Acoustic monitoring of Hector's dolphin presence in Akaroa Harbour: A preliminary analysis

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Executive Summary

1. Passive echolocation detectors (T-PODs) were used at three sites in Akaroa harbour to monitor dolphin presence through the period 16 February 2007 to 18 February 2008

2. The three sites represent inner, mid and outer harbour habitats, and are areas in which amateur gillnetting takes place.

3. Each echolocation detector successfully collected data over 336-359 days (Average = 350). Together, the instruments collected 1049 days of data.

4. Dolphins used the outer harbour site (Jacob's Ladder) consistently throughout the year. While T-PODs were operating, dolphins were detected on every day but one.

5. The Jacob's Ladder site is typical of areas used by amateur gillnetters targeting butterfish. Acoustic monitoring shows routine dolphin presence in this area, year-round.

6. The mid harbour site (Onuku) shows only a weakly seasonal pattern. Dolphins were detected more often in summer, but even in winter dolphins were detected on most days. Over the whole year, dolphins were present for over 90% of the days on which T-PODs were collecting data.

7. The inner harbour site (Robinson's Bay) shows a more strongly seasonal pattern. Dolphins were detected on almost every day during summer, but are also present on many days in winter.

8. Robinson's Bay is routinely used by flounder gillnetters. Dolphins were detected on 41% of the days during the period when such gillnetting is legal.

9. T-PODs are very conservative indicators of dolphin habitat use, mostly because they monitor a very small area (average = 200m radius, max = 400m). Therefore lack of detection does not imply that dolphins are NOT present.

10. The results for Robinson's Bay show clearly that the concession of allowing unattended amateur gillnetting in winter is unsafe. Dolphins use this area routinely in winter, and are at risk of entanglement when they do so.

Scope

This report provides a preliminary analysis of acoustic monitoring of the distribution of Hector's dolphins in Akaroa Harbour, in order to inform decision makers involved in the Hector's dolphin Threat Reduction Process. To ensure the main results are available as quickly as possible, the data analysis is necessarily of a preliminary nature. A POD calibration experiment (not reported here) which was the final part of this investigation was completed on 29 February, 2008.

Study Design

Echolocation detectors (T-PODs) were placed in three locations from to 16 February 2007 to 18 February 2008. The three locations (Robinson's Bay, Onuku, and Jacob's Ladder: see Fig. 1) were chosen to represent inner, mid and outer harbour sites, and also to represent different habitats. They also represent typical sites used by amateur gillnetters in Akaroa Harbour and elsewhere in Canterbury. The Robinson's bay site is typical of the areas used by amateur gillnetters targeting flounder, and is well within the area in which unattended flounder netting is currently permitted from the end of February to the first day of November. The Jacob's ladder site is just outside the weed off a rocky shore, and is typical of areas used by amateur netters to fish for butterfish (which is legal, if nets are attended, during the period given above for flounder netting). We have observed gillnets in use in all three sites PODs were deployed.

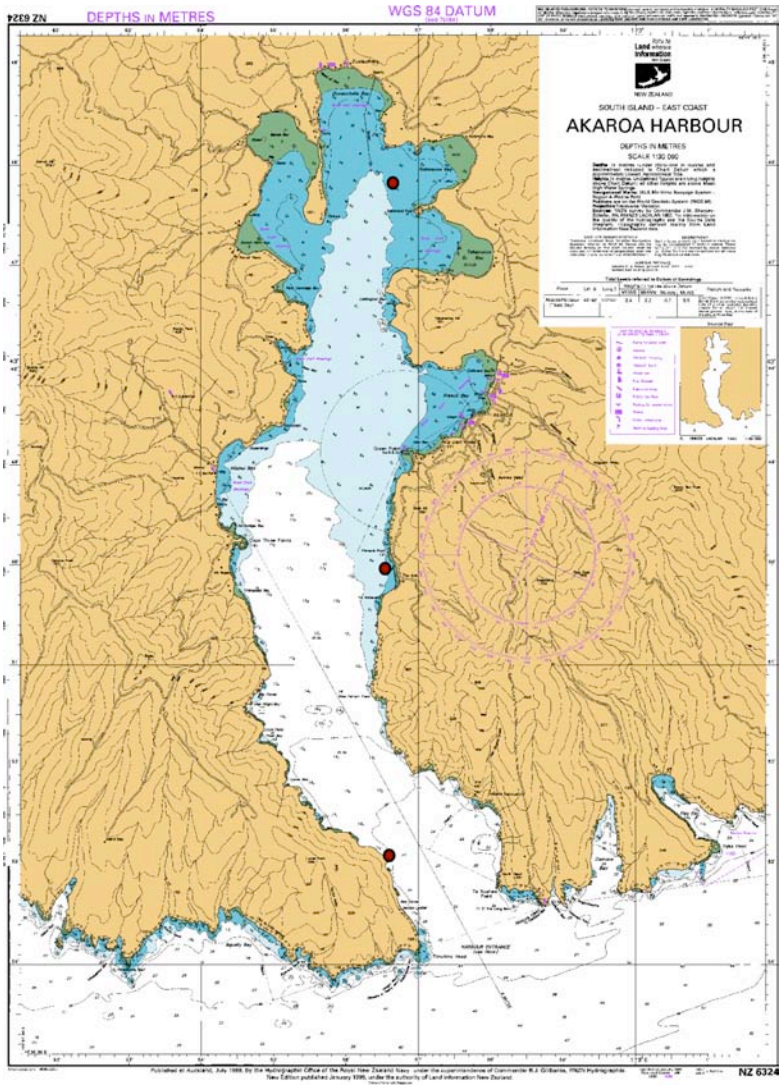

Fig. 1. T-POD locations (red dots). From N-S, sites are Robinson's Bay, Onuku, Jacob's Ladder.

Monitoring methods

T-PODs are passive, acoustic event recorders that were developed for monitoring harbour porpoise, a species not present in NZ waters, but which has almost identical sonar signals to those of Hector's dolphin (Au, 1993). T-PODs can be programmed to scan up to six different frequencies sequentially. In this study, the instruments were set so that five of the six scans were optimised to detect Hector's dolphin sonar clicks, which are narrow-band pulses centred on 120-130 kHz (Dawson and Thorpe, 1990). The remaining scan was set to detect the broadband echolocation clicks characteristic of bottlenose, dusky and common dolphins, which are the only other small cetaceans likely to use this zone. The fact that the sonar sounds of Hector's dolphin are so different to those of the other inshore dolphins allows reliable discrimination of them from acoustic records. T-PODs are widely used and have been deployed to study thirteen species of cetaceans (Tregenza, pers. comm.). Examples of recent published papers using T-PODs as their primary data gathering tool include Cox et al. (2001), Carlstrom, (2005), Cartensen et al. (2006), Philpot et al. (2007) and Verfuss et al. (2007).

Our research group has been using T-PODs to study habitat use by Hector's dolphin and Maui's dolphin since January 2003. The key advantage of using T-PODs for this purpose is that they are able to monitor dolphin presence around the clock for up to 6 weeks at a time.

T-PODs were fastened to temporary moorings so that the instrument was at a depth of between 5-9m. They were serviced at 4-6 week intervals, at which time they were removed, cleaned of any fouling organisms, downloaded and put back on the mooring. New alkaline batteries were installed on each service.

The PODs were deployed for a period of 369 days. Some data losses occurred due to (1) loss of one instrument from the mooring (it was later recovered), (2) burial of the mooring (and the POD) following an extreme weather event (3) premature battery failure.

Table 1. Number of days monitored

Site	Robinson's Bay	Onuku	Jacob's Ladder
No. days with data	359	336	354

Data Analysis

T-POD software (v. 8.19; Chelonia Ltd) classifies clicks depending on likelihood of having cetacean origin (the categories are: CET HI, CET LO, DOUBTFUL, VERY DOUBTFUL, and FIXED RATE/BOAT SONAR). As part of this process, any click trains having a very regular interclick interval are scored as most likely coming from an echo-sounder.

Via detailed analysis of POD files, and via simultaneous recordings with a wide-band sound recording system, we have found that T-POD often classifies genuine Hector's dolphin click trains into CET HI, CET Lo and DOUBTFUL categories. This observation was also made by Thomsen et al. (2005), who deployed T-PODs in a tank in which harbour porpoises were the only source of high-frequency sounds. Analysis showed that a relatively high proportion of trains (that had to be from the porpoises) were classified as CET LO and even as DOUBTFUL by T-POD software.

In this study we used click trains classified as CET HI and CET LO (together these are classed as "CET ALL". As indicated above, this is conservative, as there will have been many genuine click trains classified as Doubtful.

For the current analysis, T-POD data files were summarised as the number of encounters per day. In this process, an arbitrary decision was made to require a 10 minute silent period between subsequent encounters. In this way, a short period with a great deal of vocal activity gets scored as one encounter, even though it may contain thousands of clicks from several dolphins.

Results

T-POD echolocation detectors collected data over 336-359 days (Average = 350), which represents 91-97% of the days on which they were deployed. This was very successful considering the potential for failure due to extreme weather conditions and human interference, which is common in this type of study. Together, the instruments collected 1049 days of data.

Plots of the number of acoustic detections versus date are shown for each location (Figs 2-4). Note that the shaded areas are periods when the PODs were not collecting data.

Dolphins used the outer harbour site (Jacob's Ladder) consistently throughout the year. While T-PODs were operating, dolphins were detected on every day but one. This site is typical of areas used by amateur gillnetters targeting butterfish. Acoustic monitoring shows routine dolphin presence in this area, year-round.

The mid harbour site (Onuku) shows only a weakly seasonal pattern. Dolphins were detected more often in summer, but even in winter dolphins were detected on most days. Over the whole year, dolphins were present for over 90% of the days on which T-PODs were collecting data.

The inner harbour site (Robinson's Bay) shows a more strongly seasonal pattern. Dolphins were detected on almost every day during summer, but are also present on many days in winter. Robinson's Bay is routinely used by flounder gillnetters. Dolphins were detected on 41% of the days during the period when such gillnetting is legal, and are at risk of entanglement at this time.

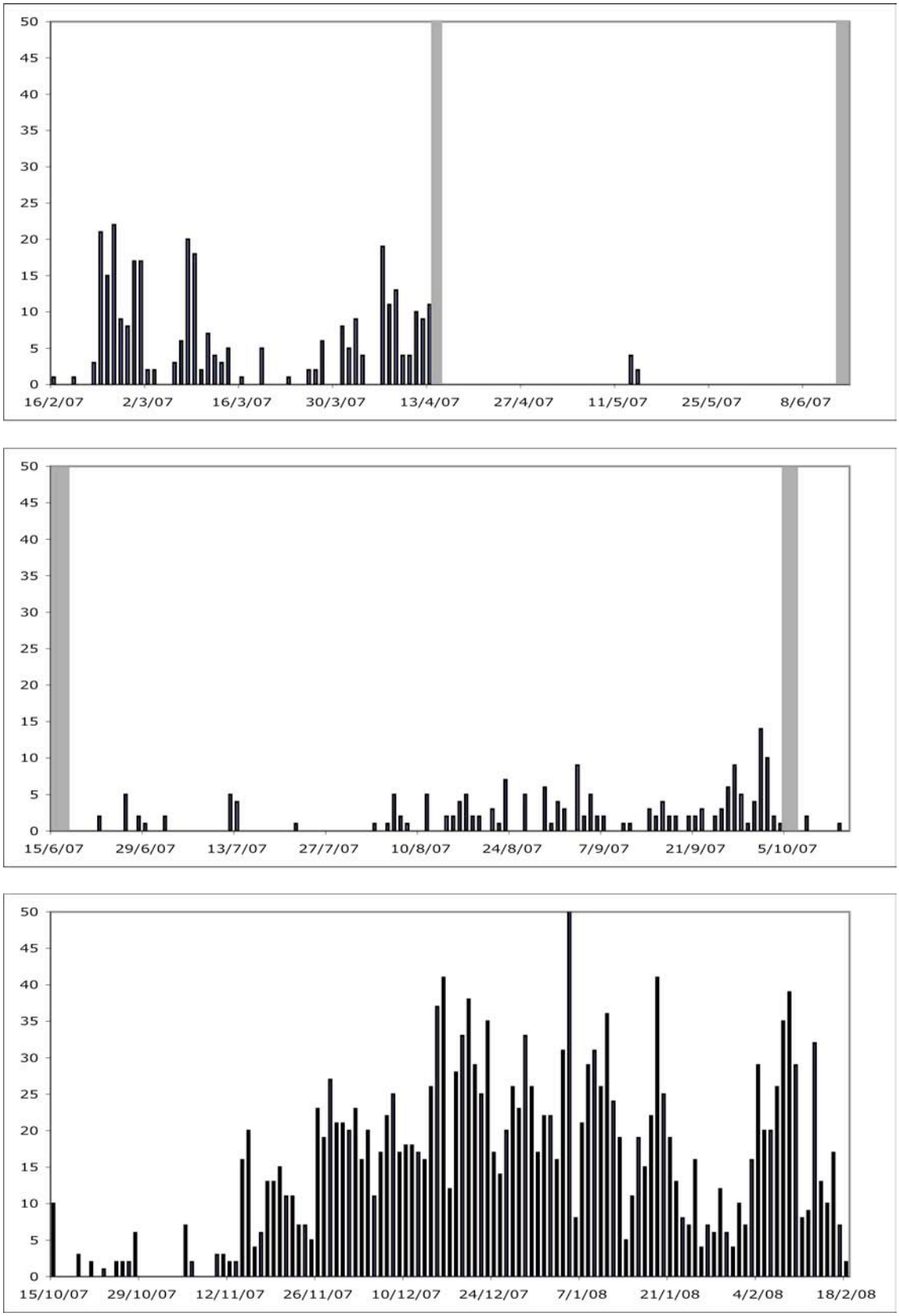

Fig. 2. Acoustic detections in Robinson's Bay. Shaded regions indicate periods of no data.

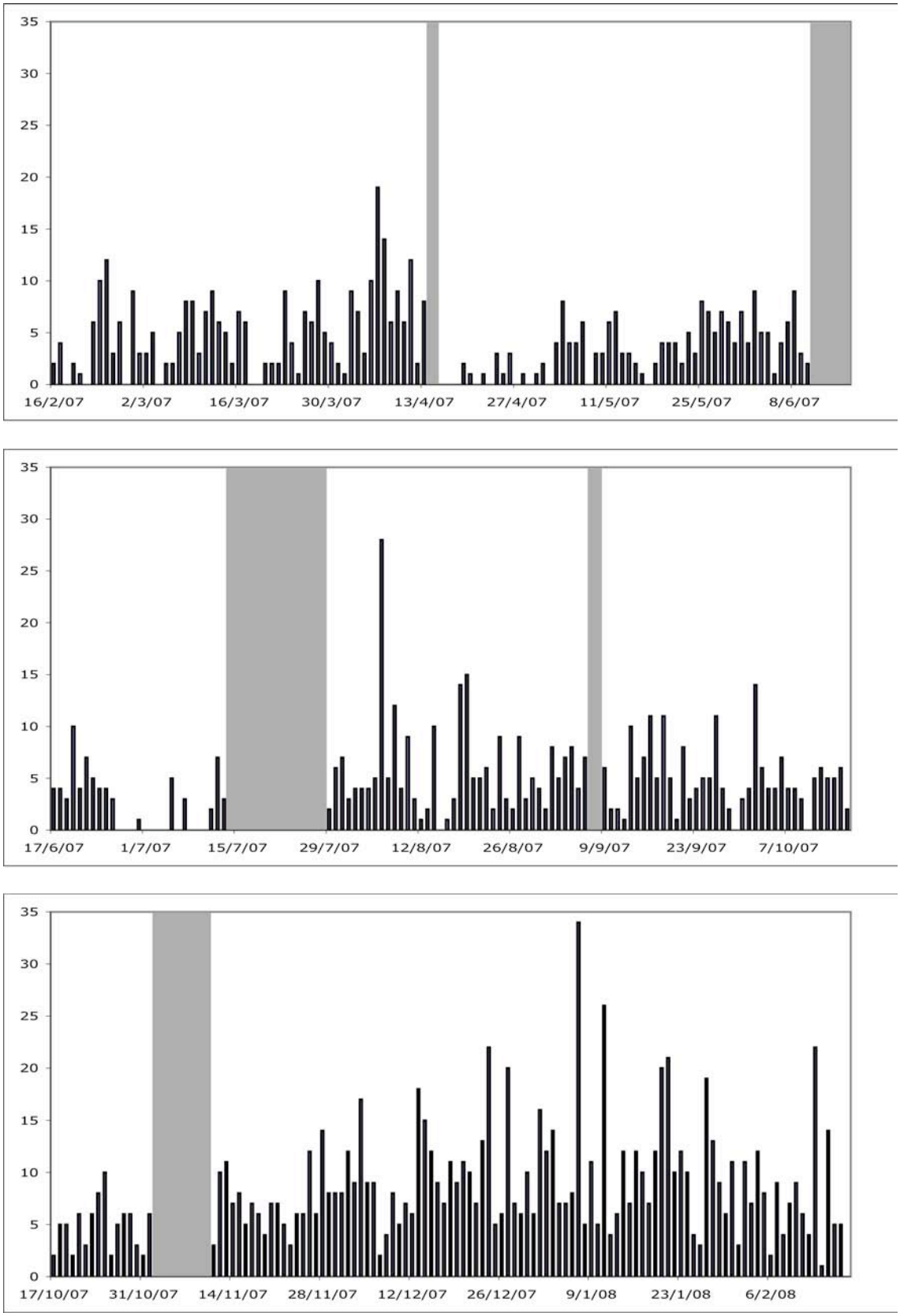

Fig. 3. Acoustic detections at Onuku. Shaded regions indicate periods of no data.

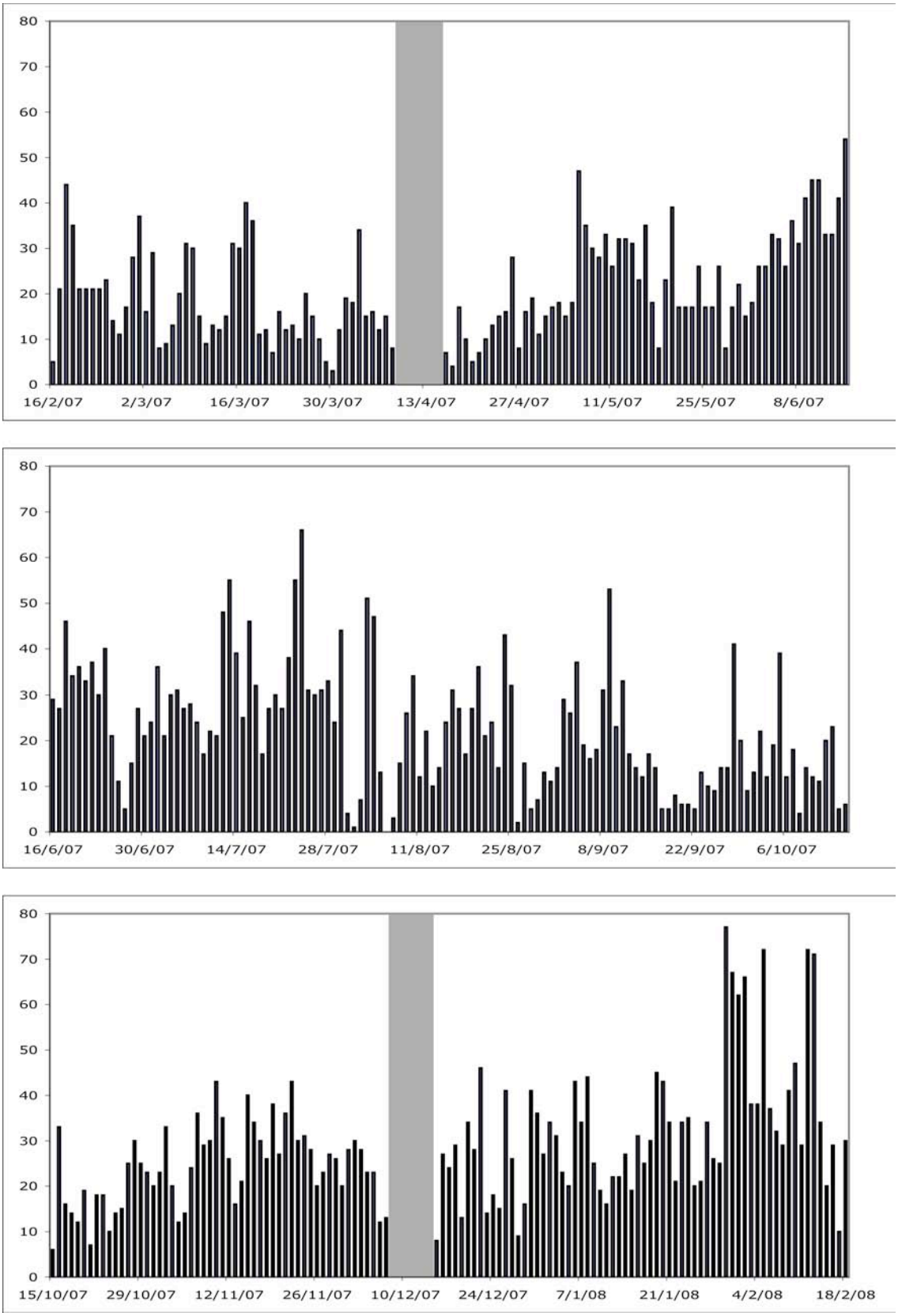

Fig. 4. Acoustic detections at Jacob's Ladder. Shaded regions indicate periods of no data.

Discussion

Our work, and that of others, shows that T-PODs are very conservative indicators of dolphin habitat use. This is for three reasons. Firstly, theodolite tracking of dolphins in the vicinity of a moored T-PODs has shown a maximum detection distance of just over 400m, and an average detection distance of about 200m (Rayment, in prep.). Even with groups that come within 100m of a moored T-POD only about 70% are detected. These estimates correspond well with estimates from Harbour porpoises (Tougaard et al., 2006), which make very similar echolocation clicks, at similar sound pressure levels. The obvious conclusion from these studies is that the T-PODs, while clearly effective, monitor a small area (Fig. 5) Secondly, the sonar emission pattern of Hector's dolphins appears to be a very narrow, forward pointing beam (Dawson & Thorpe, 1990), as it is in other dolphins (Au, 1993). Thus, sonar signals are loudest directly in front, but less so to the side and virtually inaudible from behind. Also, high-frequency sound is inherently very directional, and subject to greater absorption than lower frequencies. This means that dolphins have a far greater chance of being detected if they are facing the POD. Obviously, this does not happen often. Thirdly, studies of sonar in free-ranging Hector's dolphins show that dolphins do not echolocate constantly (Dawson, 1994). Rather, they tend to use bursts of echolocation when they need to, and are silent otherwise. All of this means that dolphins can be near the T-POD and not be detected. Put another way, acoustic methods unavoidably underestimate the amount of time dolphins spend in the area.

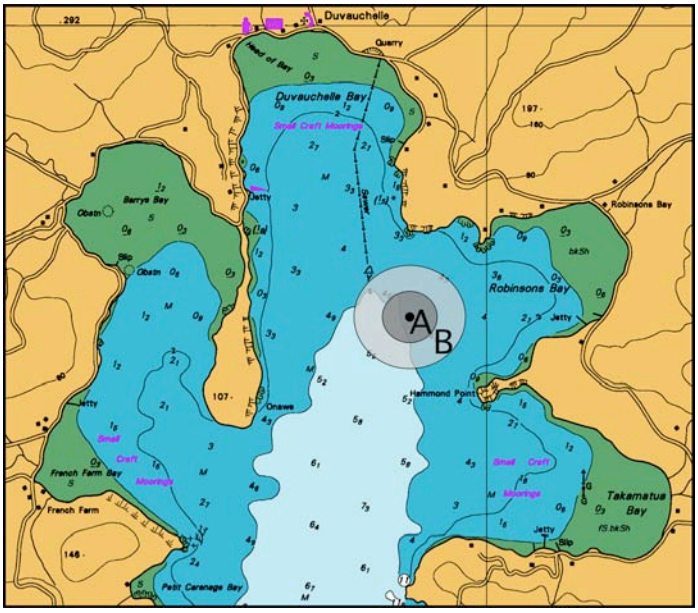

Fig. 5. Approximate detection range of T-POD echolocation detectors (data from Rayment, in prep.). Dark circle indicates average range of detection (c. 200m). Outer circle indicates approximate maximum range of detection (c. 400m).

Taken together, these factors indicate that Hector's dolphin presence, particularly in the inner harbour, is likely to be more routine than is indicated by the T-POD data. That dolphins were recorded as present on 41% of the days during which founder netting is permitted should be interpreted as a minimum estimate – it will be an underestimate and perhaps considerably so. For example, dolphins could be using the area on the west side of Onawe Peninsula, far into the "flounder area" without having any chance of acoustic detection.

The concession to allow unattended flounder gillnetting by amateur fishers in the inner parts of Akaroa, Lyttelton, Port Levy and Pigeon Bay, was made on the basis of zig-zag surveys of Akaroa Harbour published in Dawson (1991). Those surveys were undertaken over two years, and while the middle and outer harbour were surveyed weekly, the inner harbour was surveyed only once each

month. For the inner harbour, some individual months were represented by only one survey, and some by as many as three. Hence the pattern those surveys showed, of dolphin presence in the inner harbour only during summer, was based on very few surveys. That point was explicitly made in the paper, as sample size was shown in the relevant plot. It is now clear that the low sample size of those surveys should have been considered more carefully before offering the compromise to allow unattended flounder netting.

Comparison with those early visual surveys also shows that, for questions of habitat use on small scales, passive acoustic monitoring is far superior. The key point is that during a visual survey the survey vessel is in any one area for only a relatively short time, so the probability of seeing dolphins in any one spot is low. The T-PODs, however, "listen" night and day, and gather data on dolphin use of that site continuously for up to 6 weeks. For monitoring use of a particular habitat this is a much better approach.

An unavoidable constraint on T-POD data is that there is no way of telling how many dolphins are represented in the records. It is not possible to tell whether a sequence of click trains was made by a large group of dolphins echolocating only occasionally, or a small group echolocating a lot. Thus T-POD data can tell us how often a particular site is used, but not how many dolphins use it.

Acknowledgements
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