CHAPTER 5

Distribution and abundance of dusky dolphins between the Haumuri Bluffs and the Waiau River

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This study provides the first estimate of dusky dolphin abundance between Haumuri Bluffs and the Waiau River. Line-transect techniques were adapted for a small (5.5 m) power vessel. Surveys were carried out during January - February 2008, and January - March 2009, using a zigzag design to maximise encounter rates of dolphins. A total of 958 km of survey effort was completed over a period of 61.96 hours. Dusky dolphin groups encountered during the survey were mostly small (<50 animals; n = 48), resulting in an abundance estimate of 132 (95% CI = 75, 230). The infrequent occurrence of large groups in the area occasionally inflates abundance to between 949 and 1782. Evidence suggests these large groups are likely to have temporarily travelled into the area from the adjacent region of Kaikoura Peninsula – Haumuri Bluffs. Most groups encountered during the surveys were travelling, milling, or socialising/mating.

INTRODUCTION

Under current marine mammal permits, operators generally venture as far south as the Conway River mouth, and only occasionally beyond this (see Figure 1 for locations; and see Figure 1 - Introduction). With the impending end to the moratorium, tour operators have expressed an interest in being able to further utilise the area between the Conway and Waiau rivers. Research effort on dusky dolphins around Kaikoura has normally focussed on the area south of the Kaikoura Peninsula, as far as Haumuri Bluffs but occasionally further south towards the Conway River (see Würsig *et al*. 2007). Amongst the recent research findings are those that suggest dolphins tend to move south of the Haumuri Bluffs late in the day more often than they did prior to tourism (Brown, 1999). Thus, there was a need to carry out visual surveys between the Conway and Waiau Rivers.

The primary aims of these surveys were to gather information on distribution and provide a first estimate of abundance in this area. For completeness, it was decided to begin survey effort at the Haumuri Bluffs. South Bay provided the only suitable launching area for the research vessel. The Haumuri Bluffs are a straight-line distance of approximately 20 km/11n.mi. from South Bay; Conway River is approximately 27km/15n.mi; and the Waiau River is about 46km/25n.mi. Thus, there was considerable travel time involved in reaching the study area and returning to the safety of South Bay if weather conditions became unworkable. Further, the exposed nature of the coast dictated that the trip only be taken during excellent weather conditions, in order to ensure safety of the vessel and crew. The methods and resulting field effort should be considered with these constraints in mind.

Surveys were carried out during the austral summer seasons of 2007-08 and 2008-09. This chapter summarises methods and results of these surveys.

METHODS

Study area

The surveys described in this chapter focussed on the area between the Haumuri Bluffs and the mouth of the Waiau River (Figure 5.1). Survey effort and sightings were post-stratified to treat Haumuri-Conway and Conway-Waiau as separate survey strata.

Survey design

Surveys were carried out during January and February 2008; and January and March 2009 (Table 5.1). Line-transect methods were modified for use from a small vessel and non-elevated sightings platform. An overlapping zigzag design was used to provide wide coverage (figure 5.2) of likely dusky dolphin habitat. Each section of the zigzag was treated as a separate transect in order to satisfy sample size requirements, where each transect was a sample. An earlier design that utilised parallel transects was abandoned after only one attempt for both practical (small boat travelling into swell on alternate legs) and statistical (small number of sampling units) considerations. Data from this day were therefore excluded from all data summaries and analyses.

Placement of the zigzag design with respect to depth was intended to maximize encounter rates with dusky dolphins. The inshore apexes of the zigzags were generally within 2.5 – 3.0 km of shore (figure 5.2). Although dusky dolphins are not known to spend a lot of time in shallow waters, this was thought to be close enough so that groups inshore from the zigzag had a high sighting probability in good conditions – particularly large (100+) and/or active groups.

The exception to this was during the final survey period when an additional zigzag survey was plotted in the inshore waters along the same section of coast. This was in response to recent work (Weir *et al.* 2008) which suggested that nursery groups are often encountered in shallow waters. Because this was added during the final stages of the project, the results will be discussed with respect to distribution, but the data will not be used in abundance estimates.

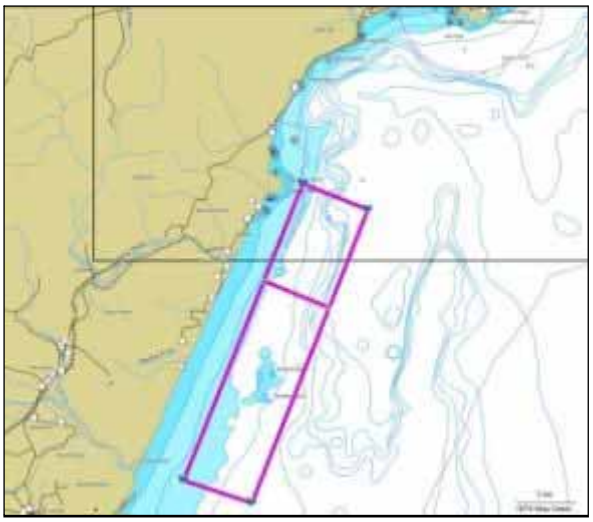

Figure 5.1. Map showing approximate study area outlined in purple[1]. Also shown is the stratification boundary, marking the border between the Haumuri-Conway and Conway-Waiau sections of the survey area.

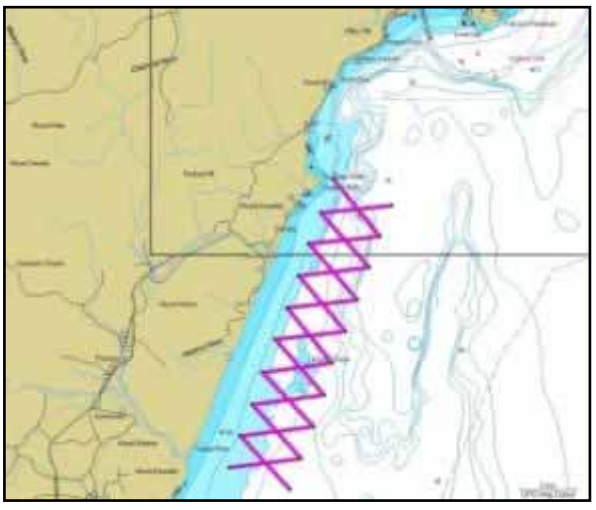

Figure 5.2. Purple lines show the line transects surveyed using the zigzag design along the near shore area from the Haumuri Bluffs to the Waiau River. Blue lines indicate water depth isobaths, with shallower depths shaded.

[1] All maps in this chapter were produced using Garmin MapSource v6.15.6 and BlueChart Pacific v9.5

Field methods

Surveys were carried out from a 5.5m rigid-hulled inflatable boat ("Punua Aihe"), powered by an 80hp 4-stroke outboard engine. For each survey, three people were on board (driver plus two observers).

Two primary observers and a secondary observer were used. The secondary observer was the boat driver, and as such was not able to concentrate fully on spotting dolphins. The primary observers each concentrated their effort on one side of the boat, from the track line to slightly abeam of the boat. Vessel speed was maintained at between 12 and 15 knots (depending on conditions). Because of the distances required to be covered each day in order to fully cover the survey area (each full zigzag was approximately 58 km in length), slower speeds were not practical.

A Garmin GPS Map60Cx was used to facilitate navigation and record effort data. Position fixes were stored every 10 seconds. Environmental data (sea state, swell, an overall visibility score, mean and maximum wind speed) were recorded at each waypoint (i.e. zigzag apex), representing the start and/or end of each transect.

When dolphins were sighted, the vessel was stopped to allow for time at first sighting and sighting cue to be recorded. The boat then approached the group, stopping when within approximately 10 metres of the animals. At that point, a second time was noted, and relevant group information recorded, such as group size, group composition and behaviour (recorded as resting; travelling; socializing/mating; milling; or feeding). Group size was estimated for group sizes between 1 and 49, and thereafter was categorized as: 50-99, 100-249, 250-499, 500-999, and 1000+. Group composition simply noted the presence or absence of adults, juveniles and calves.

Variations to standard surveys

In response to recent results showing that dusky dolphin nursery groups often show a preference for shallow waters (Weir *et al*. 2008), two exploratory surveys were conducted during the final survey periods (January and March 2009) to cover the area inshore of the regular zigzag survey path. These surveys were either straight-line, following the coast roughly halfway between the shore and 10 m depth contour (a distance of 600-700 m offshore; 25 January 2009) or a zigzag design similar to that used for the regular offshore surveys (08 March 2009).

Abundance estimation

Boat position and heading were recorded at time of first sighting a group, and when the boat was within 10 m of the group. The differences in positions and headings were used to calculate perpendicular distance of dolphins from the vessel's track line. In cases where groups were within 100 m, distance was estimated by observers.

Distance methods were used to estimate the density of small groups where group size was estimated rather than bracketed in a likely range, i.e. group size <50. Program Distance v5.0 (Thomas *et al.* 2006) was used to fit a density function to perpendicular sighting distances of small groups (<50), thus allowing for estimation of the effective half strip width (ESW). Small group density was estimated separately for Haumuri-Conway and Conway-Waiau. Sightings were truncated at 0.45km, leaving n = 41 sightings for ESW and average group size estimation.

Model candidates were: half-normal (cosine); half-normal (hermite); uniform (cosine); hazard (cosine); and hazard (polynomial). Akaike's Information Criterion (AIC) was used to select the most parsimonious model, balancing fit and complexity. ESW was estimated globally (i.e. using data pooled across both areas). Group size ($\bar{s}$) and encounter rates (n/L) were estimated globally and by survey area.

Density ($\hat{D}$) was calculated using the standard distance sampling equation (Buckland *et al*. 2001):

$$\hat{D} = \frac{n \cdot \bar{s}}{2LESW}$$

Where: n = number of sightings,

$\bar{s}$ = average group size,

L = transect length (km)

ESW = effective half strip width

Areas used in scaling density estimates to abundance were estimated using chart NZ63 (Kaikoura Peninsula – Banks Peninsula, 1:200000) and Ozi Explorer GPS Mapping Software (v3.95.4r).

Abundance estimates were thus calculated as:

$$\hat{N} = A \cdot \hat{D}$$

Using area (A; km^2) to scale up density estimates ($\hat{D}$).

Coefficient of variation of the small group abundance estimates, CV($\hat{N}$), was calculated using the coefficient of variations from the variables in the equations above (Buckland *et al*. 2001):

$$CV(\hat{N}) = \sqrt{\{CV^2(n) + CV^2(s) + CV^2(ESW)\}}$$

The CV(n) was estimated empirically using the equation:

$$CV(n) = \sqrt{\{var(n)/n^2\}}$$

Where:

$$var(n) = L\sum_{i=1}^{k} \frac{l(n_i/l_i - n/L)^2}{(k-1)}$$

Where: l_i = the length of the transect line i,

n_i = the number of sightings on transect i, and

k = number of transect lines.

The CV for ESW was estimated within Program Distance. The CV(s) was estimated from the standard error of the mean group size.

We assumed all large groups (>50) were seen, and used the number and likely group sizes of these encounters to bracket likely minimum and maximum estimates of total abundance. This was done by summing the minimum and maximum group size estimates for each day that large groups were encountered and dividing each total by the total number of days on which large groups were encountered. This gave an average minimum and maximum number of additional dusky dolphins for days on which large groups were encountered. The abundance estimate of small groups was added to each of these values to provide a likely total range of dusky dolphin abundance. This was done separately for both survey areas.

RESULTS

Dusky dolphin distribution

Sighting rates were higher for dusky dolphin groups during January 2008 than during February 2008, January 2009, and March 2009 surveys. In all other survey periods, there were few encounters with dusky dolphins south of the Haumuri Bluffs (Table 5.1 and Figure 5.3).

Table 5.1. Summary of field effort and dusky dolphin sightings, January and February 2008 January and March 2009. Times and distances represent "on effort" totals only, and do not include transit or rest periods.

Date	km (L)	Survey legs	Survey duration	Sightings (n)	n/L
Jan 2008	371	58	25.17	41	0.11
Feb 2008	213	33	13.04	4	0.02
Jan 2009	282	45	17.61	5	0.02
Mar 2009	93	9	6.14	6	0.06
Total	**958**		**61.96**	**56**	**0.06**

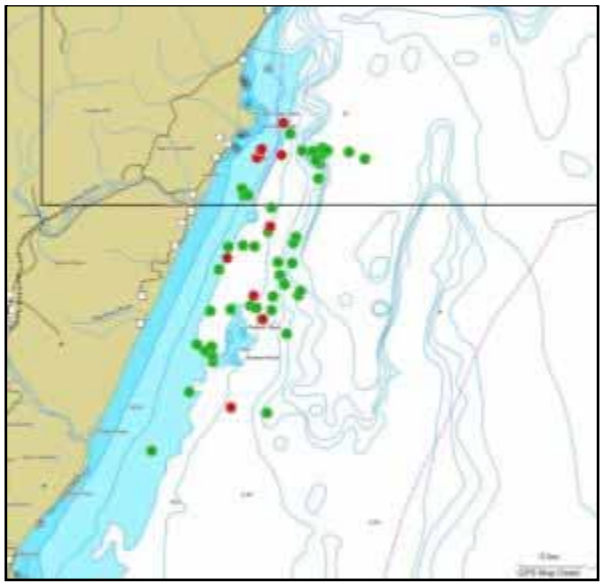

Figure 5.3. Plotted positions of all on-effort dusky dolphin sightings, 2008 (green circles) and 2009 (red circles).

Approximately equal numbers of dusky dolphin groups were encountered on surveys of Haumuri Bluffs -- Conway River and Conway River – Waiau River (table 5.2). In most cases encounter rates were lower between the Conway and Waiau Rivers than between the Haumuri Bluffs and the Conway River, reflecting the larger amount of survey effort to the south.

More dusky dolphins were encountered during mid-late afternoon than other time periods, and this was especially apparent for the area between the Conway and Waiau Rivers (table 5.3).

Dusky dolphin group size was extremely variable, with some groups numbering <50 and others several hundred. For groups where $n < 50$ (n = 48), average group size was 8.52 (CV = 17.88%). For all other groups (n = 8), two fell into the category 50-99, one each in 100-249 and 250-499 respectively; while four groups were in the 500-1000 group size category (table 5.4). Of the groups that numbered >50, six out of eight were encountered during the January 2008 surveys, while the remaining two were encountered during February 2008.

Large groups were predominantly encountered in the late afternoon. Only one large group was encountered on surveys before midday. Two were seen before 1500 hrs, and the remaining five (63%) were all seen after 1630 hrs. Five of the eight large groups (63%) were sighted in the Conway-Waiau area.

Behaviour

Sample sizes were considered too small to conduct formal statistical tests of behavioural states. Totals here may differ from those used for abundance estimates as it was not necessary to truncate sightings for the purposes of assessing behaviour.

In 2008 season most groups were travelling (n = 8; 23%), socialising/mating (n = 8; 23%) or milling (n = 13; 36%). Smaller numbers were found resting (n =2; 6%), feeding (n =2; 6%), or actively leaping (n =2; 6%).

Of the large groups encountered, half (n = 4/8) were resting, with the remainder either milling (n = 2/8) or travelling (n = 2/8).

For the small number of sightings made in the 2009 season, most (64%) were milling (n = 7/11); three groups (27%) were travelling. One group was seen leaping from a distance but never resighted on approach; therefore no behaviour was recorded.

Variations to standard survey

On 25 January 2009 a nursery group comprising approximately 50 animals was encountered in shallow (<10 m) water roughly 1.5 km northeast of the Conway River mouth. This encounter was not included in abundance sightings as it occurred outside of the standard survey area.

Table 5.2. Summary of field effort and dusky dolphin sightings, separated by area.

Area	Date	Distance surveyed (km)	Survey legs	Survey duration (hrs)	Dusky dolphin group sightings	sightings/km
Haumuri Bluffs – Conway River	January 2008	122	21	07.75	18	0.15
	February 2008	63	9	03.11	2	0.03
	January 2009	109	15	05.71	3	0.03
	March 2009	56	3	03.49	4	0.07
		350	*48*	*20.07*	*27*	*0.08*
Conway River – Waiau River	January 2008	249	37	17.41	23	0.09
	February 2008	150	24	09.93	2	0.01
	January 2009	173	30	11.89	2	0.01
	March 2009	37	6	02.65	2	0.05
		608	*97*	*41.89*	*29*	*0.05*
Total		958		61.96	56	0.05

Table 5.3. Numbers of dusky dolphin encounters by time of day.

	0600-0859	0900-1159	1200-1459	1500-1759	1800-2059	Total
Haumuri Bluffs – Conway River	1	8	6	8	4	27
Conway River – Waiau River	0	6	8	15	0	29
Total	1	14	14	23	4	56

Table 5.4. Group size summary of all dusky dolphin groups, 2008 – 2009.

Group size	Frequency	Average group size	CV (%)
1 – 49	48	8.52	17.88
50 – 99	2	-	-
100 – 249	1	-	-
250 – 499	1	-	-
500 - 1000	4	-	-

Other cetacean sightings

Two other species were encountered during surveys or transits. One large mixed pod of dusky and common dolphins was encountered on 09 January 2008. On several occasions (n = 17) during both survey seasons Hector's dolphins were encountered (figure 5.4).

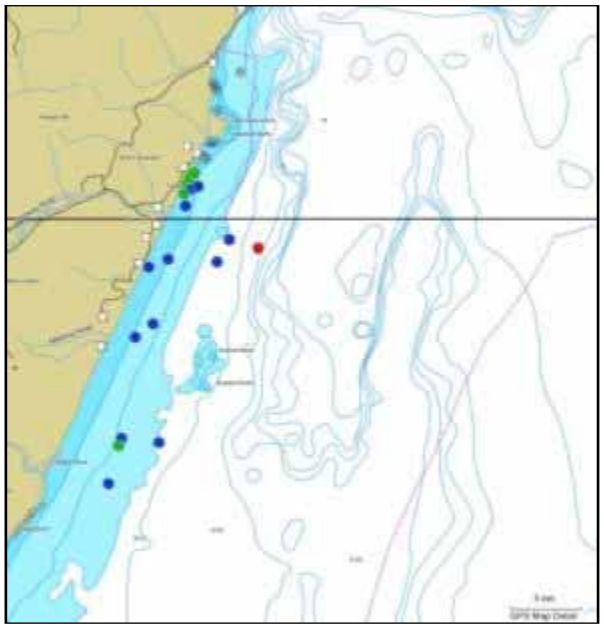

Figure 5.4. plotted locations of other cetacean sightings during the 2008 and 2009 survey seasons (red circle = common dolphins; green circles = Hector's dolphins, 2008; blue circles = Hector's dolphin, 2009).

Dusky dolphin abundance estimates

After truncation n=40 observations were available for estimation of ESW. Using AIC, a half-normal model was fitted to the distance data, giving ESW = 0.25 km (CV = 12.80%; figure 5.5).

Three sightings that were used for ESW estimation were not available for use in abundance estimates since the sightings were made outside the core survey area. Thus, average small group size for the 37 sightings available for abundance analysis was 7.70 (CV = 17.49%). Stratified average group sizes were 7.00 (CV = 34.03%; n = 18) and 8.37 (CV = 36.22%; n = 19) for Haumuri-Conway and Conway-Waiau respectively.

The average daily minimum estimate for the number of dolphins in large groups encountered between Haumuri and Conway was 267 animals, while the average maximum was 533 (n = 3 groups encountered over 3 days). In other words, on any day when large groups are encountered between Haumuri and Conway, on average these groups will account for between 267 and 533 dolphins in this area.

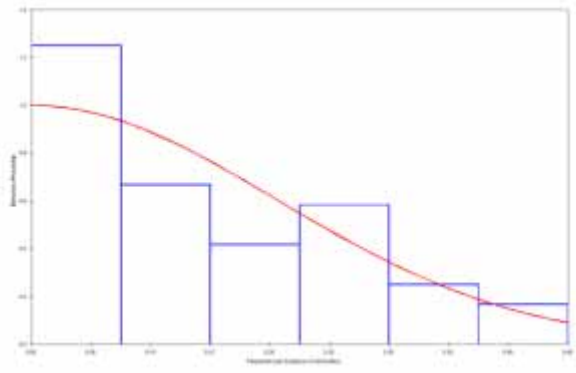

Figure 5.5. Fitted detection function using the half-normal model.

The average daily minimum for large groups between Conway and Waiau was 550 and the average maximum was 1117 (n = 5 groups encountered over 3 days). Pooling all large group encounters over both areas (n = 8) and all days (4) the average daily minimum is 613 and the average maximum 1238.

Based on stratified group sizes, and not including large groups, dusky dolphin abundance for Haumuri-Conway is estimated at $\hat{N}_{H-C}$ = 62 (CV = 42.11) and Conway-Waiau at $\hat{N}_{C-W}$ = 70 (CV = 40.15), giving a combined abundance of $\hat{N}_{Total}$ = 132 (CV = 29.06).

Using stratified large group averages, and including large groups, a minimum abundance estimate between Haumuri and Conway is $\hat{N}_{H-C,Min}$ = 329, and the maximum is $\hat{N}_{H-C,Max}$ = 595. For Conway-Waiau the minimum is $\hat{N}_{C-W,Min}$ = 620, and the maximum is $\hat{N}_{H-C,Max}$ = 1187. Combining these gives a total minimum of $\hat{N}_{Min-Total}$ = 949 and a maximum of $\hat{N}_{Max-Total}$ = 1782 (table 5). Thus, on days when there are no large groups present south of Haumuri, dusky dolphin abundance is estimated at 132 (CV = 29.06%, 95% confidence interval 75-230). On days when large groups are encountered, abundance is likely to be between 949 and 1782.

Table 5.5. Small group abundance estimates ($\hat{N}$), minimum ($\bar{s}_{min}$) and maximum ($\bar{s}_{max}$) large group averages, and combined totals ($\hat{N}_{Min}$,$\hat{N}_{Max}$) for the two survey areas.

Area	$\hat{N}$	$\bar{s}_{Min}$	$\bar{s}_{Max}$	$\hat{N}_{Min}$	$\hat{N}_{Max}$
Haumuri-Conway	62	267	533	329	595
Conway-Waiau	70	550	1117	620	1187
Total	132			949	1782

DISCUSSION

This study provides a first indication of dusky dolphin abundance from Haumuri to Waiau. It is apparent from the results that abundance is generally low in this area, but can be quite high at times. From observations made during these surveys it seems likely that density in this southern area becomes inflated when large groups that might otherwise be encountered north of the Haumuri Bluffs or at least in the immediate vicinity move further south.

On some of the days when large numbers of dolphins were encountered during the surveys, Dolphin Encounter (DE) vessels were seen at the southern-most extent of their current permit. Logically, the skippers would only travel to these areas if they were unable to find dolphins closer to Kaikoura. Radio conversations during these periods certainly indicated this was the case. Shore-based observations during January 2008 also confirm the main DE vessel activity was likely south of Haumuri Bluffs (see Chapter 6 of this report).

The results presented here should be treated as a first attempt at providing likely abundance estimates. While there were practical limitations carrying out distance sampling from a small vessel with a non-elevated platform, it was considered the best solution that fit within the constraints of the overall project. The density and abundance from the small-group calculations probably represent a reasonably good 'average' abundance for the area, with the caveat that at times it may be much higher.

Large groups were not included in the 'average' abundance estimates for a couple of reasons. Although these sightings made up a small proportion of overall sightings (n = 8 out of 48), they would have a disproportionate influence on average group size, density, and therefore abundance if they were included in standard distance sampling calculations. The drawback of this approach is that it is not a straight-forward matter to estimate the error component associated with bracketing the likely size of these large groups.

It is recommended that if further distribution and abundance surveys are to be undertaken in this area, aerial surveys would be appropriate. While aerial surveys cost more per hour compared to a small vessel, they offer other considerable advantages, such as being able to cover the area quickly and being less susceptible to weather conditions such as high swells. Dusky dolphins are highly visible from a height of around 500 ft/152.4 m. Because of the speed in covering the survey area, aerial surveys would allow for more extensive coverage of shallow, inshore waters.

The southern surveys during this project were limited to relatively small windows of available time. Ideally, with aerial surveys providing information for distribution and abundance, small boat work would supplement the data with focal follows to gain more information on dolphin behaviour and also to provide photo-identification data. It seems likely that when density south of Haumuri is high, that this is due to movement of animals that would otherwise be encountered further north. This will require more investigation.

Weir *et al*. (2008) have identified shallow (<20 m), inshore waters as being particularly important for dusky dolphin nursery groups. The limited time spent in these waters south of Haumuri prevents any conclusions being made as to the importance of the area from Haumuri to Waiau for nursery groups; however it is clearly worthy of further investigation.

A considerable number of questions have now been posed regarding the area from Haumuri to Waiau with regards to dusky dolphins:

1. How often are large groups encountered in the area?
2. Do the large groups seen in the area indicate occasional movement of animals from the Haumuri Bluffs/Goose Bay region? If so, why?
3. How important are the shallow (<20 m) waters for nursery groups?

In the meantime, some tentative conclusions and recommendations for managers can be made. It seems that dusky dolphin abundance in the southern survey area is mostly on the order of hundreds, rather than thousands. When large numbers were encountered south of the Conway River, DE vessels were seen to travel well to the south of the Haumuri Bluffs. Conversely, on days when dolphins were present in large numbers and active in the Haumuri Bluffs/Goose Bay region, few large groups were seen in the southern area.

It seems logical that the operators would only travel to the southern extent of their permit zone out of necessity; i.e. because there were few (if any) large active groups closer to Kaikoura. By extension therefore, it is possible to tentatively conclude that abundance in the southern area is occasionally inflated by movement of animals from closer to Kaikoura, and that this will coincide with the occasions when operators will also want to venture further south. It then becomes important to ask: why would these animals periodically move further south? This will require far more intensive research than was possible within the current study.