

Using Static Acoustic Monitoring to Describe Echolocation Behaviour of Heaviside's Dolphins (*Cephalorhynchus heavisidii*) in Namibia

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Abstract

Static acoustic monitoring is a cost-effective, low-effort means of gathering large datasets on echolocation click characteristics and habitat use by odontocetes. Heaviside's dolphins (*Cephalorhynchus heavisidii*) were monitored using an acoustic monitoring unit, the T-POD, in July 2008 at a site of known high abundance for this species in Walvis Bay, Namibia. The T-POD successfully detected clicks from Heaviside's dolphins, and these clicks were detected in the 120 to 140 kHz frequency range. A distinct diel pattern to the hourly mean inter-click interval was observed, with higher values during daylight hours than at night, suggesting that click trains are produced at faster rates at night time. There was no apparent diel pattern in the proportion of buzz trains produced, however. A diel pattern in click activity was observed, with many more detection-positive minutes per hour recorded between dusk and dawn, and vocalization activity dropping to low levels in the middle of the day. This corresponded with visual observations made on abundance of dolphins in the study area. These results suggest that Heaviside's dolphins use this site primarily during the night. Static acoustic monitoring proved to be an effective technique for monitoring patterns of habitat use by Heaviside's dolphins.

Key Words: habitat use, echolocation behaviour, T-POD, inter-click interval, Heaviside's dolphin, *Cephalorhynchus heavisidii*, click train

Introduction

Heaviside's dolphins (*Cephalorhynchus heavisidii*) are endemic to the Benguela ecosystem of the west coast of southern Africa, inhabiting the coastal and shelf waters of South Africa, Namibia, and southern Angola (Findlay et al., 1992). Little is known

about this species in the northern part of its range, with most ecological research to date having concentrated on populations in South Africa, which were shown to be locally abundant and have small home ranges (Elwen et al., 2006, 2009). Like other small coastal delphinids, it faces a number of threats such as coastal development, boat traffic, pollution, prey depletion, and bycatch in fisheries (Best & Abernethy, 1994; Elwen & Leeney, 2010). Populations of the congeneric Hector's and Chilean dolphins (*C. hectori* and *C. eutropia*) have been severely impacted by near-shore fishing activities (Dawson, 1991; Iñíguez et al., 2003; King & Brooks, 2004). There is a clear need for more data on the Heaviside's dolphins in Namibian waters and for ongoing monitoring of this population in parts of its range which may face human impacts.

Passive acoustic monitoring (PAM) techniques involve the detection of cetacean vocalizations from either towed or static hydrophones, and this method is increasingly being used to collect data on cetacean habitat use (e.g., Rayment et al., 2009b; Simon et al., 2010), behaviour (e.g., Leeney et al., 2007; Van Parijs et al., 2009; Akamatsu et al., 2010; Clausen et al., 2010; Kyhn et al., 2010), and even to estimate abundance (e.g., Marques et al., 2009; Whitehead, 2009). Static acoustic monitoring (SAM), using moored equipment to detect cetacean vocalizations from a fixed area, enables the observation of trends in relative abundance and of behaviours of target animals within a focal area (Kimura et al., 2010) and has several advantages over visual techniques. Automated data collection can occur around the clock, regardless of sea state or weather conditions (although these factors may somewhat affect detection rates). It thus limits biases related to environmental effects or observer experience, and it produces a detailed dataset incorporating both nocturnal and diurnal activity for relatively little effort or expense in the field (Mellinger et al., 2007). SAM is thus particularly suited to remote

areas or regions which frequently experience poor weather. The main disadvantage of SAM methods is that at present, for most species, it is not possible to calculate abundance from the resulting data, although recent research has begun to address this issue (Whitehead, 2009; Kimura et al., 2010). SAM also only detects individuals which are actively vocalizing, and only those within the given detection range of the monitoring device (approximately 250 m detection radius for harbour porpoise on T-POD [Tougaard et al., 2006], and 198 to 239 m for Hector's dolphins [Rayment et al., 2009a]). The majority of the Namibian coastline is unpopulated, inaccessible by small boat, and highly exposed to wind and swell. SAM thus provides a potential solution to long-term monitoring of inshore dolphin populations in this environment.

The T-POD is a SAM tool which has been used extensively to monitor odontocetes (Leeney & Tregenza, 2006; Leeney et al., 2007; Philpott et al., 2007; Verfuß et al., 2007; Kyhn et al., 2008; Todd et al., 2009), including Hector's dolphins of New Zealand (Rayment et al., 2009a, 2009b), a species closely related to Heaviside's dolphins. The T-POD is a self-contained, submersible hydrophone and digital processor which recognizes and logs the echolocation clicks made by odontocetes. Todd et al. (2009) provide a description of the T-POD hardware and of the processes of data collection and classification, while numerous studies have reviewed settings and T-POD functionality (e.g., Thomsen et al., 2005; Philpott et al., 2007; Kyhn et al., 2008; Simon et al., 2010). The onboard data logging nature of the T-POD makes it particularly suited to the study of odontocetes, which use narrow-band high frequency (NBHF) echolocation clicks, such as the Phocoenids (for which the instrument was initially designed; Goodson & Sturtivant, 1996) and members of the *Cephalorhynchus* genus, as the sampling rate required for real-time recording (> 250 kHz) makes long-term recordings unfeasible.

Watkins et al. (1977) reported low-level, pulsed sounds from Heaviside's dolphins at frequencies of 800 Hz and with a secondary peak in energy at 2 to 5 kHz. The limited bandwidth of the recording equipment used (60 Hz to 10 kHz) meant that the detection of high-frequency click components, since described for other *Cephalorhynchus* species (e.g., Dawson, 1988), could not be made. More recently, however, Morisaka et al. (2011) collected data on clicks from Heaviside's dolphins in South Africa using a miniature stereo acoustic data logger and an array of three calibrated hydrophones. The clicks of Heaviside's dolphins conform to the model of species using NBHF clicks (Morisaka & Connor, 2007). Heaviside's dolphin clicks were reported to have a mean centroid

frequency of 125 kHz (range 118 to 132 kHz), click duration of 74 μ s, inter-click intervals ranging from 2 to 113 ms (Morisaka et al., 2011), and overall characteristics similar to the clicks of other *Cephalorhynchus* species (Kamminga & Wiersma, 1982; Dawson & Thorpe, 1990; Kyhn et al., 2009, 2010; Götz et al., 2010).

This study documents the use of an established SAM device (T-POD) to detect Heaviside's dolphin clicks, to characterise echolocation behaviour by this species, and to describe temporal patterns in habitat use over a short period, at a single site, in Namibia. SAM has never before been used to monitor habitat use or behaviour by this species.

Materials and Methods

Walvis Bay is a large (~10 × 10 km) bay, located approximately midway along the Namibian coastline (Figure 1). The bay is formed by a long sand spit on the western edge ending at Pelican Point (S 22.8700°, E 14.4479°), where there is a known concentration area of Heaviside's dolphins (Elwen & Leeney, 2010). A large commercial harbour in the southeast corner of the bay (~10 km distant) supports several pelagic and demersal fishing fleets and a large marine tourism industry consisting of 25 boats, at least some of which operate in the bay on a daily basis (Elwen & Leeney, 2008).

A single T-POD (POD 313, Version 3) was attached 5 m below the surface to a temporary mooring approximately 500 m north of Pelican Point (S 22.8700°, E 14.4479°) in 30 m of water. The mooring was made up of a large weight,

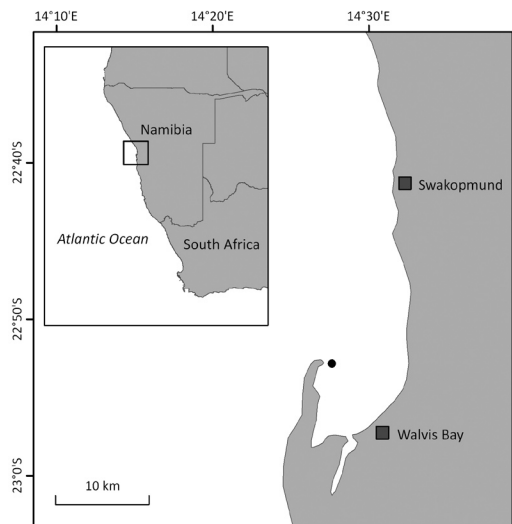


Figure 1. Study location at Walvis Bay, Namibia; the T-POD mooring site at Pelican Point is indicated by the black circle.

attached by a length of chain to a smaller anchor which could be lifted by hand from the research vessel. A line ran between this anchor and a surface marker buoy. Loops in this line allowed for the attachment of the T-POD at a point 5 m below the buoy. Data were collected between 28 June and 3 July and 16 to 25 July 2008, amounting to 337 h of data. The deployment site features a muddy bottom and small tidal range (1.4 m at spring tides; South African Naval Hydrographic Office, www.sanho.co.za) with negligible tidal currents. Boat traffic is considerable in the area, mostly comprising small (8 to 12 m) dolphin-watching boats with outboard engines (90 to 250 hp). Larger ships entering and exiting the harbour passed at least 2 km north of the T-POD. Pelican Point is of low elevation and exposed to the strong southerly winds common along the Namibian coast, making it entirely unsuitable for carrying out comparative land-based visual observations around the T-POD.

Data Processing

The T-POD was initially set to detect clicks in a range of frequencies in order to assess which frequency band was most effective for detecting clicks from Heaviside's dolphins. T-PODs function by comparing the output of the two bandpass filters, A and B (Table 1). The target filter (A) is set to the frequency of the cetacean clicks to be detected, if known; and the reference filter (B) is set to another frequency known to contain the least energy within a click. Target frequencies for 10-s scans carried out by the T-POD were evenly spaced between 50 and 150 kHz. After a 48-h test deployment, the optimal settings for detecting this species were determined to be similar to those which have previously been used for both harbor porpoises and Hector's dolphins (Rayment et al., 2009b; Tougaard et al., 2009). The highest detection rate (number of clicks detected by the T-POD per day) was seen in scans with a target frequency of 130 kHz, with declining detection rates in scans with other settings where the frequency of detected clicks was either less or greater than the target frequency in those scans. The T-POD was then set as shown in Table 1, with three scans/min to detect the high-frequency Heaviside's dolphin clicks (target frequency: 130 kHz; reference frequency: 90 kHz) and three scans set to allow for detection of other dolphin species with lower-frequency, non-NBHF clicks (target frequency: 50 kHz; reference frequency: 90 kHz) such as bottlenose dolphins (Philpott et al., 2007; Simon et al., 2010). Upon retrieval, data were downloaded and processed using the instrument-specific software (*TPOD.exe*, Version 8.24; train filter Version 4.1; www.chelonia.co.uk). The automated train detection

function in the program filters out clicks arising at random from background noise, resulting in files containing only clicks in sequences (trains), which may include cetacean and boat sonar sources. From these filtered data, the *TPOD.exe* software designates various levels of probability of a click train being of cetacean origin (see Thomsen et al., 2005, for further details). The two most reliable categories of cetacean click trains, "high" and "low" probability (as defined by the *TPOD.exe* software), were used for further analysis.

Table 1. Final T-POD settings; number of clicks logged was limited to 240/scan. "Ch" – Heaviside's dolphins; "Tt" – bottlenose dolphins. Scans alternated between each set of settings, resulting in three scans each per minute for each setting. For an explanation of the setting parameters, see Todd et al. (2009) and Simon et al. (2010).

	To detect Ch	To detect Tt/other spp.
Target (A) frequency (kHz)	130	50
Reference (B) frequency (kHz)	90	90
Ratio A/B	5	4
A integration period	short	short
B integration period	long	long
Minimum intensity	3	3

Bottlenose dolphins (*Tursiops truncatus*) were also present in the study area and produce clicks which can be recorded by the T-POD. Clicks from this species are bimodal and have energy both in a lower (50 to 70 kHz) frequency range and around the same higher frequency as Heaviside's dolphins (Au, 1993; dos Santos & Almada, 2003), which can make species distinction difficult. Simon et al. (2010) highlight the fact that on-axis clicks from bottlenose dolphins can have their peak energy at 100 kHz or higher and thus presumably could be detected on T-PODs with "porpoise" settings (target filter at 130 kHz) but might fail to be detected by a T-POD with "dolphin" settings (where the target filter is set at 50 kHz). However, off-axis bottlenose dolphin clicks can have peak energy at around 50 kHz and are therefore likely to be detected with "dolphin" settings. It is thus possible that the automatic export of high-frequency trains, expected to be of Heaviside's dolphin origin, could include some trains from other cetacean sources, most likely bottlenose dolphins in this case. To reduce the likelihood of this occurring, we further filtered our data by excluding time periods in which bottlenose dolphin-like clicks (50 to 70 kHz) were recorded. For data calculated per minute, any whole minutes of data in which bottlenose dolphin-like clicks were recorded, as well as the minute before and after that time, were

removed (out of 21,288 Heaviside's dolphin trains, 315 [1.0%] were removed). For calculations per hour, the entire hour was excluded from analysis if low-frequency clicks were recorded and ten or fewer high-frequency clicks were detected (out of 337 h of data, 45 h contained both bottlenose dolphin-like and Heaviside's dolphin clicks, of which 12 h [3.5% of total] were removed).

Characteristics of Click Trains

Data on Heaviside's dolphin click trains were exported from *TPOD.exe* to a spreadsheet for further analysis. Mean inter-click interval (ICI) was calculated for every Heaviside's dolphin click train individually and averaged for each hour of the day. Because the *TPOD.exe* click train identification software can occasionally include a click of non-cetacean origin at the beginning or end of a cetacean train, thereby generating a false value for ICI (N. J. Tregenza, pers. comm., January 2009), mean ICI was considered a more representative measurement than minimum ICI (MICI) (Carlström, 2005; Todd et al., 2009). Feeding-buzz ratio (FBR) has previously been used as an indicator of potential feeding behaviour for odontocetes (Todd et al., 2009). The terms *feeding buzz* or *click burst* have been used to describe the very fast click trains (i.e., with small ICI values) produced as cetaceans or bats approach and capture targets such as prey items (e.g., Goodson et al., 1988, 1994; Miller et al., 1995; Johnson et al., 2004, 2006, 2008; Akamatsu et al., 2005; Madsen et al., 2005; Melcón et al., 2007; Verfuß et al., 2009). In the terminal phase of the approach of harbour porpoises to prey items, the ICI is first reduced from about 50 ms to intervals below 10 ms and is then kept short and constant at values between 1.4 and 1.6 ms (Verfuß et al., 2009). In order to investigate diel patterns in the proportion of "fast" click trains from harbour porpoises, Carlström (2005) chose 10 ms as the value below which to define such trains, based on the shapes of the frequency distributions of MICI and on ICI of captive animals, which were recorded during different behaviours from other studies (Carlström, 2005, and references therein). For this study, we therefore chose to use ICI values below 10 ms as a possible indicator of feeding behaviour or target-locking. FBR values were calculated by dividing the number of click trains in each individual hour with a mean ICI of < 10 ms by the number with a mean ICI of ≥ 10 ms, creating a ratio of fast, possibly feeding-associated click trains to all other trains (Todd et al., 2009). A high ratio would thus suggest more time spent producing buzz trains and therefore possibly engaging in feeding behaviour.

To investigate the diel pattern in mean ICI, a generalized linear model (GLM) was used to

predict the mean ICI of a train as a function of a sinusoid curve with a period of 24 h. A log link and gamma errors were used due to a right-skew in the distribution of mean ICI. The mean ICI of trains recorded within a short time of each other is unlikely to be fully independent, leading to the potential overestimation of the significance of diel patterns. We therefore reduced the impact of this autocorrelation by including the log-transformed mean ICI of the most recently recorded train as a time-lagged predictor variable in the model. To investigate diel patterns in FBR, each train was classified as a *buzz train* (mean ICI < 10 ms) or not (mean ICI ≥ 10 ms), following the same analytical procedure as in Todd et al. (2009) but using mean ICI instead of MICI. A GLM with binomial errors and a logit link was used to predict the probability that any given click train was a buzz train, as a function of a 24-h sinusoid, and whether or not the previous train was a buzz train. These probabilities were converted to ratios using $FBR = \text{probability}/(1-\text{probability})$ for plotting.

Temporal Patterns of Habitat Use

To describe patterns of habitat use over the deployment period, T-POD data were processed as the number of Detection-Positive Minutes per hour (DPM.h⁻¹) for every complete hour for which the unit was logging (see data filtering protocol above regarding detection of possible bottlenose dolphin clicks). A Gaussian linear model was fitted to arcsine-transformed DPM.h⁻¹ data from the T-POD. The diel pattern was modeled as a sinusoid of the 24-h period, and the DPM.h⁻¹ from the previous hour was included to account for the autocorrelation inherent in this type of dataset. All statistical analyses were carried out using the program *R* (R Development Core Team, 2010). The significance of terms in linear models and GLMs was tested by comparing AICs before and after their elimination from the model (Crawley, 2006).

Results

Almost all the detections on the T-POD were made in the higher-frequency (90 to 130 kHz) scans, with very occasional detections in the lower-frequency scans (after exclusion of 78 click trains, containing 2,311 "bottlenose dolphin" clicks, 20,973 click trains, containing 428,866 clicks, remained for analysis). Thus, the exclusion of the time periods in which lower-frequency detections were made is unlikely to have affected general patterns in the data. Anecdotal information from tour operators and the sightings data several operators have collected over the past 5 y suggest that there are only two odontocete species sighted with any regularity in the region: Heaviside's dolphins

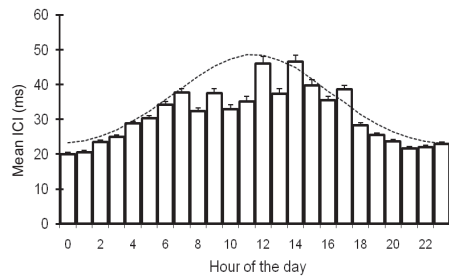
and bottlenose dolphins (Elwen & Leeney, 2008). Boat-based photo-identification surveys carried out by SE and RHL over a 2-mo period within which the T-POD data were collected (22 May to 28 July 2008) confirm this assumption, and Heaviside's dolphins were by far the most regularly encountered and numerous of the two species (Table 2). No other cetaceans with NBHF click type are known to occur in the area; thus, after filtering of the data as described above, all remaining clicks in the higher-frequency scans have been assumed to be produced by Heaviside's dolphins.

Table 2. Number of sightings (and number of animals) made by the research team from both research cruises for photo-identification data collection (26 cruises; 152 h) and on tour boats (6 trips; 21 h); ranges indicate the sums of minimum and maximum group size counts. Number of individuals represents the sum over all encounters rather than number of unique individuals.

Species	N encounters (N individuals)
Heaviside's dolphin	168 (1,061-1,515)
Bottlenose dolphin	30 (259-353)
Killer whale (<i>Orcinus orca</i>)	1 (2)
Humpback whale (<i>Megaptera novaeangliae</i>)	9 (16)
Southern right whale (<i>Eubalaena australis</i>)	1 (1)

Having excluded lower-frequency click detection periods, the remaining dataset was analysed to describe Heaviside's dolphin echolocation behaviour. Mean ICI ranged between 0.82 and 333 ms (median of 19.6; inter-quartile range between 13.9 and 34.5), although only ten trains had mean ICI values above 167 ms. There was a distinct diel pattern in mean ICI, with higher values during daylight hours than at night (Figure 2a)—that is, slower click trains during the day and faster click trains at night. Both the diel sinusoid (ΔAIC on removal from the full model = +872.00) and the lagged component (ΔAIC = +4,115.70) contributed highly significantly to the prediction of the mean ICI of a train. FBR ranged between 0.04 and 0.22, but there was no apparent diel pattern in the data (Figure 2b). The lagged component contributed significantly to the prediction of FBR (ΔAIC = +32,288.06), but the diel sinusoid did not (ΔAIC = -0.85). Pulse repetition frequency (PRF) ranged between 3 and 1,219 clicks/s, with most trains having PRFs below 100 clicks/s (Figure 3). A small secondary peak in PRF, which corresponds with fast “buzz” trains, is visible at 500 to 550 clicks/s. A diel pattern was apparent in the

a.



b.

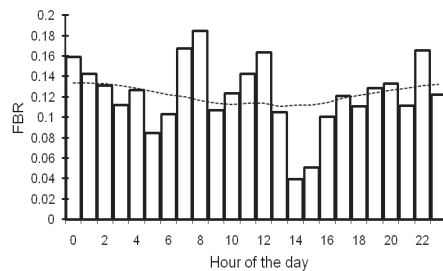


Figure 2. (a) Hourly mean inter-click intervals (ICI) + s.e. per train and (b) hourly mean feeding buzz ratio (FBR) (number of trains with mean ICI < 10 ms/number of trains with mean ICI \geq 10 ms); hour 0 refers to the hour between midnight and 0100 h; dotted lines represent the fitted sinusoid curve for each model.

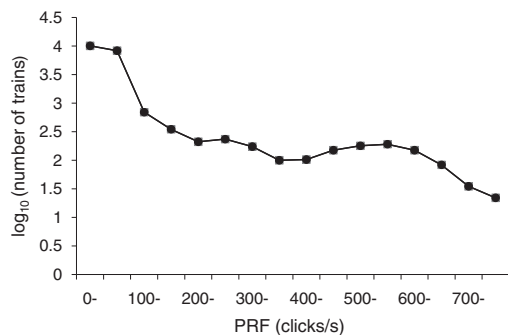


Figure 3. Distribution of PRF values (in 50 clicks/s bins) for all Heaviside's dolphin click trains detected by the T-POD on a \log_{10} scale

presence of Heaviside's dolphins at Pelican Point, measured as $\text{DPM}\cdot\text{h}^{-1}$ (Figure 4). Detections were considerably lower between ~0600 and ~1600 h than in the evening or during the night. Both the autoregressive term (ΔAIC = +241.12) and the diel sinusoid (ΔAIC = +15.67) contributed significantly to the prediction of $\text{DPM}\cdot\text{h}^{-1}$ from the T-POD data.

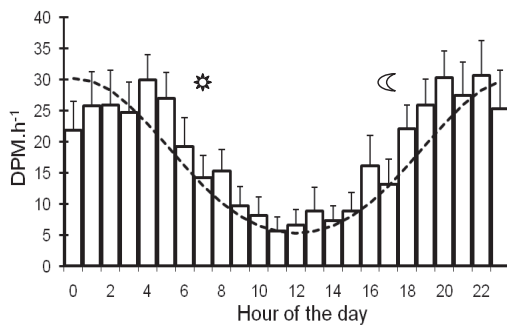


Figure 4. Diel patterns in the detection of Heaviside's dolphin sounds at one location in Walvis Bay, Namibia, monitored by a T-POD; mean (+ s.e.) hourly detection rates (DPM.h⁻¹), 28 June to 3 July and 16 to 25 July 2008 ($n = 14$ for most hours; minimum $n = 8$). Average sunrise (0630 h) and sunset (1723 h) times over the T-POD deployment periods are indicated by symbols. The dotted line represents the fitted sinusoid curve. Hour 0 refers to the period between midnight and 0100 h.

Discussion

This study reports on the first use of the T-POD to monitor the vocalizations of Heaviside's dolphins. Although based on a relatively brief period of data, we detected a large number of vocalizations at a detection rate (DPM.h⁻¹) up to one order of magnitude higher than that detected in a similar trialing study of the use of T-PODs on Hector's dolphins (Rayment et al., 2009b). Comparative information relating acoustic to behavioural data is limited for congeneric dolphin species, thus much of the following discussion is interpreted based on more detailed studies of the acoustically similar Phocoenids.

T-POD detection rates showed a distinct pattern over the 14-d sampling period. DPM.h⁻¹ was high overnight, between 2000 and 0600 h, and it dropped off during daylight hours, reaching the lowest levels around midday. Visual observations made during concurrent boat surveys, run in the area between ~0730 and 1300 h, documented a decrease in Heaviside's dolphin abundance in the late mornings, suggesting that the reduced acoustic detections at midday are due to a reduction in dolphin presence at this site rather than changes in vocalization frequency only. Observations in the late afternoon and evening, when the SAM data suggest that we would have seen an increase in numbers again, were not available as strong winds prohibit boat-based work and tour boats do not operate (Elwen & Leeney, 2008).

Click rates were comparable with those reported for Heaviside's dolphins (ICIs of 2 to 113 ms; Morisaka et al., 2011) and harbour

porpoises (MICIs up to 120 ms; Carlström, 2005). It is possible that the very few click trains with mean ICI values above 167 ms represent false positive detections. Click trains from Heaviside's dolphins at Pelican Point displayed higher mean ICIs during the daytime than at night, indicating that clicks were produced at faster rates during the night. Click trains with lower ICI values have been associated with the investigation of objects at close range and feeding (Akamatsu et al., 2005; Carlström, 2005; Verfuß et al., 2009). In a study of harbour porpoise click behaviour in Scotland, Carlström (2005) reported a peak in mean MICI per train at night and suggested that this slower click rate indicated that porpoises used their echolocation to explore their surroundings at greater distances during the night than in the day. In contrast, our findings document higher mean ICI during daylight hours and lower values at night. The approximately sinusoidal pattern in mean ICI data suggests a diel pattern which may be linked to daylight or patterns in prey behaviour. The considerable level of boat traffic, and thus underwater noise, around our study area during daylight hours and especially until around midday may also influence echolocation behaviour at this site.

Photo-identification surveys for this species throughout Walvis Bay have provided a population estimate of several hundred individuals, with group sizes of between one and eight individuals (Elwen & Leeney, 2009). The Pelican Point aggregation area where our data were collected is the only site of predictable Heaviside's dolphin abundance for tens of kilometres in each direction, and at least one dolphin was observed there during each visit to the area by the research boat (over 100 visits between 2008 and 2010; Elwen & Leeney, unpub. data), which might suggest that this habitat is linked to feeding activity. Todd et al. (2009) used T-PODs to monitor echolocation behaviour around an offshore gas installation in the North Sea and found that median MICI values for harbor porpoises were significantly lower at night than during the three other predefined diel phases, a similar pattern to the findings of our study. They suggested that their findings indicated a greater proportion of echolocation behaviour allocated towards target-locking and feeding activity at night; however, this suggestion was supported by a significantly higher FBR during that time. A diel pattern in FBR might be expected if Heaviside's dolphins were feeding at Pelican Point on prey items which themselves exhibited diel patterns in availability. Our data showed no diel pattern in FBR despite the observed diel pattern in mean ICI, suggesting that the latter is not connected to feeding behaviour. Alternatively, a higher threshold in PRF (e.g., trains with click rates > 500 s⁻¹)

may be more appropriate for the calculation of FBR in Heaviside's dolphins. FBR varied considerably from one hour to the next during the daytime (Figure 2b), which may reflect a complex diel pattern with multiple peaks in feeding or sampling error among the smaller numbers of trains detected during daylight hours (Figure 4). Heaviside's dolphins may thus be feeding at this site, but on prey items which have no pattern in availability. Alternatively, Heaviside's dolphins may use buzz trains for purposes other than or in addition to feeding such as for communication.

The apparent diel pattern in habitat use at Pelican Point is entirely opposite to that seen in the southern part of the species' range in South African waters. Observations made from shore (Elwen et al., 2009) and satellite telemetry (Elwen et al., 2006) showed that Heaviside's dolphins in South Africa were closest to shore during the mornings, between 0600 and 1200 h, and were furthest from shore (up to 20 km) at night. The clear diel onshore-offshore migration pattern observed in South Africa is thought to be associated with feeding nocturnally on vertically migrating demersal prey, most likely juvenile shallow water hake (*Merluccius capensis*) (Sekiguchi et al., 1992; Elwen et al., 2010). While the short duration of the current dataset limits the conclusions that can be drawn from these observations, it may be that Heaviside's dolphins at Pelican Point are feeding on prey with different diel patterns to those in South Africa, or they may be engaging in nonfeeding behaviours at this site. It is currently unknown where the dolphins using Pelican Point go when not present at this site. This species has been sighted at over 80 km from the coast (Findlay et al., 1992), and a recent aerial survey reported Heaviside's dolphins along several kilometers of the coast, south of Walvis Bay (Leeney, unpub. data). It is thus possible that the population disperses throughout this area when not aggregated at Pelican Point and may use offshore waters as well. The high levels of daytime boat traffic due to marine wildlife-watching tourism activities in Walvis Bay may also affect patterns of habitat use by Heaviside's dolphins at Pelican Point. Given that populations of this species appear to have small home ranges of ~50 to 80 km alongshore (Elwen et al., 2006), Heaviside's dolphins utilizing Pelican Point may be particularly susceptible to stressors specific to this region. Clearly, further detailed work investigating the acoustic behaviour, habitat use patterns, and diet of Heaviside's dolphins is needed to fully understand the ecology of this species at this site and to ensure its protection. Ongoing SAM data collection at this and several other sites will, in the future, provide insight into longer-term temporal patterns of habitat use by

Heaviside's dolphins in Namibian waters (Elwen & Leeney, 2009).

Although the SAM dataset is small, it nonetheless highlights the value of static acoustic monitoring in this environment and for around-the-clock collection of data on habitat use. The T-POD proved an appropriate tool for monitoring habitat use by Heaviside's dolphins, and the initial data suggest distinct diel patterns of vocalization activity, potentially indicative of abundance at this specific site. This study documents the first known use of a SAM tool to assess temporal patterns in Heaviside's dolphin echolocation click behaviour.

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