Update on review of threats to the recovery of NZ sea lions and other otariid species – for NZ sea lion TMP

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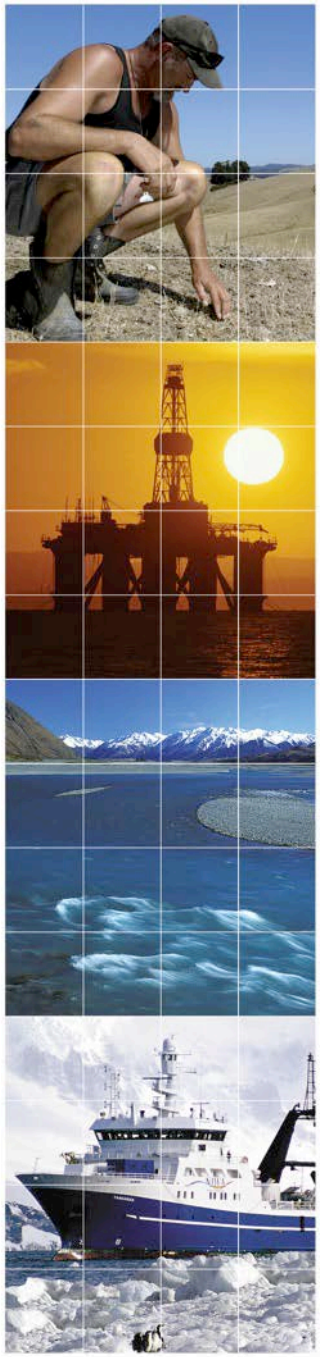


This presentation

1. Purpose of literature review
2. Summary of threats to otariid species
3. Summary of threats to NZ sea lions

Purpose of literature review

- Inform development of TMP
- Review threats to recovery of population size and breeding distribution of otariid species – common threats?
- Comprehensive list of threats that might apply to NZ sea lions
- Review will be passed to TMP expert group
- A draft at this stage! Comments welcome

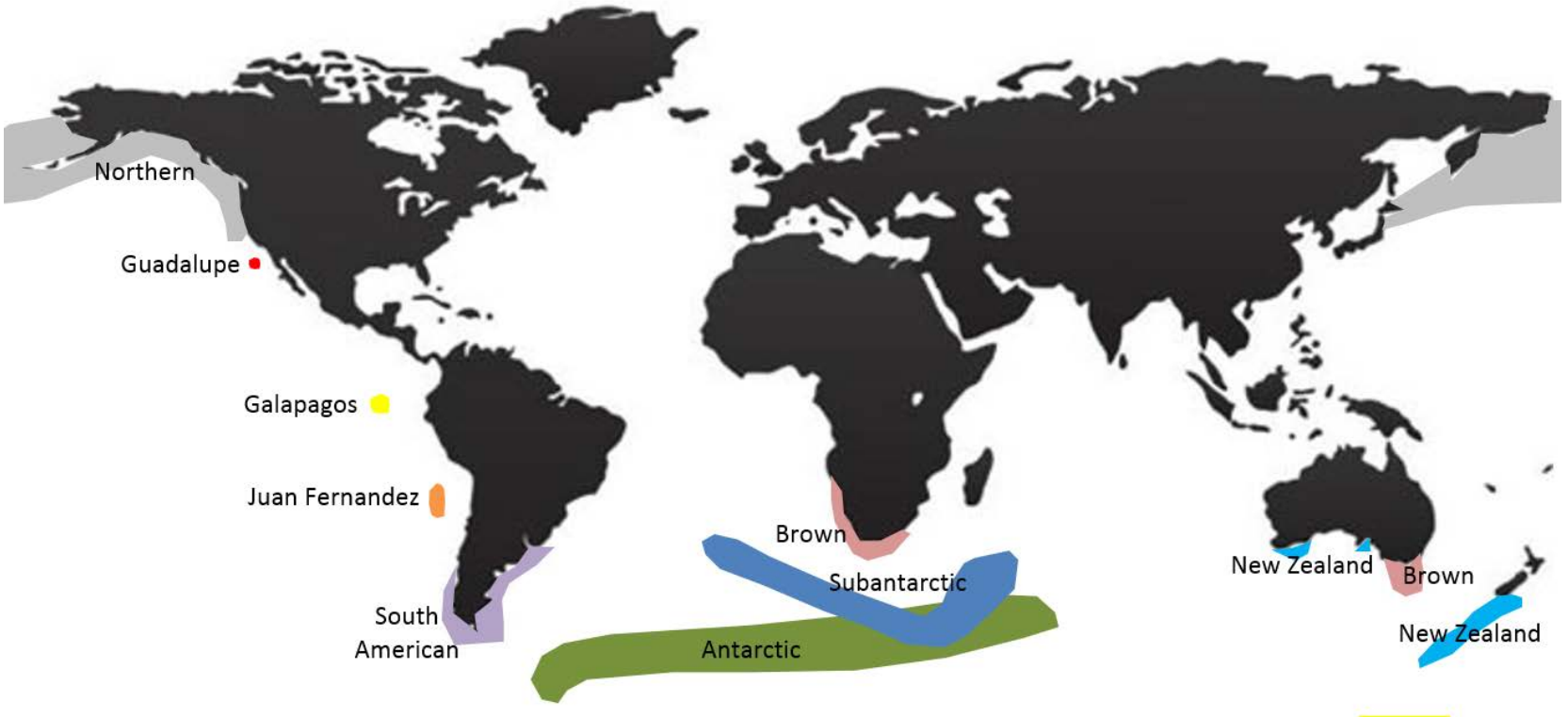
Sources

- Species recovery plans
- Journal articles
- MSc/PhD theses
- Department of Fisheries/Environment Reports
- FAO review and others

Otariid species history

- Reduction of breeding range and population size by subsistence hunting and commercial sealing;
- As with NZ sea lions, many reduced to very low population size (< 100 individuals)
- Rapid recovery of population size in many species, e.g. Antarctic fur seals…
  - 1 breeding population <100 individuals early 20th Century
  - Currently 4-6 million individuals

Otariids
9 fur seal species



Otariids
7 sea lion species (including 1 extinct)

Summary of threats to otariids - Appendix B

Species	Population (IUCN status)	Distribution	Key threats	References
Sea lion species				
Australian sea lion (*Neophoca cinerea*)	~14,000; stable or slightly declining (EN)	Southern and Southwestern Australia; not recovered former breeding locations in Tasmania and Bass Strait, extirpated by commercial sealing in 18th/19th C	Threats include incidental mortality relating to fisheries and entanglement in fishing gear and other marine debris. Minor threats include habitat degradation, human disturbance at colonies including deliberate killings, disease, pollution, prey depletion and climate change.	Australian Department of the Environment (2013); Goldsworthy et al. (2003); Goldsworthy & Page (2007); McIntosh et al (2013)
California sea lion (*Zalophus californianus*)	~350,000; different population trajectory comparing populations (LC)	Eastern North Pacific; recent recolonization of historical breeding sites in Northern California	Pup mortality and low natality rates during El Niño events and periods of warm climate affecting prey abundance; changes in carrying capacity; direct fishery interactions; entanglement in marine debris; bioaccumulation of chemical pollutants (e.g., DDT and PCBs); disease from exposure to terrestrial animals; toxic bloom related mortality.	Carretta et al. (2007); Francis & Heath (1991); Lowry & Maravilla (2005); Mellin (2012); NOAA (2015); Silvagni et al. (2005); Szteren et al. (2006)
Galapagos sea lion (*Zalophus*	~20,000; decreasing from	Nearly all pups born at the Galapagos;	Mortality, low pupping rates and disease epidemics	Alava & Salazar (2006); Trillmich &

Summary of threats to otariids
Types of threats

- Natural
  - Climate variation
  - Predation
  - Disease
  - Genetic
  - Behavioural
- Anthropogenic
  - Direct/indirect fishery effects
  - Hunting/poaching/harassment
  - Pollution
  - Alteration of habitat

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Summary of threats to otariid sp. Natural: climate variation

- Large climate perturbations e.g. El Niño have major negative effects on pup survival and pupping rate of array of otariid sp. (data may be insufficient for estimating adult survival):
  - ~**100% pup mortality** South American SLs 1997/98 (13% in previous yrs) (Soto et al. 2004)
  - **~100 pup mortality**, disease epidemics in Galapagos sea lion & fur seal during El Niño & low natality in next year (Alava & Salazar 2006);
  - **24% natality** of California SLs in El Niño (77% across all years) (Melin 2012);
  - Very low natality of South American SLs in 1997/98 (**~5% of pup production**) (Soto et al. 2004)

Summary of threats to otariid sp. Natural: climate variation

- Large climate perturbations e.g. El Niño have major negative effects on pup survival and pupping rate of array of otariid sp. (data may be insufficient for estimating adult survival)
- Adverse climate regimes (typically associated with surface warming) appear to cause protracted periods of decline in otariid populations
- Climate effects related to changes in prey abundance in most cases (all?);

Summary of threats to otariid sp. Natural: climate

Potential climate effects on the abundance or distribution of NZ sea lion prey species include:

- SST and recruitment of red cod (Beentjes & Renwick 2000);
- Surface chlorophyll a concentration (from satellite derived data) and squid catch rates in commercial fisheries (Hurst et al. 2012);
- ENSO and Chilean jack mackerel abundance (Arcos et al. 2001).

Summary of threats to otariid sp. Natural: disease & parasites

- Commonly recorded in large proportion of otariid species, including bacterial/viral
- Primarily affects pup mortality (though data may be lacking for older individuals)
- Considered a constant threat for otariids given social breeding, reduced genetic diversity & concentrated breeding range
- Pathway of infection usually unknown, though evidence from California sea lions and Galapagos fur seals of infection from terrestrial animals (feral and domesticated dogs)
- Disease prevalence may be exacerbated by poor nutritional status, e.g. *Streptococcus* and starvation incidence in brown fur seals (also depressed pupping rate in that year)
- Parasites thought to be more important than disease for Northern fur seals

Summary of threats to otariid sp. Natural: predation

- Key predators identified for most otariids though consumption rates not well understood (& hence relative effect on otariid populations);
- Ecosystem modelling on Steller sea lions indicates that predation may be more of a problem at small population size;
- High rates of scarring at Auckland Islands attributed to great whites; though no temporal variation in occurrence of scarring in 8-year study;
- Potentially more of a problem for small populations on NZ mainland and Stewart Island (where great white population is known to be high)?

Summary of threats to otariid sp. Natural: genetic

- Low genetic diversity of otariid species, tends to be higher for fur seals – attributed to rapid recovery of population size and breeding range expansion of fur seals (Robertson & Chilvers 2011);
- Increased susceptibility to disease;
- Rapid population growth of some otariid species from very low population size (from <100 to 10,000+, e.g. Guadalupe fur seal) despite low genetic diversity
- Genetic diversity of NZ sea lions similar to other sea lions (summary in Robertson & Chilvers 2011)

Summary of threats to otariid sp. Natural: behavioural

Male harassment…

- Male harassment causes pup/female mortality
- Probable cause of non-colonial breeding at low population size and may slow recovery of small population size

Dispersal…

- Strong philopatry and breeding site fidelity limit rate of breeding range expansion
- Breeding site relocations tend to be at haul out sites situated close to large breeding colonies
- Rapid growth rate of new colonies - once colonial breeding is advantageous?

Summary of threats to otariid sp. Anthropogenic: direct fishery effects

- Incidental fishery mortalities of all otariid species
- High capture numbers not deemed sufficient to drive population decline of Northern fur seal to due large population size (~1 million);
- Low capture numbers deemed sufficient to affect population trajectory of Australian sea lions, given low pop size (~15,000) and low productivity
- Population effects of incidental mortality depend on mortality relative to population size and productivity (e.g. age at first pupping/pupping rate), which will vary with prey availability etc.

Summary of threats to otariid sp. Anthropogenic: indirect fishery effects

- Indirect effects via resource competition and “even less directly” through alteration of food web structure;
- Examples of fishery catches of otariid prey comparable to consumption rates:
  - Walleye Pollock and US populations of Steller sea lion (Lowry et al. 1989; NMFS 2008)
  - Southern arrow squid and NZ sea lion (Meynier 2010)
- Ecosystem complexity, data & model limitations confound assessment of interactions between otariids, pred/prey and fisheries;
- Ecosystem modelling suggested commercial catches of different fisheries could impact on Steller sea lion populations (Guenette et al. 2006)

Summary of threats to otariid sp. Anthropogenic: harassment

- Sources of harassment include:
  - Intentional killing (persecution)
  - Disturbance by members of public
  - Disturbance by scientific teams
  - Domestic pets
  - Vehicle strike
  - Noise
- Can cause mortality, injury, dispersal of breeding populations, changes in behaviour

Summary of threats to otariid sp. Anthropogenic: pollution & marine debris

- Thick pelage and concentrated breeding distribution render otariids susceptible to major oil spills;
- Major threat to Galapagos fur seals, northern fur seals and South American fur seals given proximity of breeding sites to oil fields and oil transportation routes
- Bioaccumulation of PCBs and DDT in California sea lions
- Entanglement in lost fishing gear & marine debris in all otariids, perceived a key threat to Australian sea lions

Summary of threats to otariid sp. Anthropogenic: habitat alteration

- Alteration at different scales:
  - Local (e.g. alteration terrestrial habitat at breeding/haul out sites)
  - Regional (e.g. introductions of invasive species)
  - Global (anthropogenic climate change)
- Difficult to quantify effects, particularly in marine environment, though known to be critical for terrestrial mammal populations
- Considered a threat to Australian SLs
- High pup mortality of NZ sea lions in rabbit burrows prior to eradication from Enderby in 1993 using poison & dogs
- Climate change effects likely to be major & long lasting

Key findings >>> TMP process

- Natural threats to otariid populations cause population change in absence of anthropogenic threats, e.g. climate-driven
- Population effects of fishery mortality depend on mortality imposed relative to population size and productivity of population (which varies through time)
- Minimal information for assessment of some threats, e.g. predation, indirect effects, habitat alteration
- Behaviour may slow population growth of small populations & will also limit rate of breeding range expansion
- Threats to NZ sea lion populations common to global otariid species – we can learn from experiences elsewhere
- Due consideration of natural & behavioural threats should improve efficacy of conservation measures

Acknowledgements

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NIWA
Taihoro Nukurangi

End of presentation