

Trawl footprint by target species

Tables and plots showing the estimated swept areas for each species are in Appendix 3 (tables are in files <species id>_footprint_stats.pdf and <species id>_footprint_stats.xls, e.g., barracouta data are in BAR_footprint_stats.pdf and BAR_footprint_stats.xls; plots are in files <species id>_BOMECEC_fig_part<number>.pdf and <species id>_fig_part<number>.pdf, e.g. BAR_BOMECEC_fig_part1.pdf and BAR_fig_part1.pdf. See file README.doc for more information). Results are provided for each species for each fishing year and for the period 1989/90 to 2009/10.

The calculated statistics for bottom trawling can be used to monitor changes in fishing activity. For some species the number of tows and the total swept area per year vary considerably with time. For example, southern blue whiting had a large peak in both number of tows and swept area in the 1991/92 fishing year (Figure 13). From the 1992/93 fishing year onwards the number of tows and the swept area are considerably lower. The most recent years have shown a continuous small rise in numbers of both.

The graph for hoki (Figure 14) shows that the number of tows and the total swept area are not necessarily directly correlated. The peak for the total swept area occurs at 2002/03, five years after the peak number of tows. These trends could reflect an increase in trawl length and/or use of twin-rig trawl nets. In 1997/98 the average trawl length was 21.8 km, and less than 1% of those tows are thought to be twin-rig because trawling with twin-rig gear was introduced in that fishing year. In 2002/03 the average tow length was 23.8 km, but 26% of these were twin-rig (the average twin-rig tow length was 25.6 km). Therefore the increase in swept area five years after the peak number of tows may reflect a small increase in average tow length (21.8 to 23.8 km) and a larger increase in the use of twin-rig gear (from less than 1% to 26%).

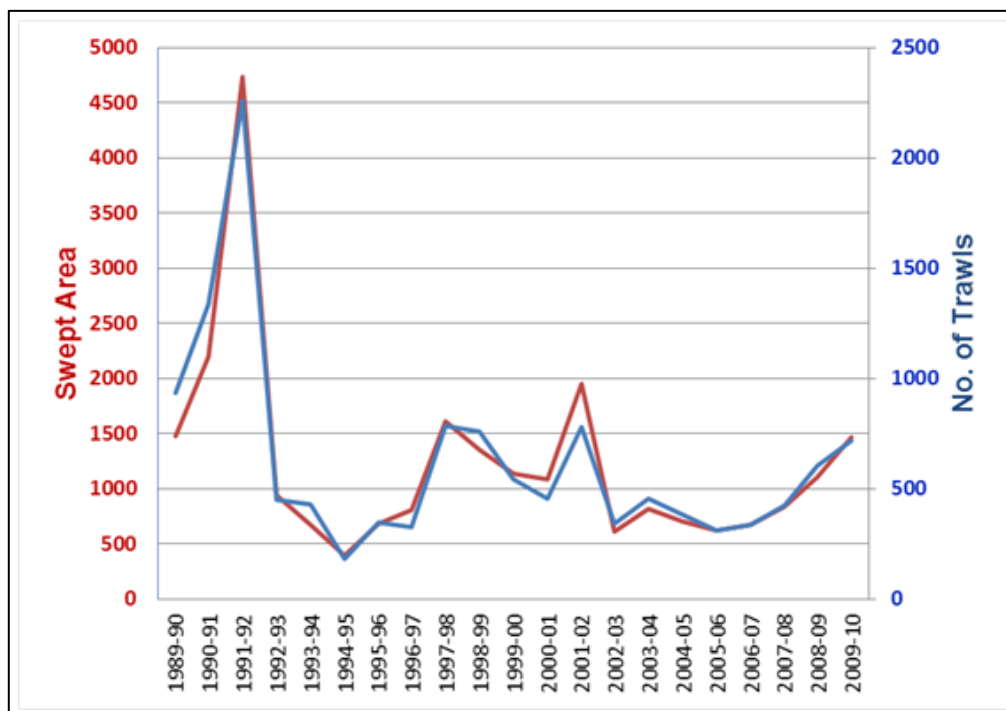


Figure 13: Number of tows and swept area (km²) for target species southern blue whiting.



Figure 14: Number of tows and swept area (km²) for target species hoki.

TCEPR data and frequency

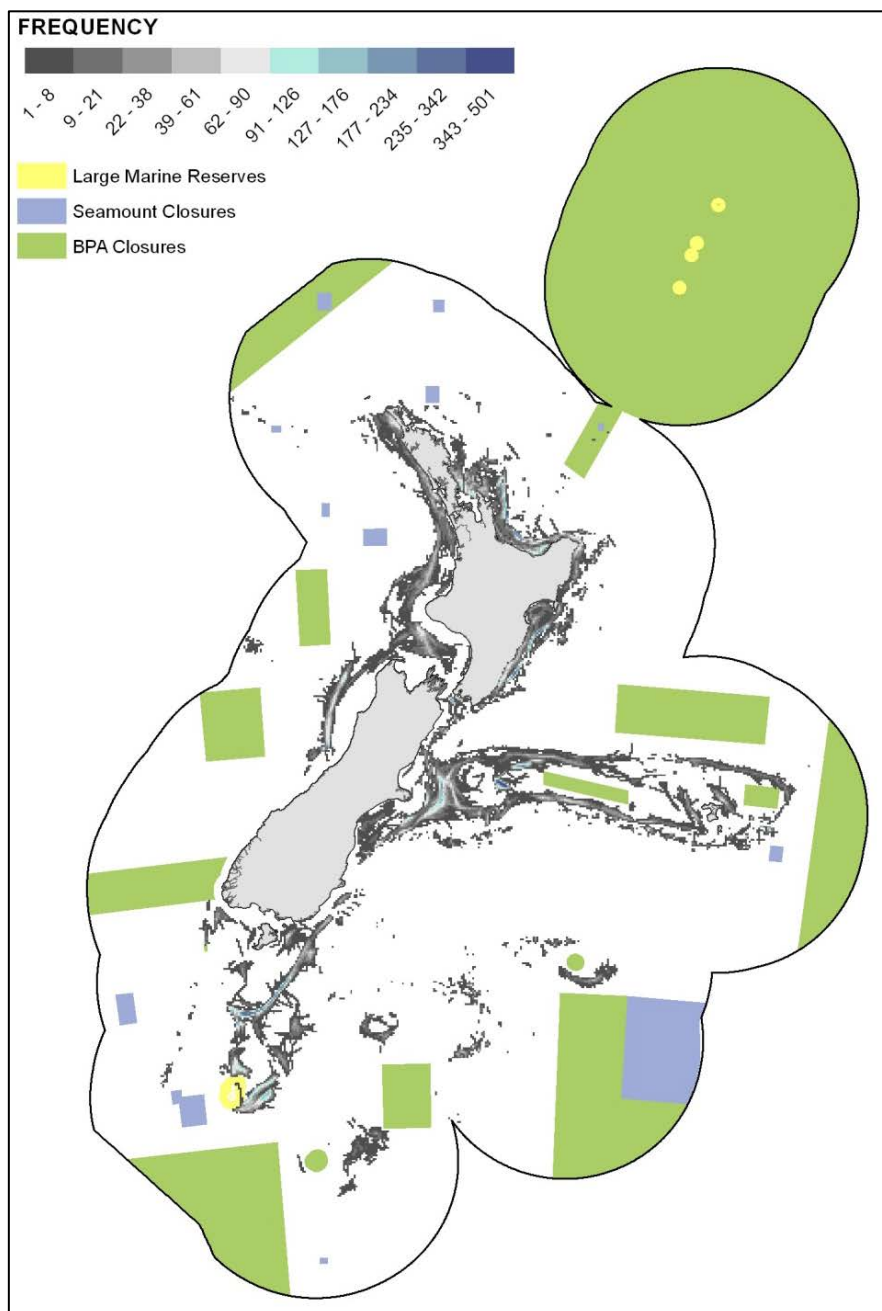
Tables and plots showing the estimated trawl frequency for each species are in Appendix 3 (tables are in files <species id>_freq_stats.pdf and <species id>_freq_stats.xls, e.g., barracouta data are in BAR_freq_stats.pdf and BAR_freq_stats.xls; plots are in files <species id>_freq_fig_part<number>.pdf and <species id>_area_fig_part<number>.pdf, e.g. BAR_freq_fig_part1.pdf and BAR_area_fig_part1.pdf. See file README.doc for more information). Results are provided for each species for each fishing year and for the period 1989/90 to 2009/10.

Frequency of fishing by year was calculated by counting the number of trawls that crossed each cell in a raster grid that covered the EEZ and TS. A total of 167 477 cells, each 5 km x 5 km in size, were used for the analysis. The results can be directly compared with the analyses of Baird et al. (2011).

For the period 1989/90 to 2009/10 tows were reported in 39 731 of these cells, about 24% of the total number of cells. The highest tow frequency in a cell was 16 539. The mean frequency of tows for all fished cells was 167, and the mean frequency of tows in all cells was 40. The largest cumulative swept area in a cell was 10 010 km². The mean swept area for cells that tows were reported in was 80 km², and the mean for all cells was 19 km². For the fishing year 2009/10, 12 866 cells were contacted by bottom tows, about 8% of the total number of cells (Figure 15). For this most recent year in the dataset the highest number of tows in a cell was 501, and the mean frequency of tows for those cells that tows were reported in was 15.

For the period 2005/06 to 2009/10 the mean frequency of towed cells within the fishable area for all species combined declined from 17.7 to 14.7 between 2005/06 and 2008/09, but

increased slightly to 15.3 in 2009/10. The increase in 2009/10 was reflected in the 0–400 m, 400–800 m and 800–1200 m depth zones, but not in the 1200–1600 m depth zone (Figure 16).



Statistics for 2009-10

No. of filled cells reporting tows	12 866
Cells reporting tows	7.8%
Highest frequency of tows	501
Mean frequency in towed cells	15.3
Mean frequency in all cells	1.2

Figure 15: Estimated frequency of trawling in areas of sea floor contacted by bottom trawling for all species 2009/10 (top), and related statistics (bottom).

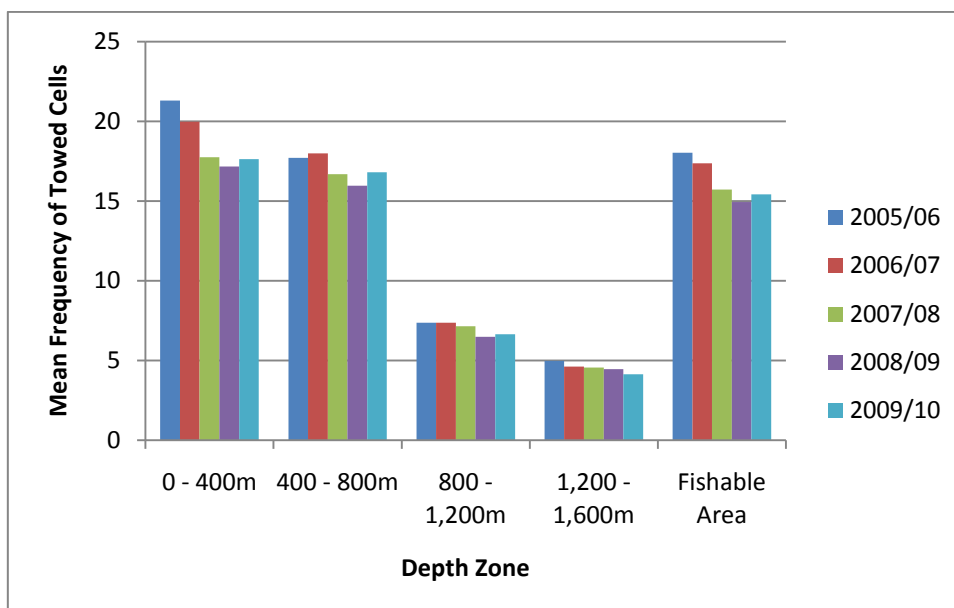


Figure 16: Mean frequency of towed cells for all species combined within the overall fishable area and by depth zone for the period 2005/06 to 2009/10.

For tows targeting hoki, the mean frequency of tows for all trawled cells between 2005/06 and 2009/10 was stable at around 14. There was a slight dip to 12.5 in 2007/08 and to 11.8 in 2008/09 when the Total Allowable Commercial Catch (TACC) was reduced by 10 000 t. When the TACC was increased by 20 000 t in 2009/10 the mean frequency increased back to 14.2. Interestingly, the swept area for hoki did not increase in response to the 20 000 t TACC increase, remaining constant at around 19 000 km² (Figure 14), suggesting that tows occurred in a reduced number of cells. The highest mean frequency occurred in the 400–800 m depth zone where there were between 13 and 16 tows in trawled cells. A similar trend occurred in the 0–400 m depth zone where the number of trawls ranged between 9.3 and 11.7 (Figure 17).

For oreo, there was an increase in the mean frequency of tows in trawled cells from 6.3 in 2005/06 to 7.6 in 2009/10. The highest frequency of trawls occurred in the 800–1200 m depth zone where the average number of tows per cell increased from 6.7 in 2005/06 to 8.3 in 2009/10. The trend in the deeper than 1200 m depth zone was flat. In the 400–800 m depth zone there was an increase from 2.8 to 5.6 over this period, while in the 0–400 m depth zone there was an abrupt decrease from 3.4 to 1.7 between 2007/08 and 2008/09, (Figure 17). The total area trawled declined from 1472 to 1079 km² between 2005/06 and 2008/09, coincident with a 3000 t TACC decrease in 2007/08, before increasing again to 1372 km² in 2009/10, coincident with a 250 t TACC increase.

Figure 18 shows the pattern of fishing for southern blue whiting in a small area of the fishery (Bounty Plateau) for the period 1989/90 to 2009/10. The tow path distribution shows that the fishing effort is concentrated in areas south-west and south-east of the island. The calculation of frequency of tows per cell quantifies this variation, varying from 1 tow per cell to 138 per cell in this region.

Statistics from this type of analysis for barracouta show that 9202 cells, about 5.6% of the total, had some fishing effort in the period 1989/90 to 2009/10. The largest cumulative swept area in any one cell was 909 km². The mean and standard deviation were 13 km² and 40 km²,

respectively. The maximum number of tows across any one cell was 1447. The mean and standard deviation were 28 and 78 tows, respectively. Figure 19 illustrates the distribution of area contacted and the number of tows in each cell (note that the entire ranges are not shown in the figure). More than 90% of the cells fished for barracouta have a contact area less than 40 km² and fewer than 70 tows.

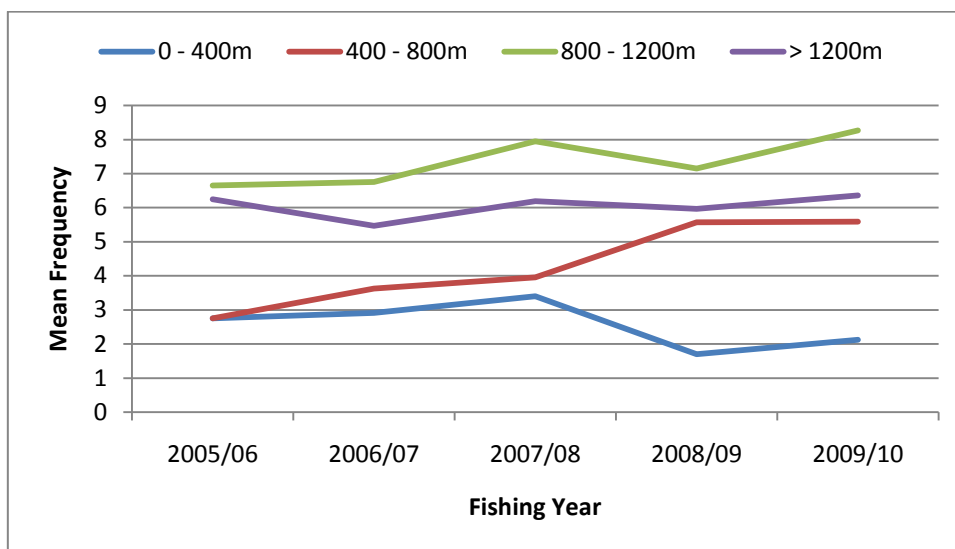
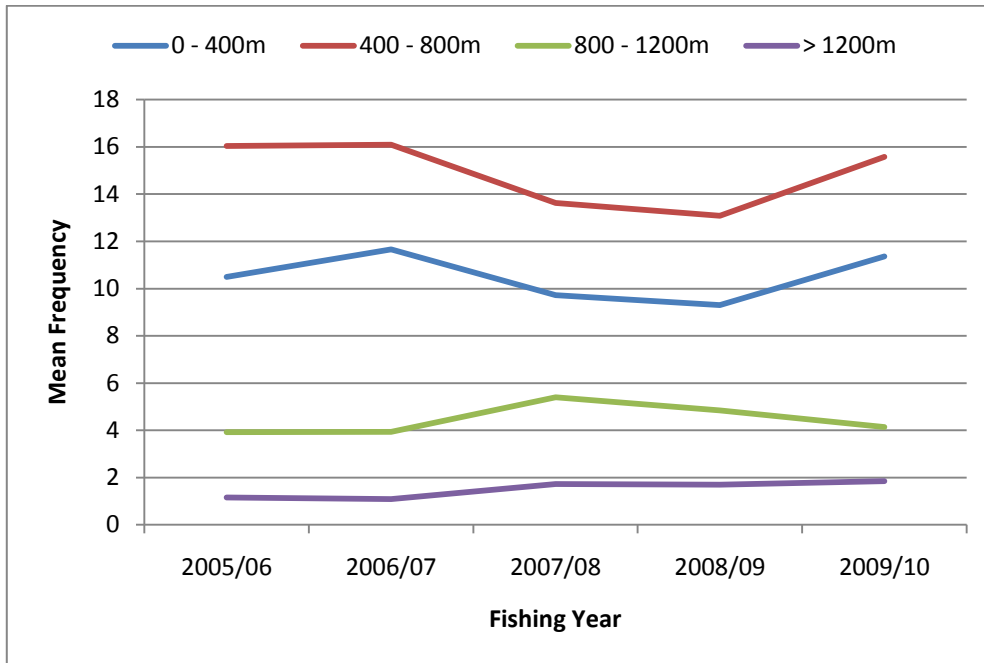


Figure 17: Mean frequency of tows in trawled cells for the period 2005/06 to 2009/10 for hoki (top) and oreo (bottom).

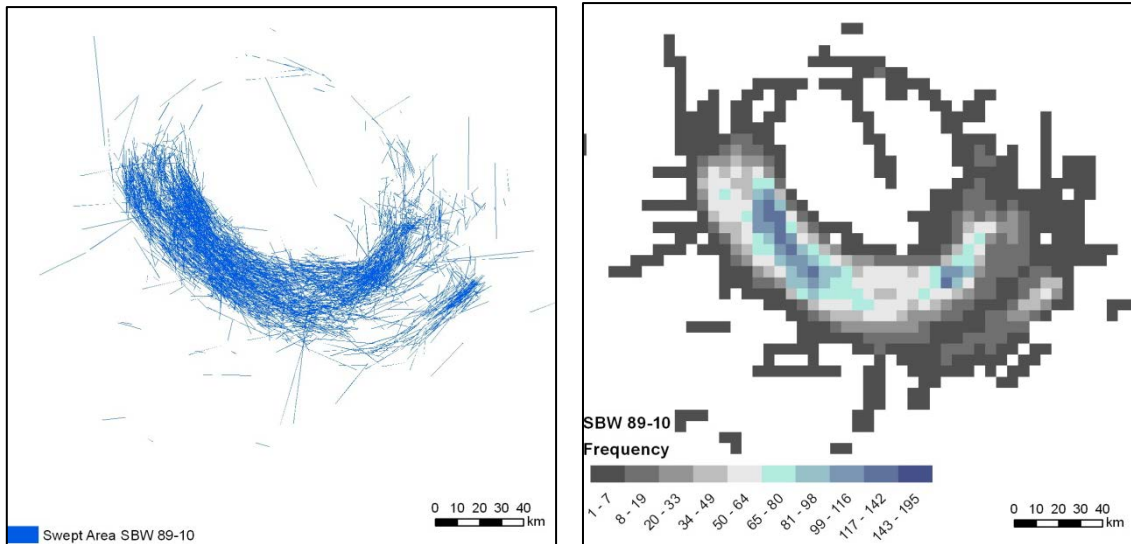


Figure 18: Frequency analysis for southern blue whiting on Bounty Plateau for the period 1989/90 to 2009/10 showing tow path distribution (left) and the frequency of tows in each cell (right).

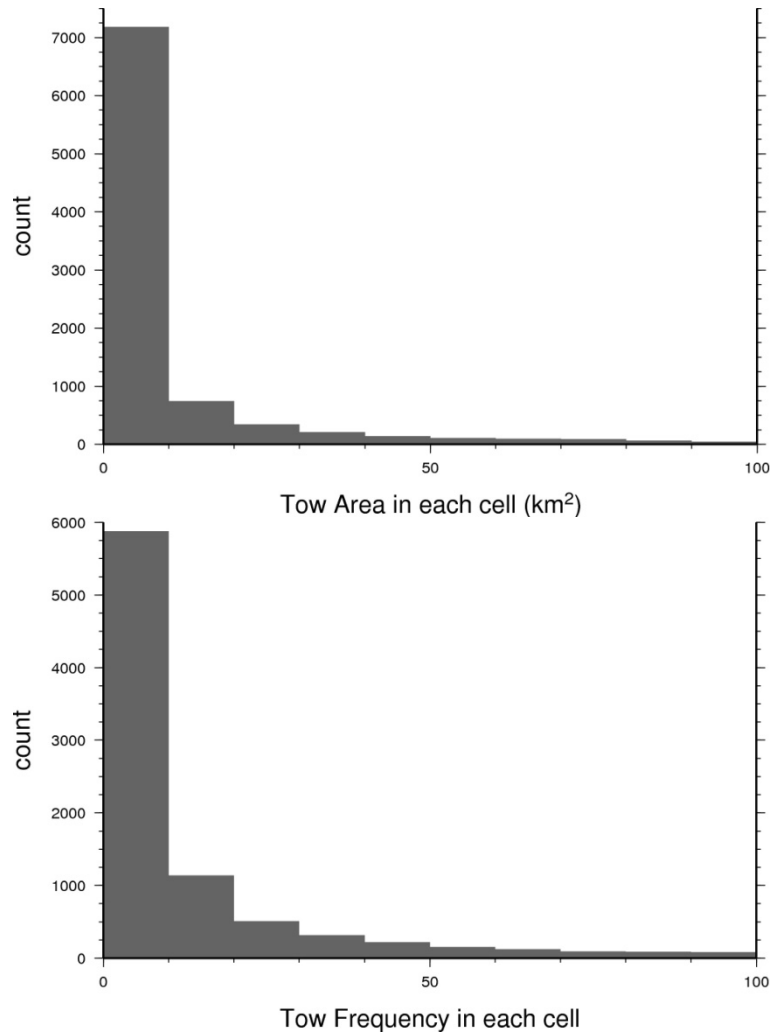


Figure 19: Frequency analysis for barracouta for the period 1989/90 to 2009/10 showing the area contacted in each cell (top) and of the number of tows contacting the seafloor in each cell (bottom). The area histogram uses a 10 km² bin size and the tow frequency histogram uses a 10 tow bin size.