POP2011-04 Basking shark bycatch review
Presentation of methodology

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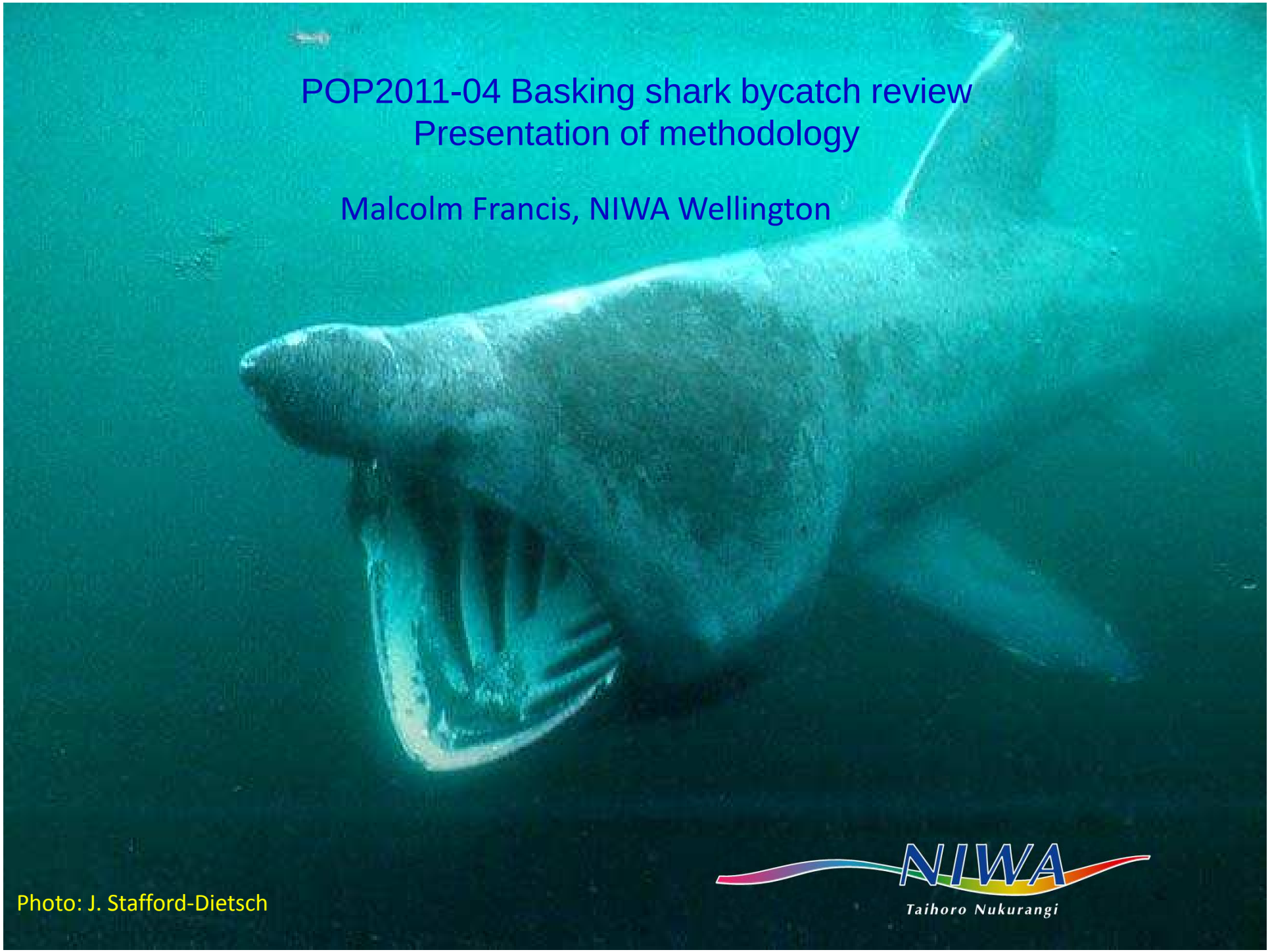


Photo: J. Stafford-Dietsch

NIWA
Taihoro Nukurangi

Background

Observers on large trawlers operating around southern NZ have reported numbers of basking sharks being caught

Images: Ministry of Fisheries

Background

Mortality rate is assumed to be 100% ….

Sharks are often processed for fins or livers

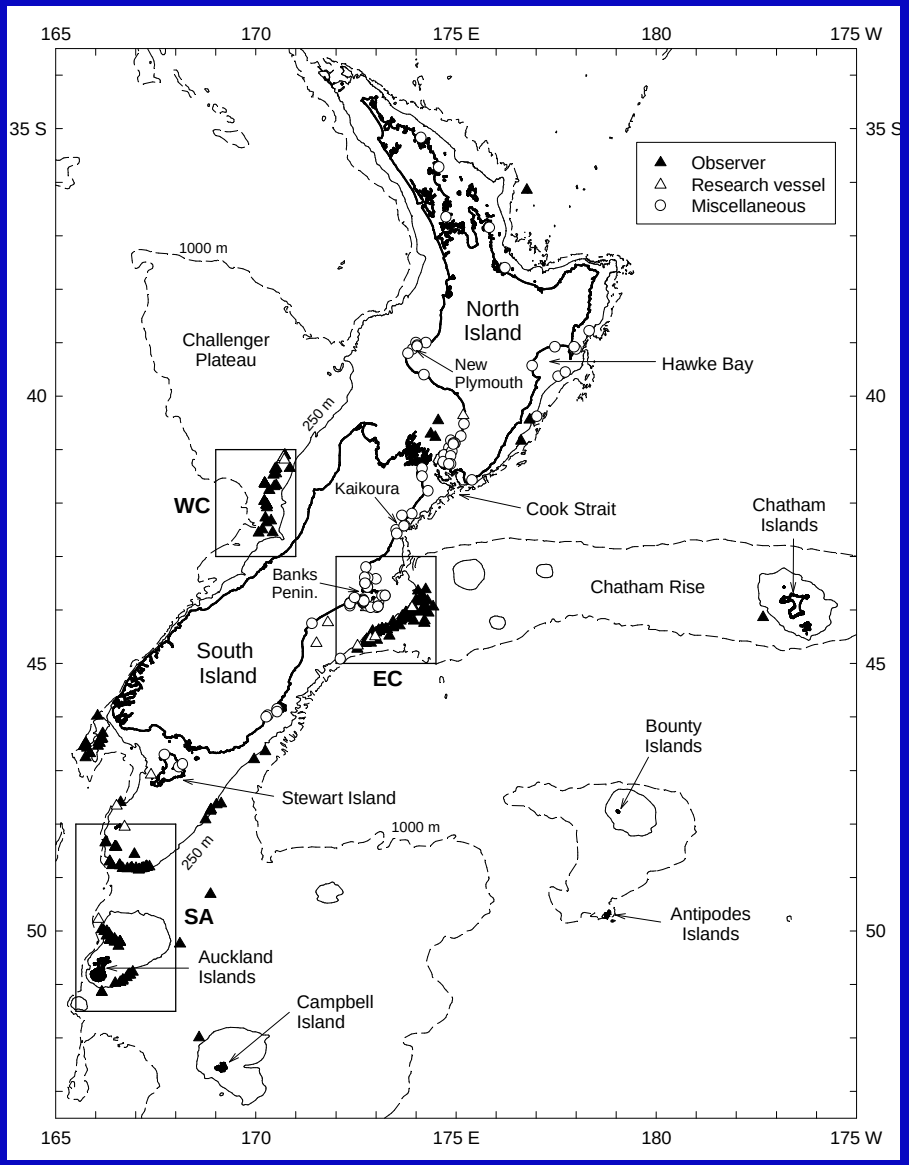
Images: Ministry of Fisheries

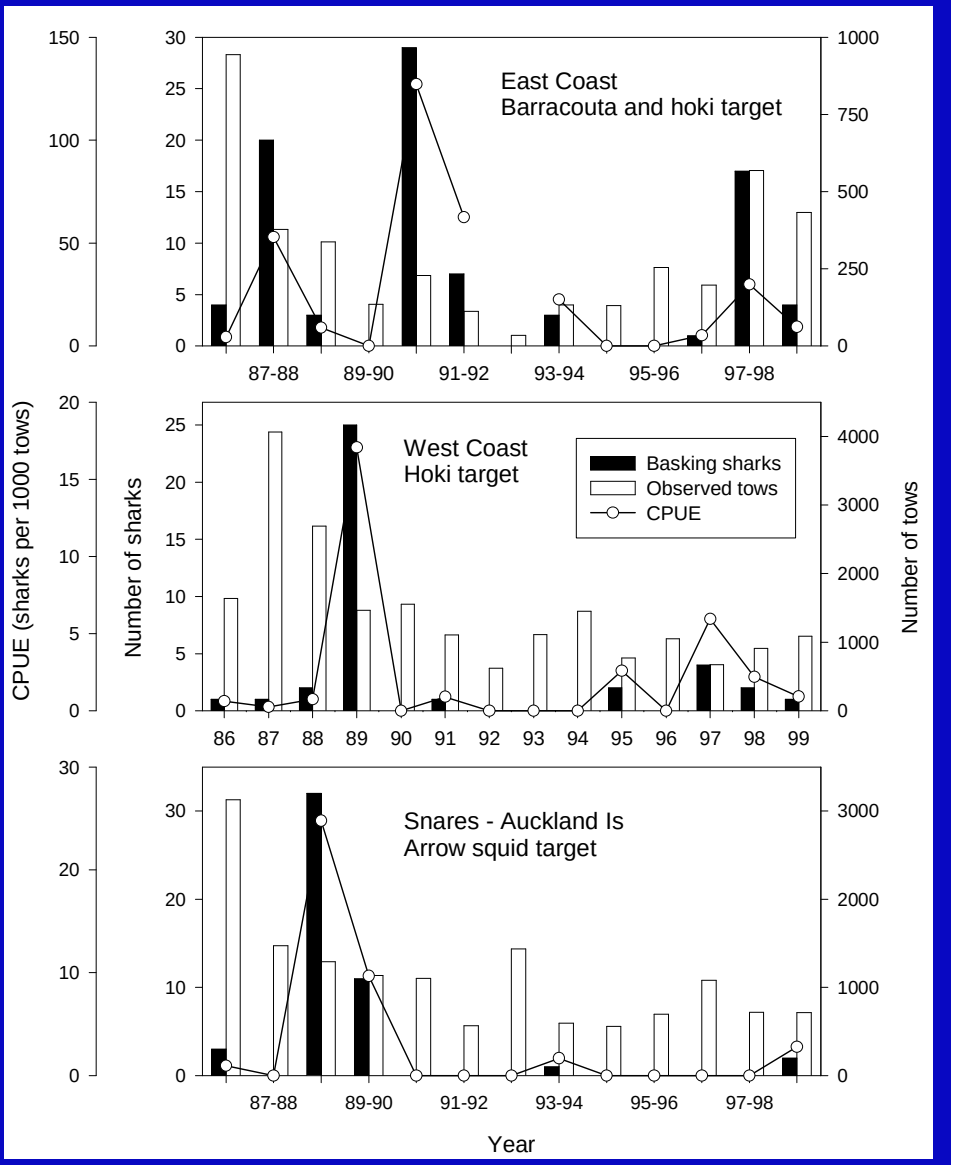
Background

But even if returned to the sea whole, it is unlikely that any survive

Images: Ministry of Fisheries

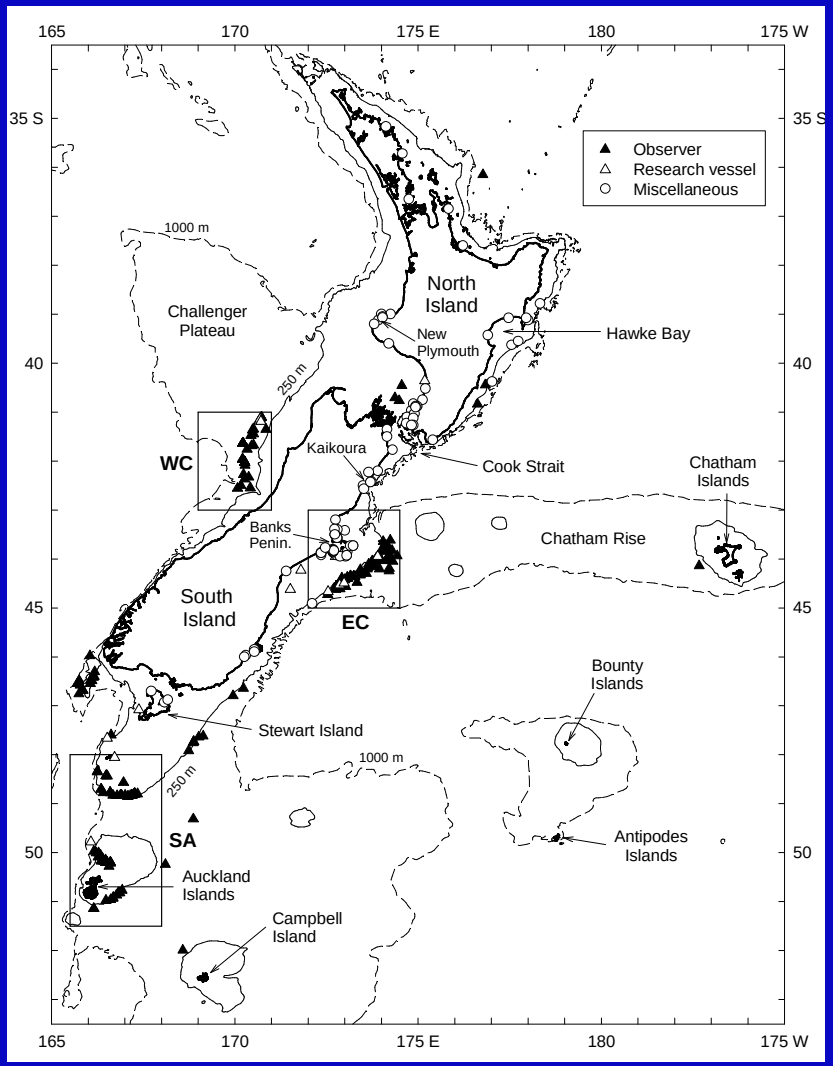
Background

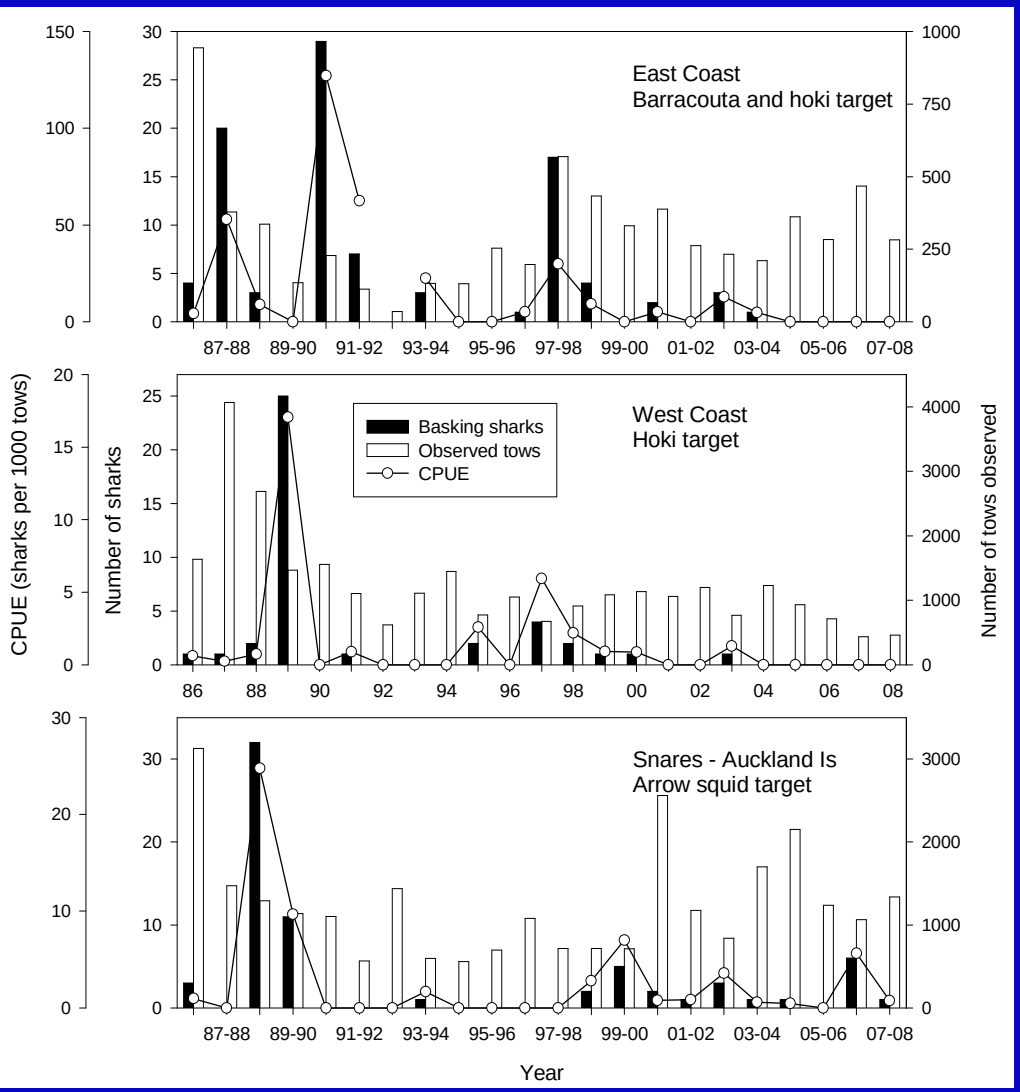




Francis and Duffy (2002): Distribution, seasonal abundance and bycatch of basking sharks (*Cetorhinus maximus*) in New Zealand, with observations on their winter habitat. *Marine biology 140(4)*: 831-842

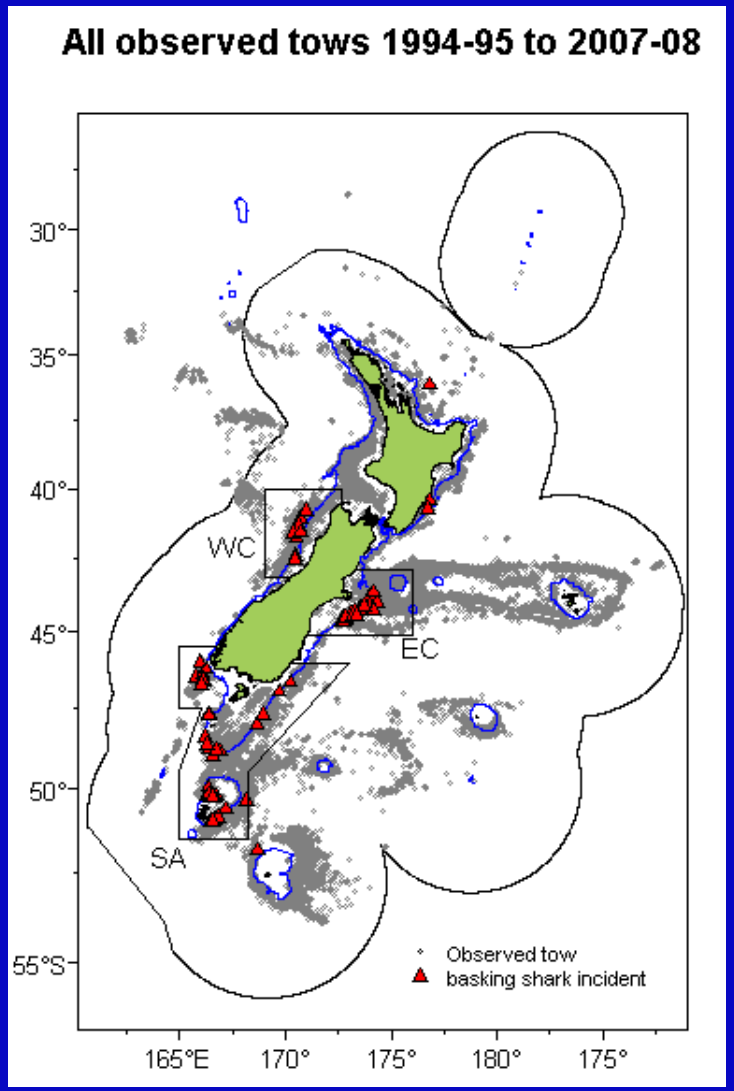
Background





Francis, M. P.; Smith, M. H. 2010: Basking shark (*Cetorhinus maximus*) bycatch in New Zealand fisheries, 1994–95 to 2007–08. *New Zealand aquatic environment and biodiversity report 2010/49*. 57 p.

Background



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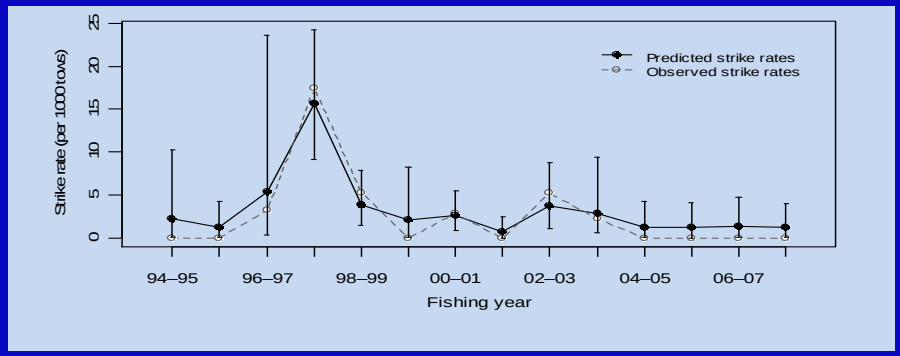

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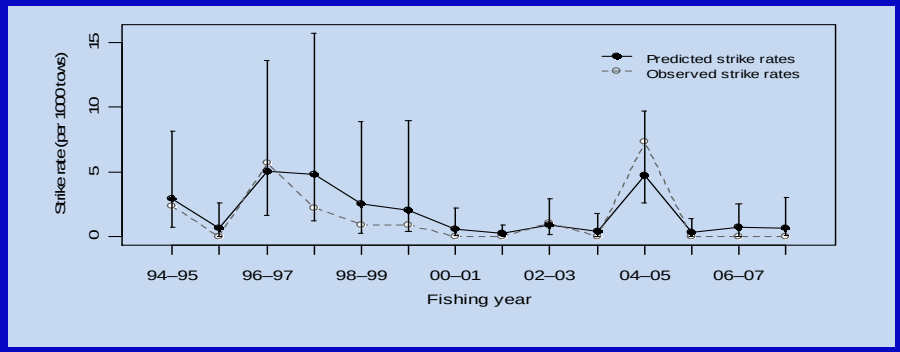

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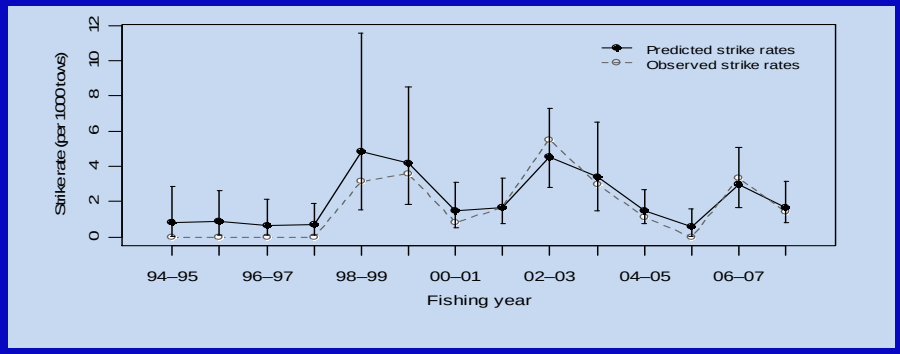


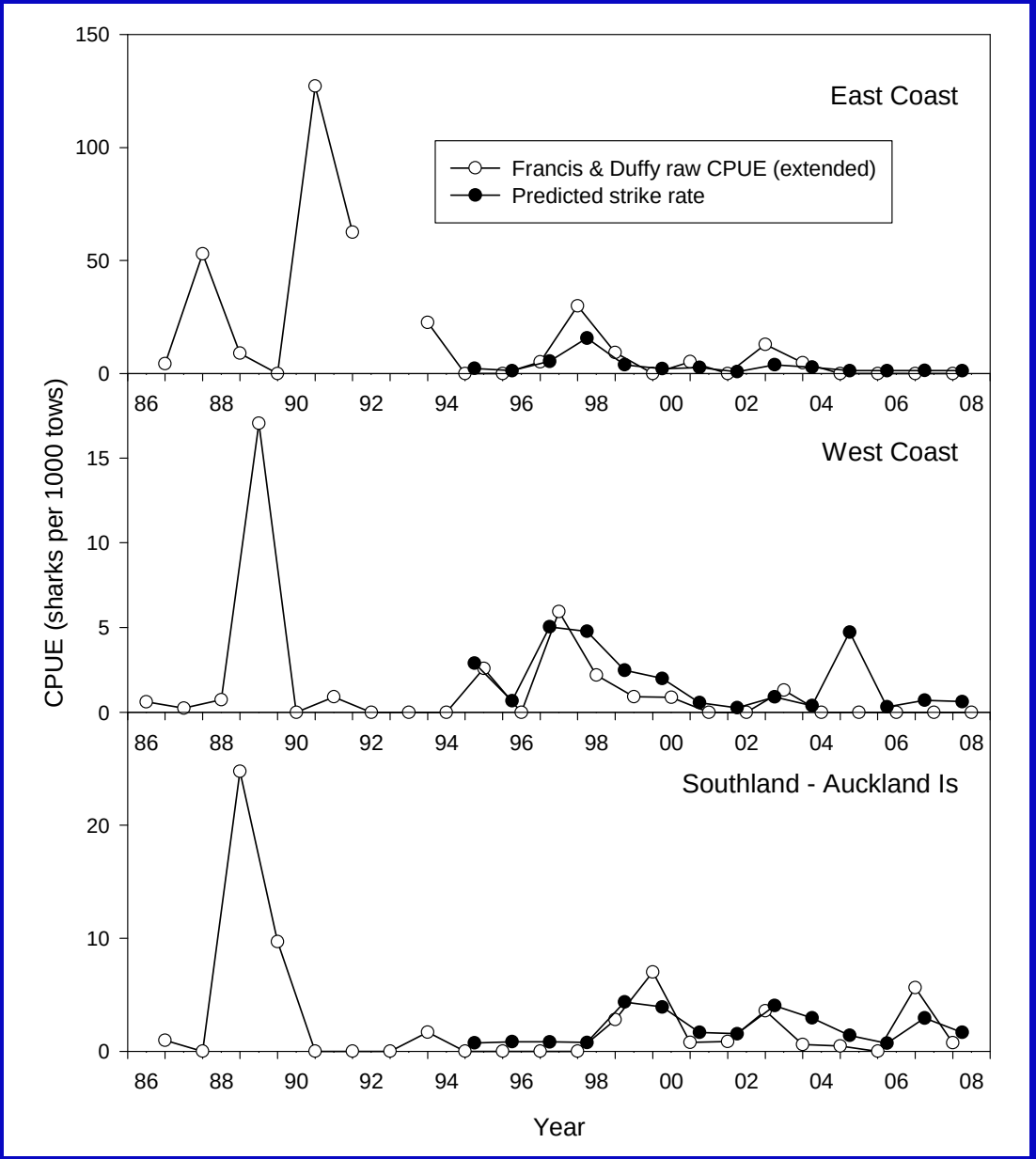
Francis, M. P.; Smith, M. H. 2010: Basking shark (*Cetorhinus maximus*) bycatch in New Zealand fisheries, 1994–95 to 2007–08. *New Zealand aquatic environment and biodiversity report 2010/49*. 57 p.

Background

Two sets of relative abundance indices:

1. Unstandardised CPUE 1986-2008

2. Modelled strike rates 1994-95 to 2007-08



What causes the fluctuations in catch rates – abundance or availability?

Hypotheses:

1. The low numbers of sharks observed in trawl bycatch in the last decade, and a lack of basking sharks observed by DoC aerial survey flights around Banks Peninsula in recent years, are a result of population declines caused by fishing. There may not have been large aggregations of basking sharks in New Zealand since 1991.

2. Fluctuations in catch rates are driven by environmental factors; specifically, high catch rates during the late 1980s and late 1990s resulted from increased water temperatures.

3. Changes in the composition of trawl fleets, and the way that they operate, have reduced the level of interactions between sharks and trawlers; specifically, catch rates may have been higher in early periods because some foreign fishing vessels may have been targeting sharks because of the value of their liver oil and fins.

Objectives

Overall objective:

- To identify factors related to apparent reductions in basking shark captures within the New Zealand EEZ

Specific objective:

- To identify factors, including variation in fishing vessels and areas, related to the apparent decline in bycatch of basking sharks within the New Zealand EEZ over the period 1994/95 to 2007/08.

Methodology

Approach:

Generate a series of indices describing (a) water temperature and (b) trawl fleet composition and operational methods that can be correlated with basking shark catch rate indices.

Methodology

We will use three datasets to generate temperature indices for the three core fishery regions:

1. Satellite sea surface temperature (SST) with daily global 25 km resolution dating back to 1981 (Reynolds et al. 2007).

2. Average temperature through the water column will be assessed from satellite measurements of sea surface height (SSH) (Sutton et al. 2005). Warm water is less dense than cold water, so a warm water column expands and stands slightly taller than a cold water column. SSH analyses are global, with roughly 100 km and 10 day resolution back to October 1992.

3. Expendable bathythermograph (XBT) measurements of temperature in the upper 800 m of the ocean have been measured along transects made by vessels steaming between Wellington and Sydney at approximately quarterly intervals since 1991 (Sutton et al. 2005).

Methodology

SST and SSH data will be averaged (a) separately across each of the three fishery areas for which basking shark catch rate indices have been generated, and (b) across the 2-4 months with the greatest predicted catch rates in each area (December to February in East Coast, May-June in West Coast, and October-January in Southland-Auckland Islands (Francis & Smith 2010)). These annual indices will be calculated for each of the three areas over 23 years (1986 to 2008) for SST and 14 years (1994-95 to 2007-08) for SSH.

XBT data are available for the West Coast fishery area (the Wellington-Sydney transect passes through the northern corner of the area), but there are no analogous XBT transects for the other two fishery areas. The XBT transect made closest in time to the May-June West Coast catch rate peak will be used. Annual temperature indices will be generated for several depth bands (e.g. 200 m, 500 m, 800 m) for the 14 years 1995 to 2008.

Methodology

Trawl fleet composition and operational fishing methods will be described using data extracted from the Ministry of Agriculture and Forestry warehou catch-effort database and the vessel registry. For each trawl tow occurring in the three core fishery areas during the months and years of interest, we will extract relevant vessel and operational data including vessel nationality, towing power, location (latitude and longitude), depth, headline height, tow length and target species. Time series of maps and bubble plots will be generated to determine whether there has been any significant change in these variables in any of the three fishery areas since 1986.

Methodology

Environmental and operational fishing variables will be used as predictor variables in statistical models fitted to each of the two time series of bycatch rates, separately for each of the three fishery areas. Analyses will range from simple to complex, the most suitable approach being decided following preliminary inspection of the data. Likely candidates include Generalized Linear Models, Generalized Additive Models, G tests of independence, linear regression and correlation, and locally weighted smoothing regression (loess). Where possible, we will fit interaction terms to investigate interactions between variables that may be more informative than the individual variables (e.g. different nationality vessels may fish different parts of a given fishery area).

Analytical and model results will be used to identify any temporal trends in explanatory variables that correlate with the trends in bycatch rates.