the observed fishery or gear.
- Risk assessment estimates: Model-based estimates of total annual mortalities from a specific gear or fishery.

Other sources not used here: sightings database, strandings database, necropsy records

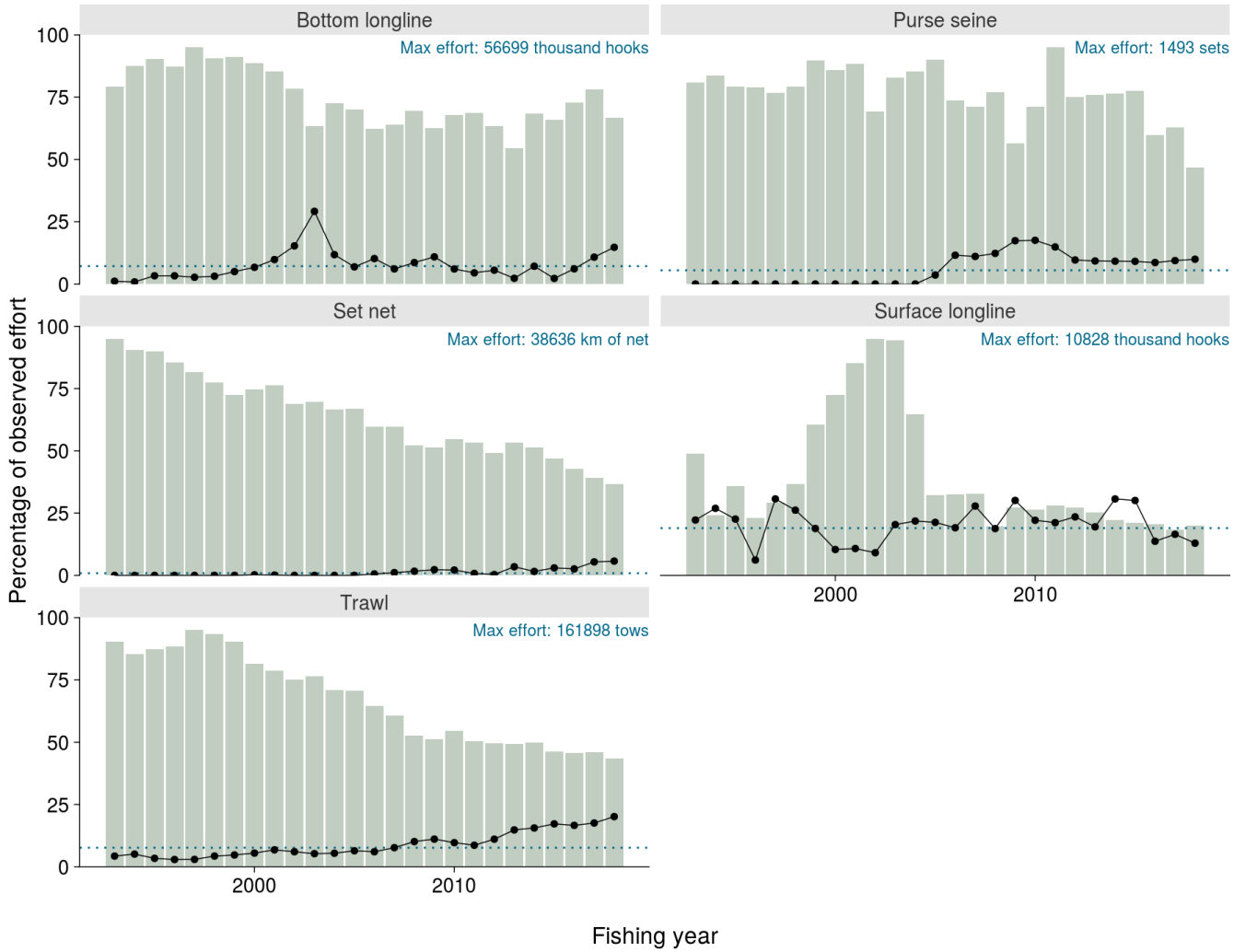
Methods

Overview of approach

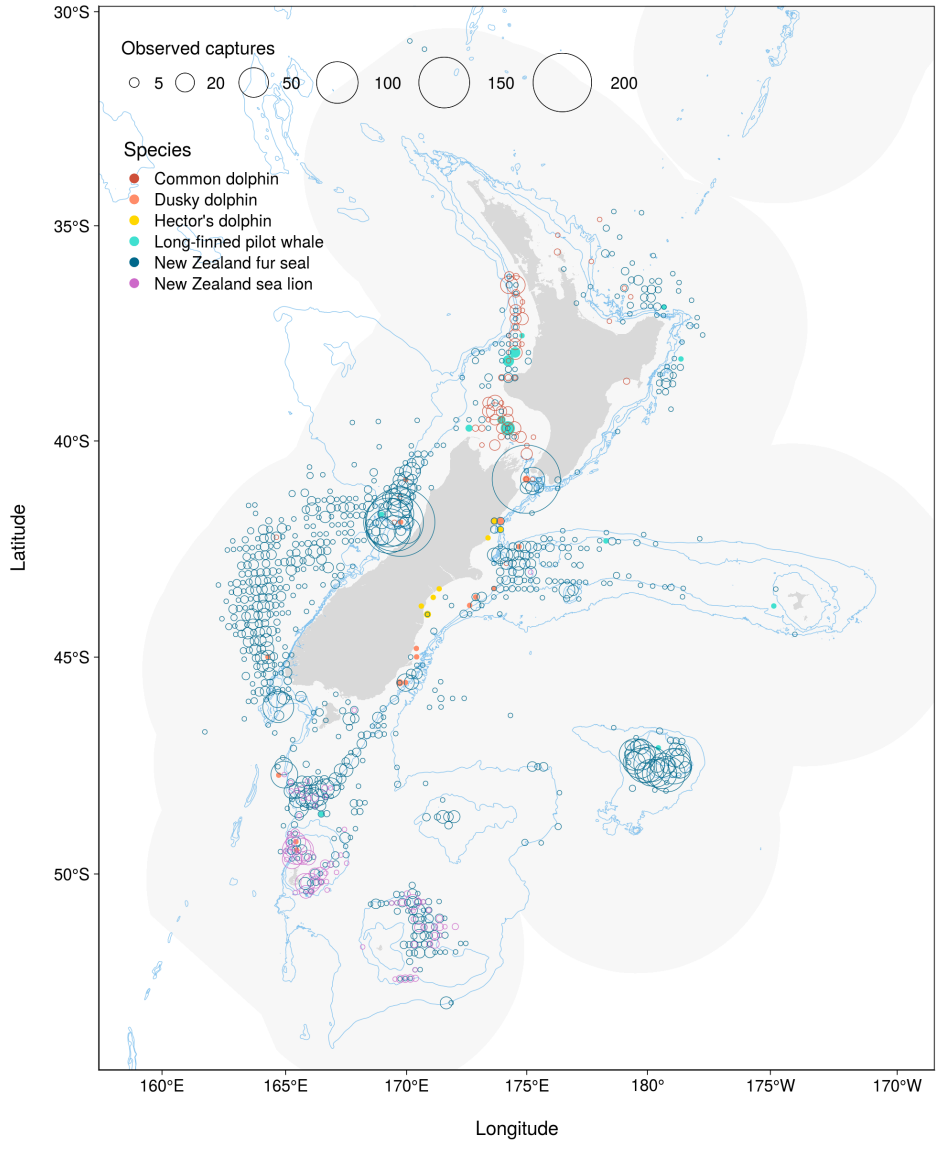
- Observed captures from Protected Species Database (prepared from Fisheries New Zealand extract; psc.dragonfly.co.nz).
- Non-fish/protected species catch return form (NFPSCR) records (prepared from Fisheries New Zealand extract).
- Aggregated captures for all species and gear type (trawl, set net, surface longline, bottom longline).
- Modelled estimates collated when available (common dolphin, Hector's dolphin, New Zealand sea lion and New Zealand fur seal).
- Also: temporal trends in captures and OCPUE (+ spatial trends for New Zealand fur seal).

Results

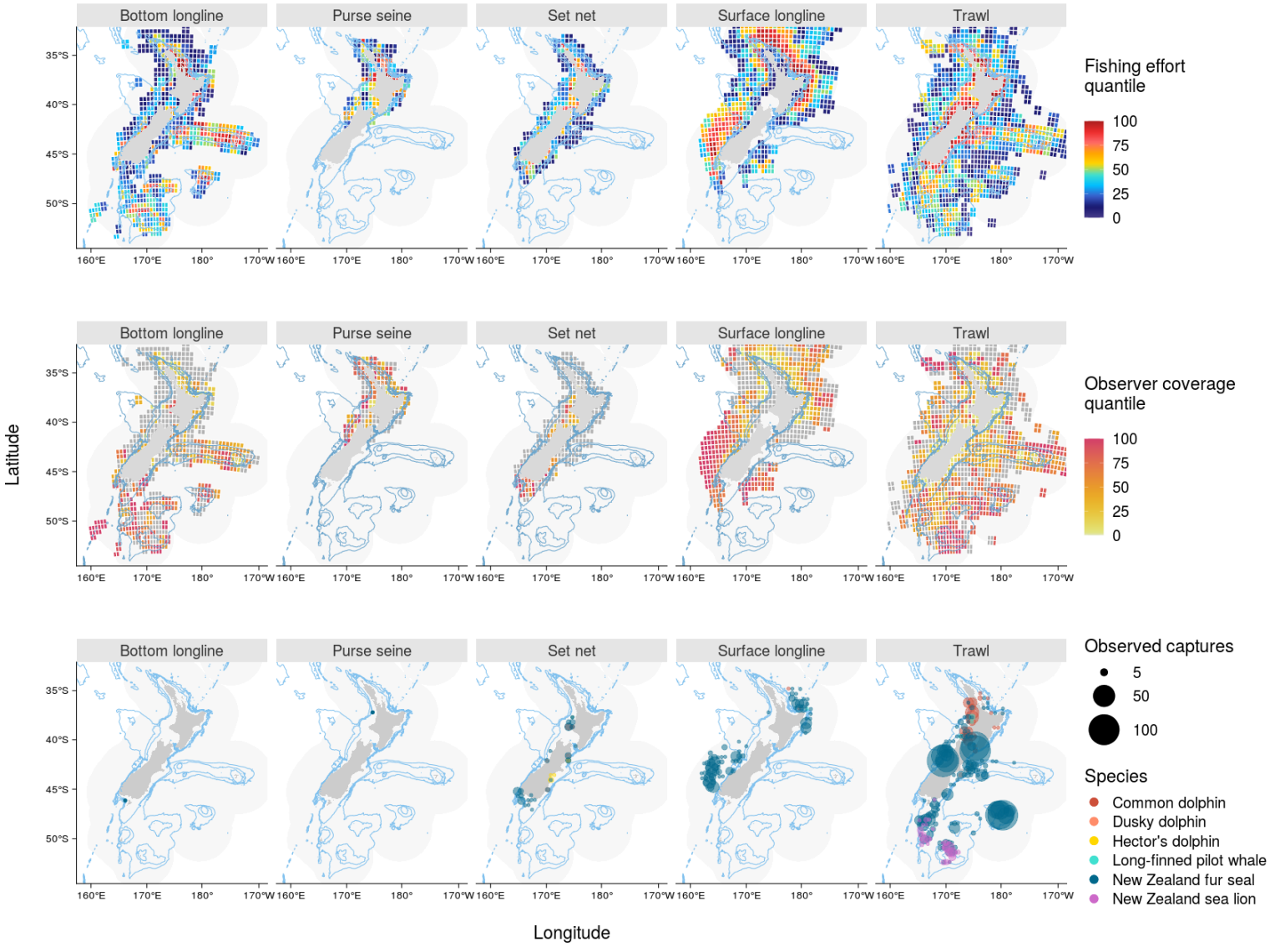
Observer coverage



Spatial distribution of observations

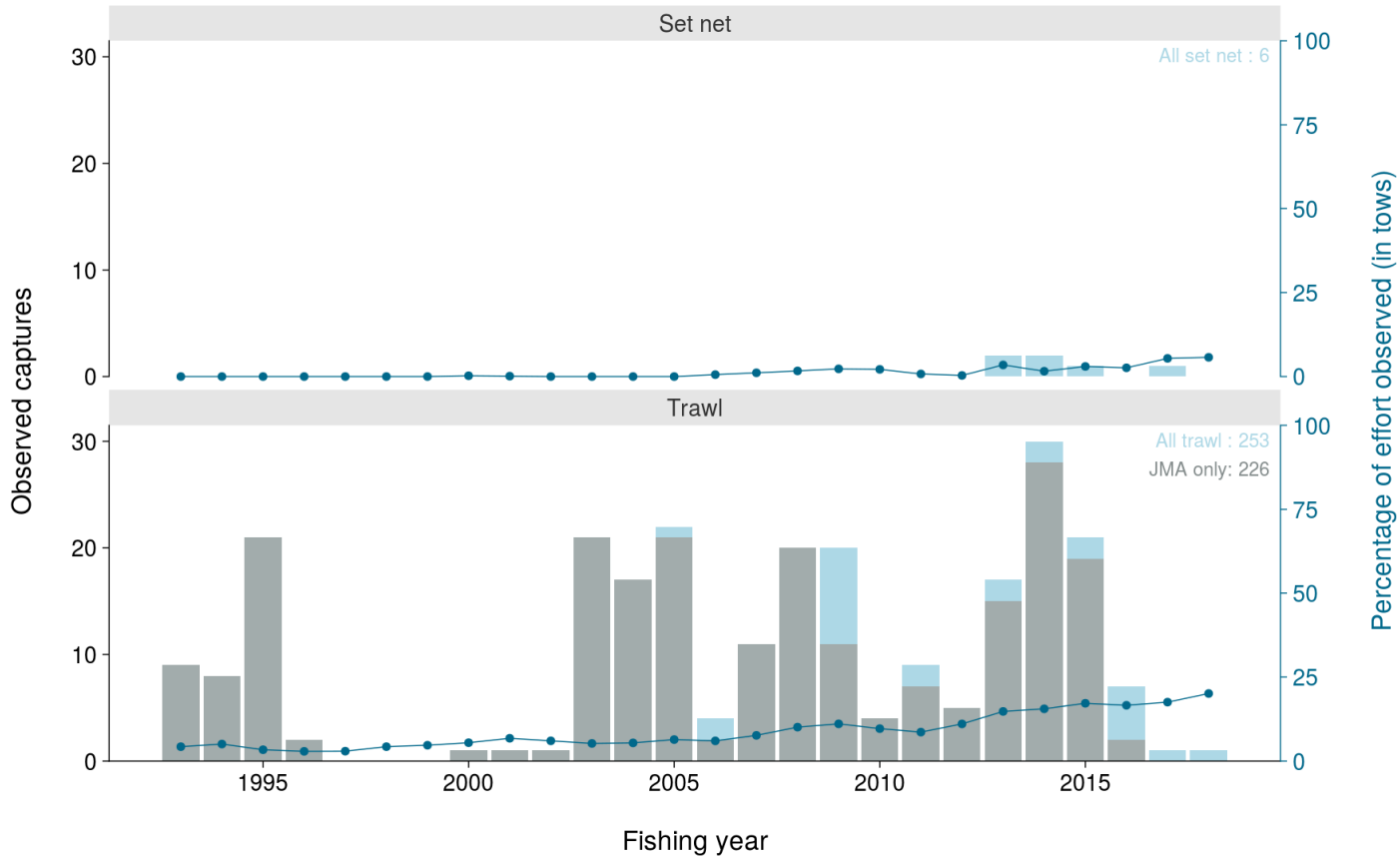


Observations vs. effort



Common dolphin

Observed captures



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Common dolphin

Modelled captures

- Approach: Fleet-wide captures estimated from Bayesian GLMM of observer catch rates (Abraham et al. 2016).
- Time span: 1995–96 to 2014–15.
- Fisheries: All trawl fisheries, split between the West Coast North Island trawl fishery and other trawl fisheries.
- Recently updated to 2017–18 for the jack mackerel fishery (Abraham et al. 2020).

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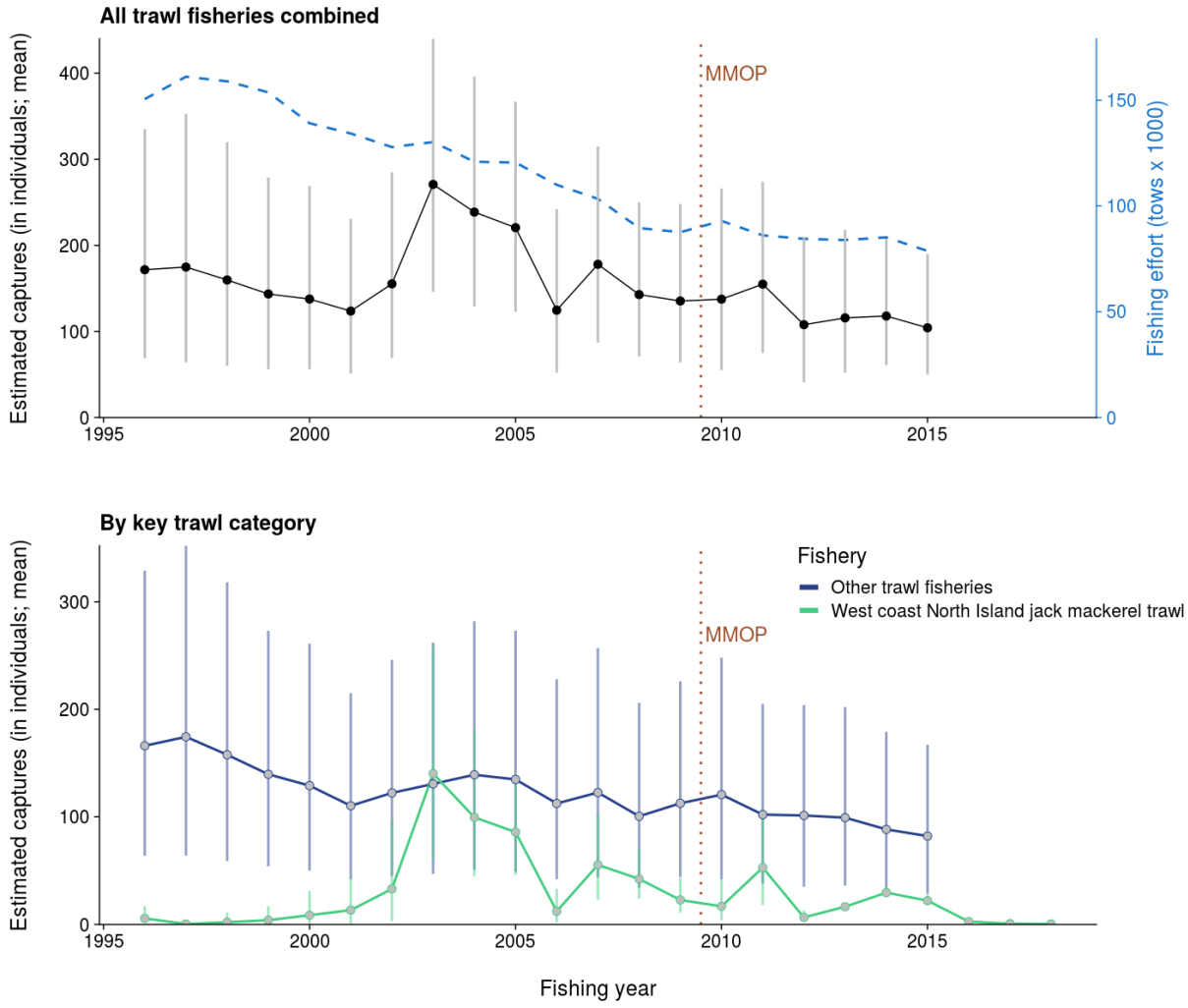
Common dolphin

Modelled captures



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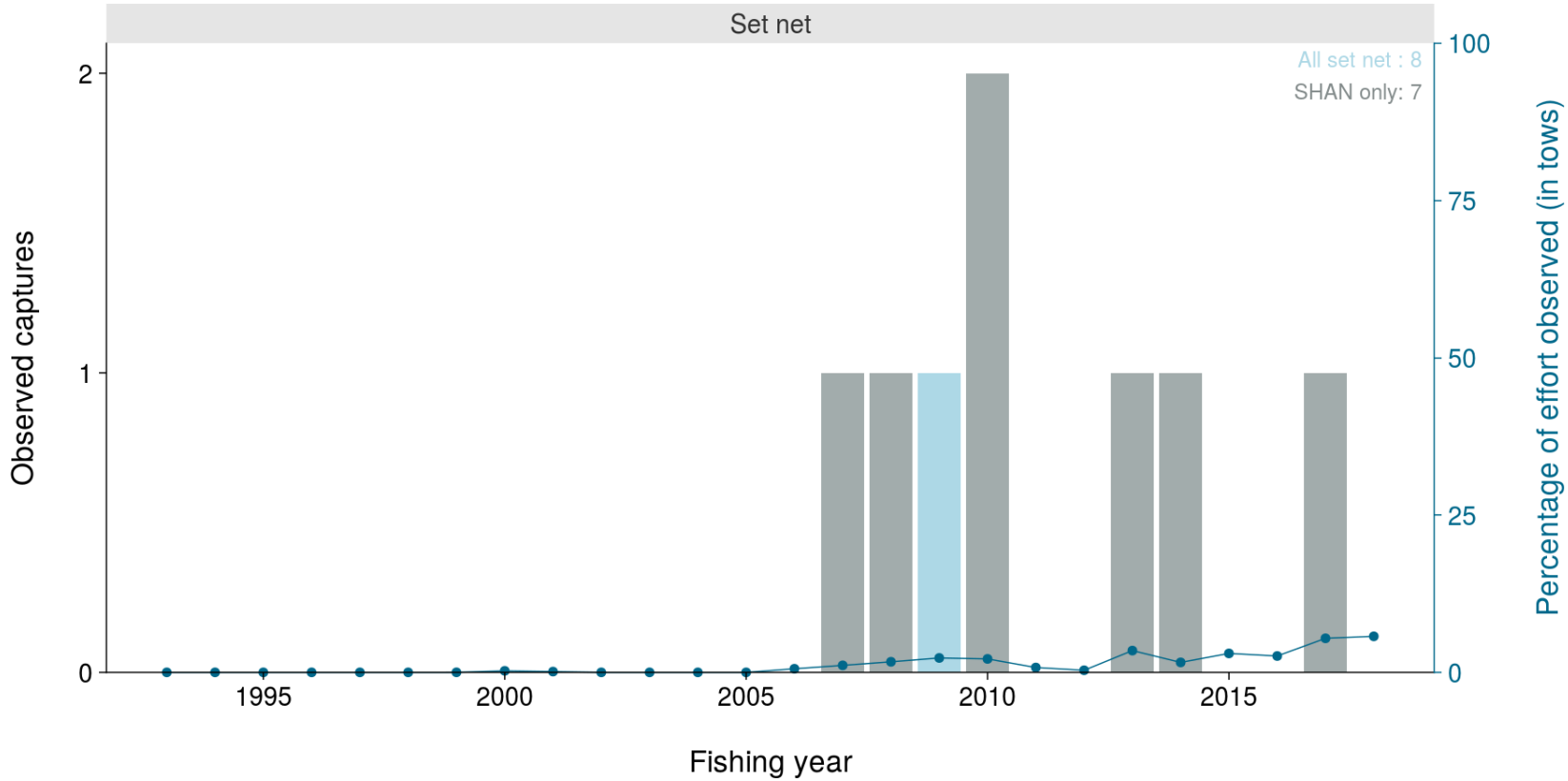
Hector's dolphin

Observed captures



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Hector's dolphin

Modelled captures

- Approach: Risk assessment from Roberts et al. (2019)
- Mortalities estimated from observed captures and the spatial overlap of fishing effort with the species' distribution.
- Time span: 1992–93 to 2016–17.
- Fisheries: Inshore trawl and set net.

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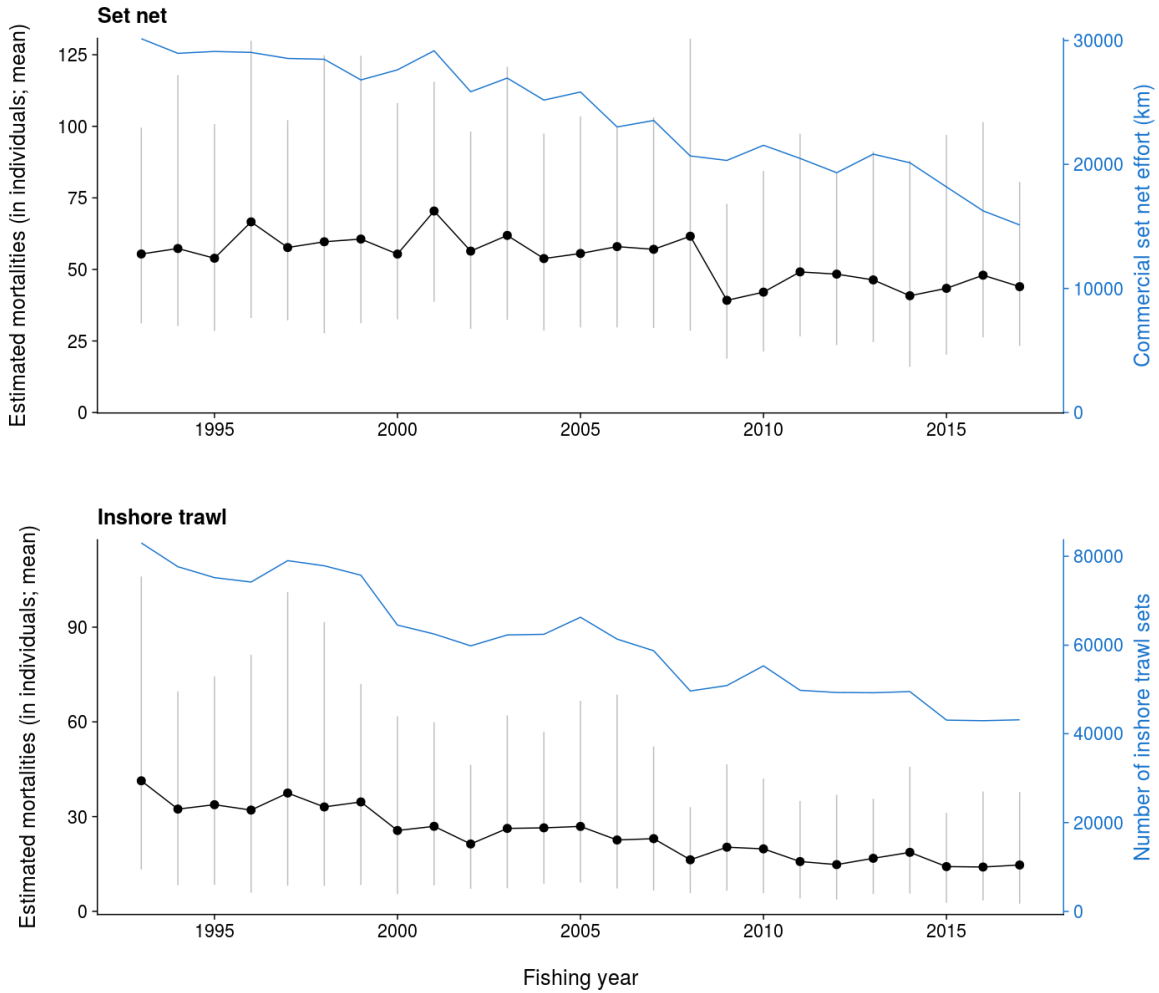
Hector's dolphin

Modelled captures



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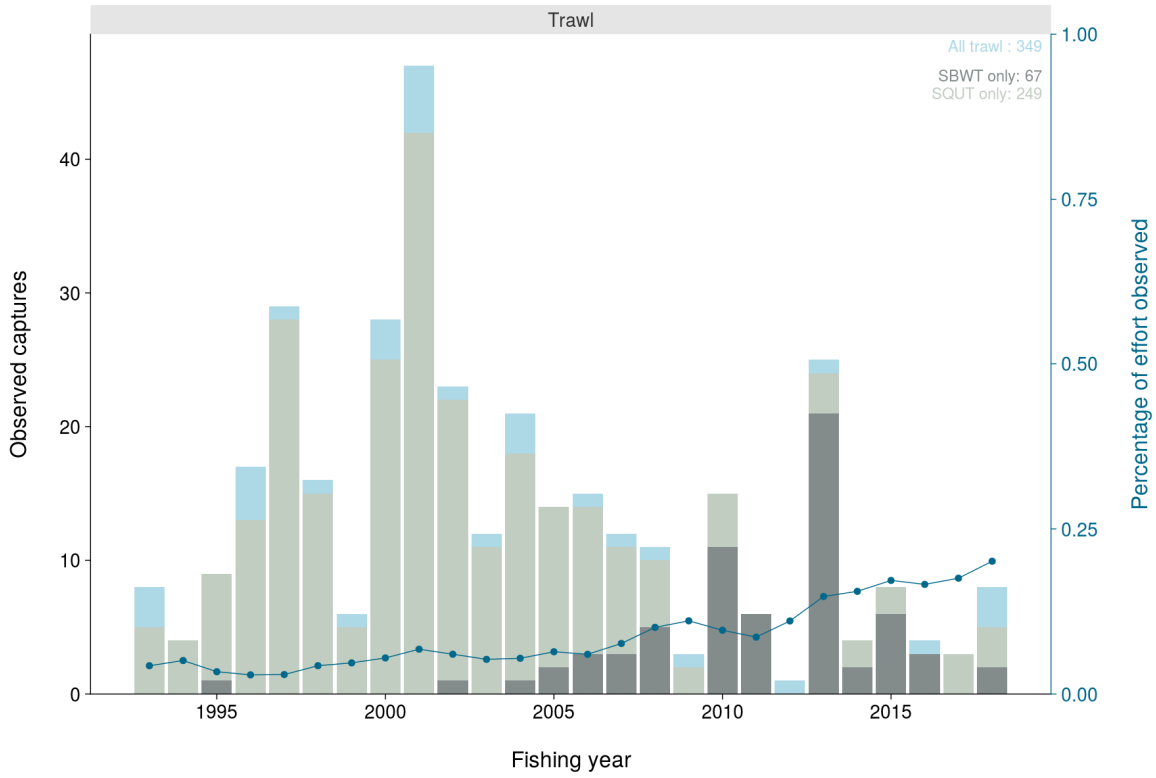
New Zealand sea lion

Observed captures



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New Zealand sea lion

Modelled captures

Two sources of estimated captures based on different modelling approaches:

1. Risk assessment for Auckland Islands (Large et al. 2019):

   - Female mortalities estimated from observed captures, cryptic mortality and the spatial overlap of fishing effort with the species' distribution.
   - Time span: 1992–93 to 2016–17.
   - Fisheries: Bottom - and midwater trawl targeting squid, trawl targeting scampi, other trawl fisheries.

New Zealand sea lion

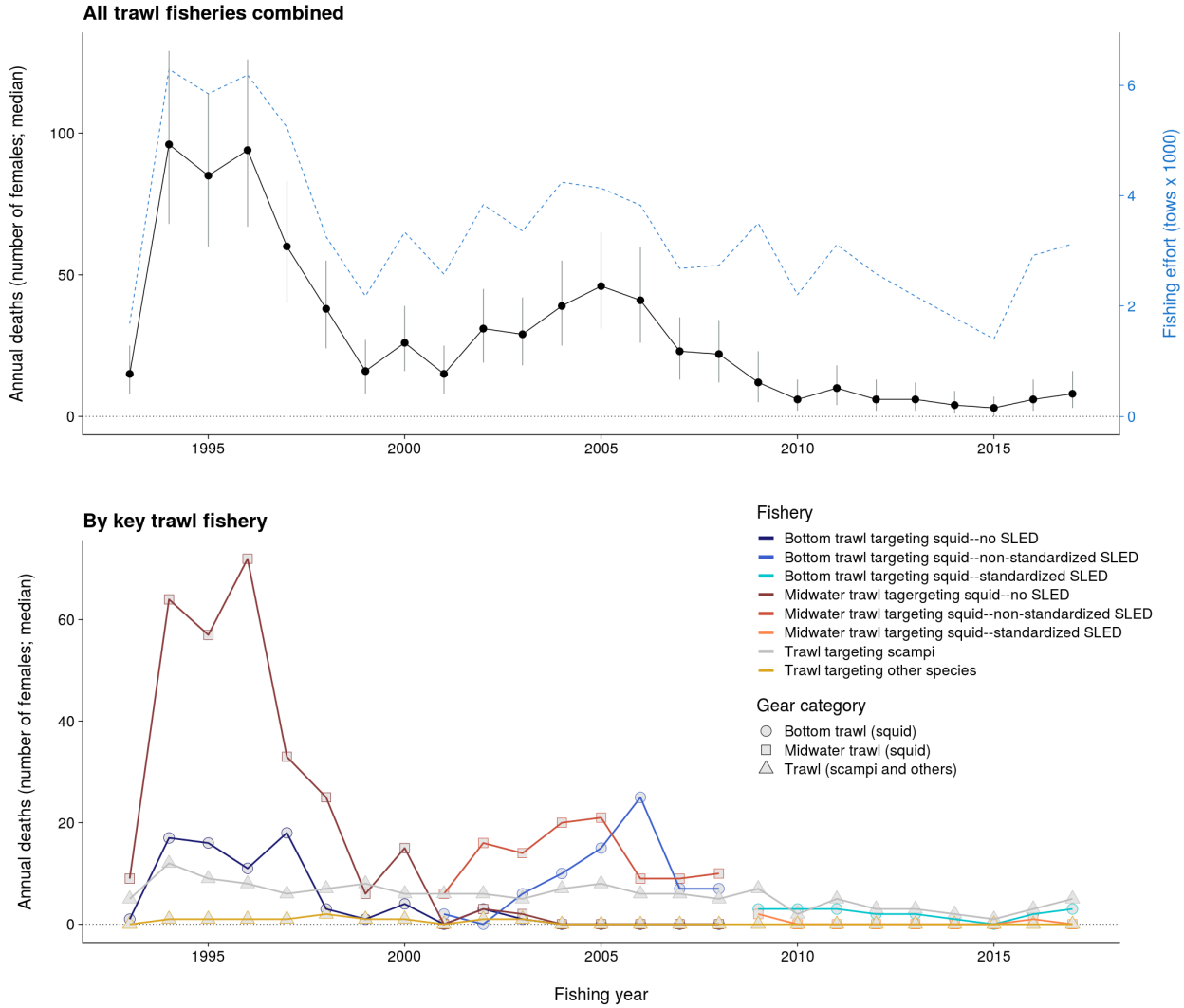
Modelled captures

2. Bycatch model (Abraham et al. 2016):

- Fleet-wide captures estimated from Bayesian GLMM of observer catch rates.
- Time span: 2002–03 to 2014–15.
- Fisheries: Trawl targeting squid near Auckland Islands, trawl fishery targeting southern blue whiting near Campbell Islands, other trawl fisheries (including scampi).

New Zealand sea lion

Modelled captures–risk assessment



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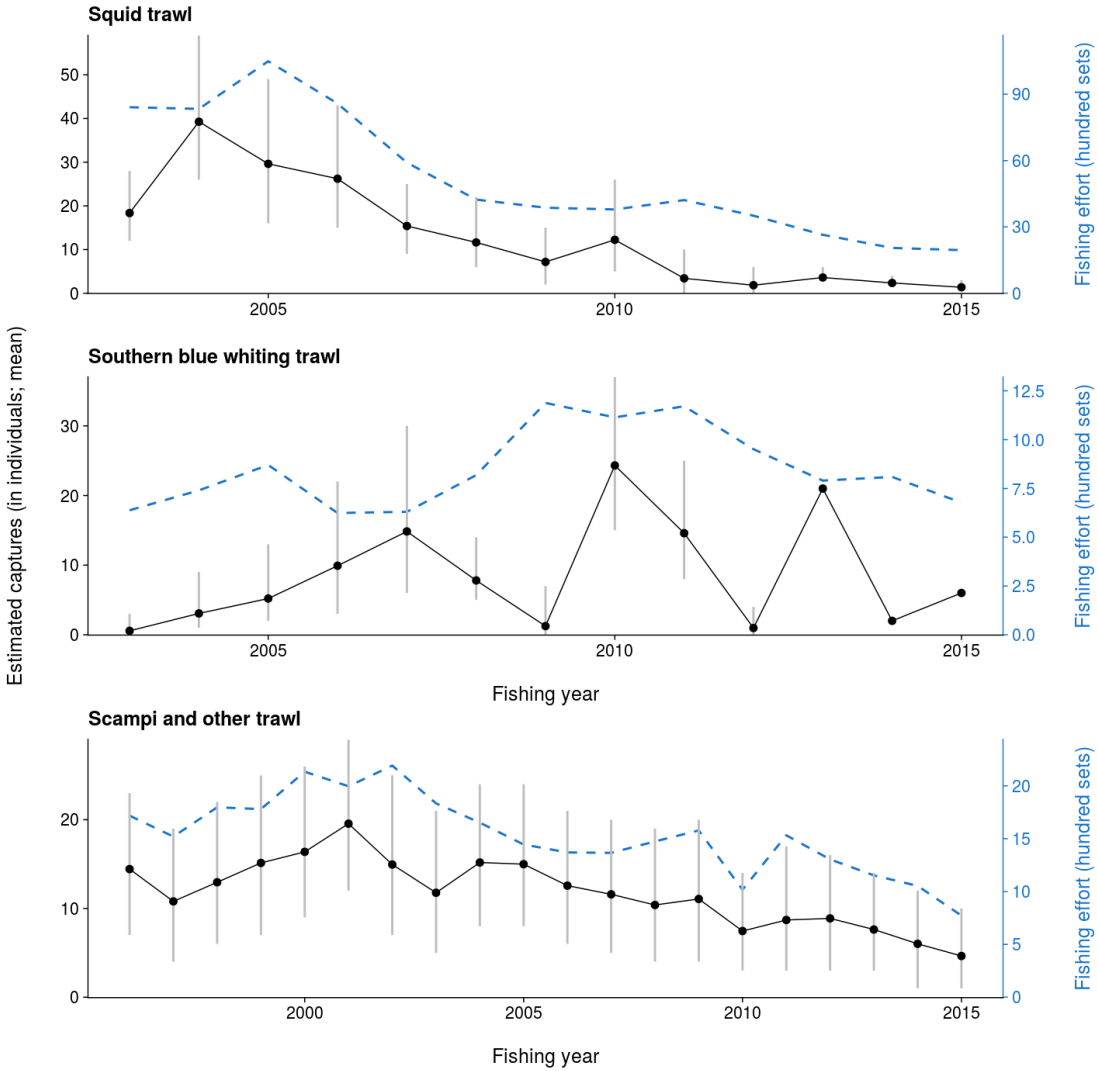
New Zealand sea lion

Modelled captures–bycatch model



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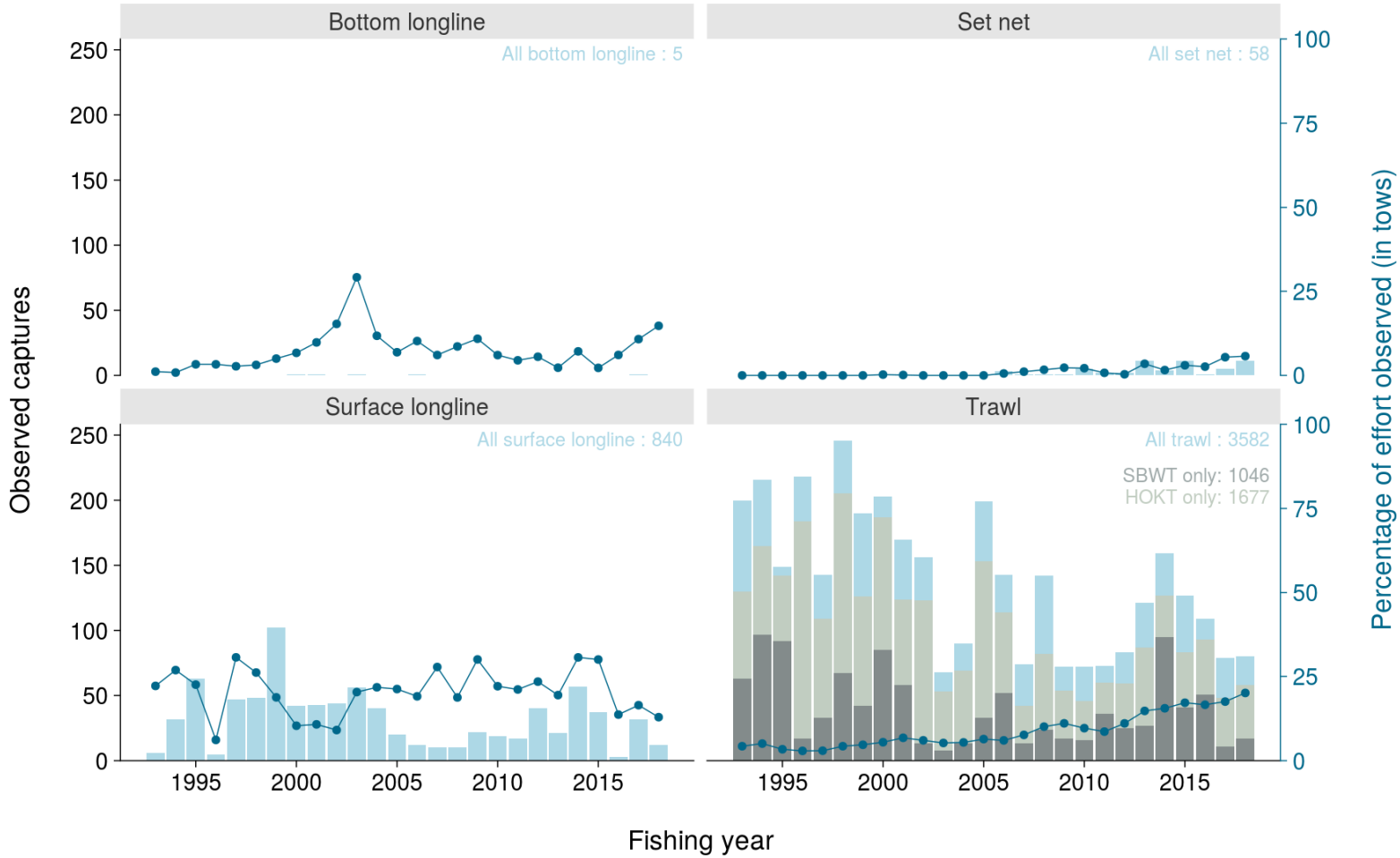
New Zealand fur seal

Observed captures



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New Zealand fur seal

Modelled captures

- Approach: Fleet-wide captures estimated from Bayesian GLMM of observer catch rates (Abraham et al. 2020).
- Time span: 2002–03 to 2017–18.
- Fisheries: All trawl and surface-longline fisheries.

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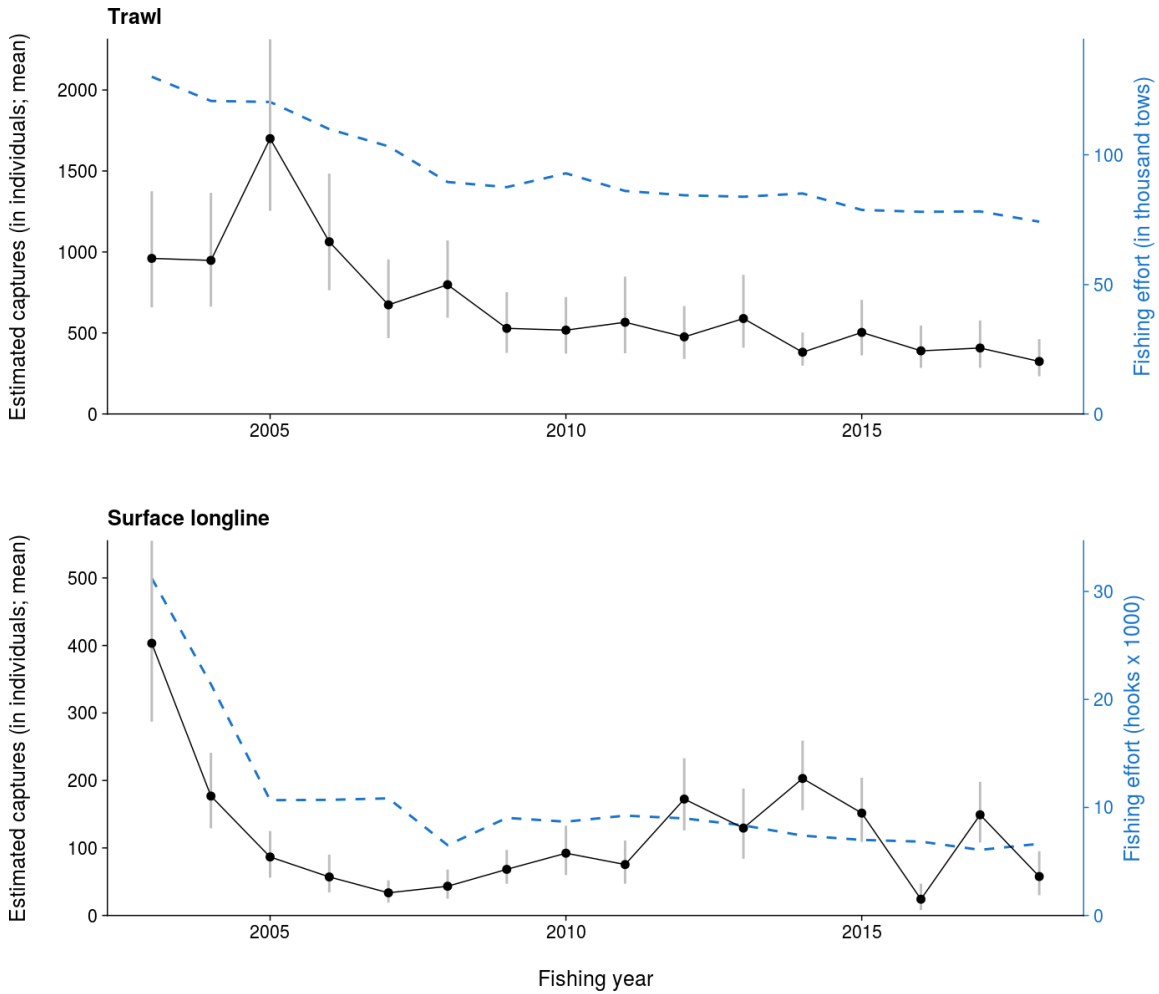
New Zealand fur seal

Modelled captures



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Marine mammal bycatch in New Zealand

Key points

Marine mammals across all species groups interact with fisheries: whales, dolphins and pinnipeds.

Most frequently observed species: New Zealand fur seal, New Zealand sea lion, common dolphin.

Anecdotal records for most other species (but can still have impact on the population depending on status).

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Marine mammal bycatch in New Zealand

Key points

Three drivers of capture rates over time to differentiate:

- the extent of the fishing effort within the species' habitat;
- the local population abundance of the species;
- changes in vulnerability to fishing gear.

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Marine mammal bycatch in New Zealand

Key points

- Trawl fisheries had highest interactions overall for multiple species, with particularly high capture rates in specific target fisheries.
- Captures have declined over time for key fisheries following the introduction of mitigation measures.
- New Zealand fur seal highest captures overall, few mitigation efforts.
- Low observer coverage in key fisheries compromises the accuracy and precision of estimates.
- Fisher reporting through NFPSCR form potentially a key tool providing unique information, but reliability unclear.

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Objective 2:

Review of mitigation techniques for reducing incidental marine mammal captures

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Methods

Literature review

Technical mitigation methods that may be applicable to a New Zealand context.

Recent reviews of marine mammal bycatch mitigation:

- pot, trap and set-net fisheries in New Zealand (Laverick et al. 2017);
- set-net fisheries in New Zealand (Childerhouse et al. 2013);
- expert workshop on global mitigation measures (FAO 2018);
- reviews of global mitigation techniques (Werner et al. 2015, Leaper & Calderan 2017, Hamilton & Baker 2019);
- recent studies (e.g., Falkland Islands trials of exclusion devices; Iriarte et al. 2020).

Results

Literature review

Rigorous testing of mitigation measures frequently difficult:

- Low interactions rates and small sampling sizes.
- Differences between trial and control conditions.
- Concomitant implementation of several measures prevents individual assessments.
- Effectiveness usually species - and fishery - specific.

Focus here on potential mitigation techniques for New Zealand context.

Mitigation techniques

Trawling

Acoustic deterrent devices

- Effectiveness unclear. Potential for small cetaceans, but further trials required.
- Dolphin Dissuasive Devices® used in NZ jack mackerel trawl fishery, but effectiveness not formally tested.

- Ineffective.

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Mitigation techniques

Trawling

Exclusion devices

- Limited trials, potential for small cetaceans, further research required.

- Considered effective, depending on design.
- Required in NZ subantarctic trawl fisheries (SQU, SBW) to mitigate NZ sea lion bycatch.
- Limited trials for NZ fur seal captures in hoki trawl fishery.
- Mandatory in Falkland Islands squid trawl fishery.

Mitigation techniques

Longline

Weakened hooks

- Further research required, including injury & post-escape survival.

- Not formally tested.

Catch protection devices

- Potentially effective, depending on the design and fishery, but further research required.

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Mitigation techniques

Set net

Acoustic deterrent devices

- Effective for some (non-NZ) small cetacean species, but not for Hector's dolphin; further research required.
- Potential for negative impacts, such as displacement from critical habitat.

- Not formally tested, unlikely to be effective. Potentially acting as an attractant.

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Mitigation techniques

Set net

Visual changes to net

- Adding light-emitting diodes potentially effective, but further research required.

- Not tested.

Mitigation techniques

Pots and traps

Reduction in rope length

- Minimise rope at the surface, reduce float numbers – considered effective in Western Australian rock lobster fishery.

- Pinnipeds not generally documented in interactions with this gear in New Zealand.

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Bycatch mitigation in New Zealand

Recommendations

- Dolphin Dissuasion Devices® in northern North Island jack mackerel trawl > systematic data collection & analysis to assess their effectiveness.
- SLEDs in subantarctic squid and southern blue whiting trawl > further research into cryptic mortality?
- High number of NZ fur seal interactions with trawl gear warrants further trialling of exclusion devices.
- Longline: Interaction rates low, trials difficult.
- Set net: Spatial and temporal restrictions currently the most appropriate measures.
- Pots and traps: Interaction rates low, trials difficult.

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Bycatch mitigation in New Zealand

Conclusions

- General lack of information pertaining to effective mitigation measures.
- Successful mitigation usually through close collaboration with fishing industry.
- Importance of concomitant observer coverage highlighted.
- Data collection to allow assessment of mitigation efficacy.

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