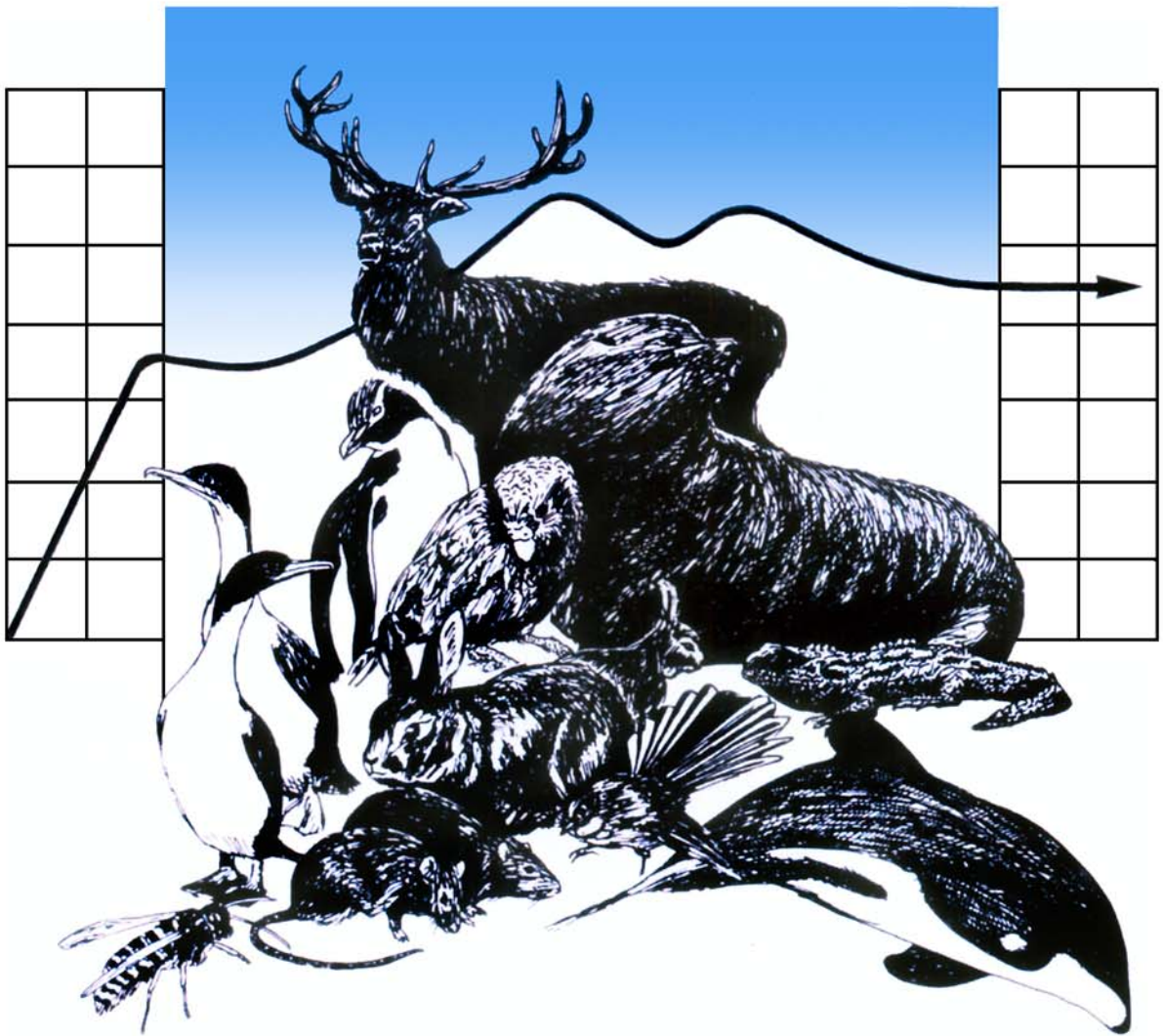


DEPARTMENT OF ZOOLOGY



WILDLIFE MANAGEMENT

Beach behaviour of yellow-eyed
penguins (*Megadyptes antipodes*)
on Enderby Island, Auckland
Island Group, New Zealand.

M.J. Young

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University of Otago
Department of Zoology
P.O. Box 56, Dunedin
New Zealand

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Behaviour of yellow-eyed penguins (*Megadyptes antipodes*) on Enderby Island, Auckland Islands, New Zealand.

M.J. Young^{1,2}

¹Wildlife Management, Zoology Department, The University of Otago, PO Box 56 DUNEDIN

²Coastal Otago Area Office, Department of Conservation, PO Box 5244 Moray Place DUNEDIN.

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Abstract

Yellow-eyed penguins (*Megadyptes antipodes*) at Sandy Bay, Enderby Island, Auckland Islands were monitored by undertaking beach observations in the austral summer of 2008/09. The purpose of the monitoring was to determine the movement and behaviour of yellow-eyed penguins, and whether alertness or movements are altered in the presence of humans, both tourists and researchers, or New Zealand sea lions (*Phocarctos hookeri*, NZ sea lions). The number of penguins seen on consecutive days with or without tourists present were not significantly different, nor were the patterns of landing and departure per hour. The exposure times to people or sea lions for landing penguins was significantly lower at the western end than the eastern end of Sandy Bay, because the distance between the birds landing site to vegetative cover was shorter. Alert behaviour for landing penguins was significantly higher when humans were present, regardless of the presence or absence of sea lions on the beach. Excluding the rock platforms to the east of the bay, overall alert behaviours were significantly higher for the western end of the beach where DOC research huts are and where most tourist parties are observed to land. The short duration of exposure times at the western end of Sandy Bay may counteract the increased proportion of disturbance there, allowing landing penguins to escape any perceived threats by retreating either to the water or under vegetative cover quickly. Concurrent monitoring of adjacent nest sites indicated that there was high early guard phase chick mortality due to starvation, and that adults were in poor body condition during the 2008/09 season. Thus, disturbances that lead to delays in landings and departures may have direct consequences for breeding yellow-eyed penguins in poor seasons. It is recommended that the Department of Conservation continue to cap the number of tourists and number of days permitted to land on Enderby Island to reduce the number of human-penguin interactions during their breeding season. Limiting zodiac landing times at Sandy Bay to between 8am and 6pm is considered imperative. Validation of an acceptable distance to approach, consistency of tour group size, tour group routes and “no stopping zones” will assist in the management of wildlife interactions on Enderby Island.

1. Introduction

New Zealand's subantarctic islands are subject to visits from commercial operators offering specialist ecotourism opportunities. The Department of Conservation (DOC) currently regulates these visits by permitting landings at places of interest within the subantarctic; however there are specific conditions regarding the activities, group size landed and number of landings permitted. Such conditions are required to reduce the impact upon the physical, aesthetic and natural values for which these wild places are revered, and to prevent undue stress upon the wildlife, flora and facilities present. A "Minimum Impact Code" for visitor compliance is issued to all passengers, guides and crew. This code must be strongly adhered to at all times during landings, as well as the conditions of entry permits and their attached schedules (DOC 2004a, 2004b, 2008).

Enderby Island (688ha) in the Auckland Island group is a popular destination for ecotourism, with up to 600 people permitted to land upon the island as part of commercial operations per year from 1 November through to 30 April (DOC 2004a). The timing of the tourist vessel season overlaps with the breeding cycles of most of the seabirds present on the island including the yellow-eyed penguin (*Megadyptes antipodes*), which is classified as a 'nationally vulnerable' species (Hitchmough et al. 2007). The Auckland Islands are thought to represent approximately 27 to 32% of the total yellow-eyed penguin population, and previous population estimates suggest that Enderby Island accounts for up to 63% of the Auckland Islands population (Moore 1990). The current total yellow-eyed penguin breeding population is estimated to be approximately 2000 breeding pairs (McKinlay 2001). Research on yellow-eyed penguins on mainland South Island, New Zealand, suggests that they are incompatible with a continuous disturbance regime such as tourism. Reduced breeding productivity, lower fledgling weights and increased hormonal stress responses have all been recorded for the species at sites exposed to tourism (Roberts and Roberts 1973; Wright 1998; McClung et al. 2004; Ellenberg et al. 2007; Ellenberg et al. 2008). Concern for the penguins that utilise the western end of Sandy Bay beach close to the research quarters and main landing area on Enderby Island has been raised, and attempts to mitigate any negative impacts upon this area are recommended in landing permits and their attached schedules.

The Department of Conservation, Southern Islands Area, commissioned a study of the yellow-eyed penguin population on Enderby Island for the austral summer of 2008/09. Interactions between ecotourists, researchers, NZ sea lions and yellow-eyed penguins were monitored to determine whether the behaviour of yellow-eyed penguins was altered by the presence of humans and sea lions during their breeding season. In addition, beach counts at all landing areas identified in previous studies were undertaken to determine a revised population estimate for the island, and disease screening and monitoring of nests were also performed to determine baseline levels (M.J. Young and L.S. Argilla, unpublished data).

The aims of this study were to: a. describe the movements of yellow-eyed penguins at Sandy Bay, Enderby Island, and to test the prediction that these movements are altered in the presence of humans (ecotourists and researchers) and NZ sea lions, and; b. to determine the frequency of behaviours of yellow-eyed penguins landing at Sandy Bay, Enderby Island, and whether alert behaviours are increased in the presence of humans (ecotourists and researchers) and sea lions.

2. Materials and methods

2.1 Study site

Sandy Bay is a major landing site for yellow-eyed penguins on Enderby Island, and is part of the Auckland Islands Nature Reserve administered by the New Zealand Department of Conservation. The sandy beach faces south and is dissected by four unnamed streams, and to the east of the bay there are two rock platforms that also facilitate penguin landings and departures. Coastal sward extends for several hundred metres from the beach, where it is fringed by small coastal shrubs and southern rata forest (*Metrosideros umbellata*). Tussocks (*Poa* sp.) to the east of the bay fringe the rock platforms. At the western end where the research huts and boatshed are located, the pathway between stream one and stream two is known as ‘Penguin Alley’. For the purposes of this study, the beach and the rock platforms were divided into six major landing areas, as outlined in Table 1 and shown in Figure 2. New Zealand sea lions breed in harems on the sandy beach from December to January as described by Chilvers et al. (2007), and during the study period they dominated the area between streams two and three. Peripheral male and sub-adult male sea lions used the other sandy areas and sward above the beach, and occasionally hauled out on the rock platforms to the east of the bay. All penguin observations in this study were made from the research quarters at the western end of the beach, as this proved to be the most favourable vantage point in all weather conditions and prevented observer disturbance.

Table 1. Landing and departure areas at Sandy Bay, Enderby Island.

Code	Landing Area	Description
SB1	Sandy Bay 1	From the western cliffs to Stream 1, including the huts and boatshed
PA	Penguin Alley	From stream 1 to stream 2, including the sward
SB2	Sandy Bay 2	From stream 2 to stream 3, including the sea lion harems on the beach
SB3	Sandy Bay 3	From stream 3 to stream 4, including the small sand dune
SB4	Sandy Bay 4	From stream 4 to the end of the beach, and the large dune complex
SBE	Sandy Bay East	The two rock platforms to the east of the bay

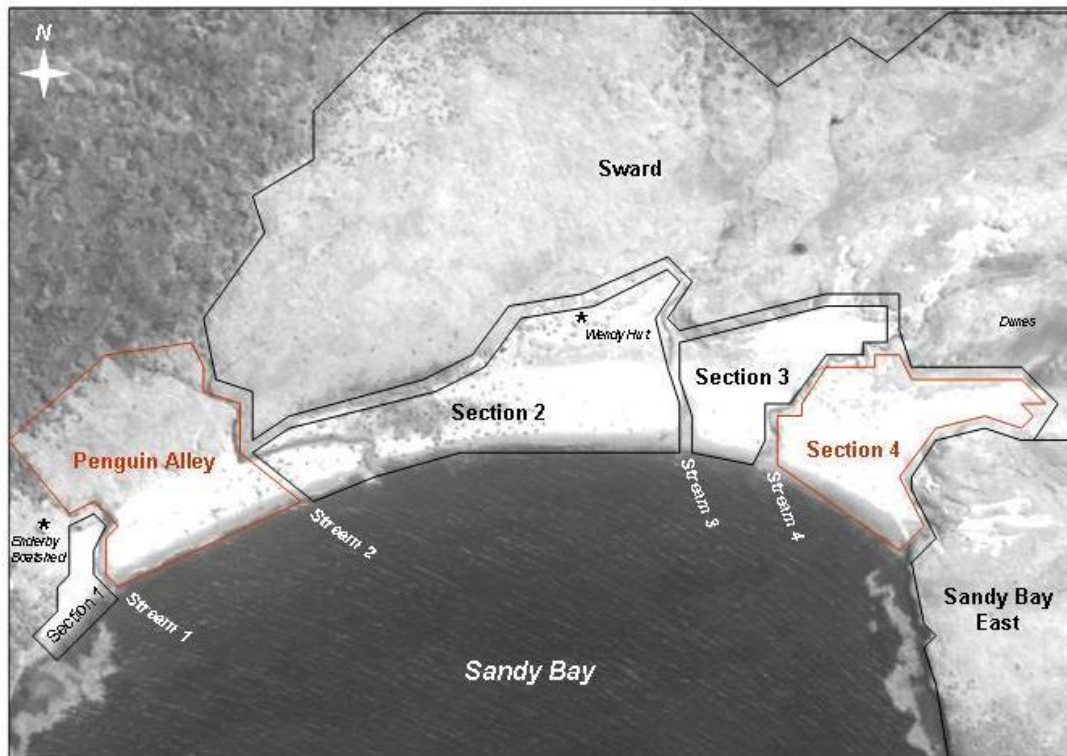


Figure 2. Sandy Bay, Enderby Island. Areas in red indicate the areas used by tourist operators for landings and departures observed in December 2008 and January 2009.

2.2 Study species

Yellow-eyed penguins are found on the south east coast of mainland South Island, New Zealand, as well as Stewart Island and its offshore islands, and the subantarctic Campbell and Auckland Islands (McKinlay 2001). The Auckland Islands are the least studied component of the population, with only one published population estimate undertaken in the late 1980s (Moore 1990; Moore 1992a). Yellow-eyed penguins, or hoiho, are large, stout seabirds, characterised by the yellow halo on the crown of adult birds and their yellow iris. Fledglings and juveniles (c. 1 year) are distinguished from adults by morphological differences including a grey eye and no distinct colour band on their crown (Reilly 1995). Age at first breeding is 2 – 4 years, with adults staying close to their breeding grounds year round, whereas juveniles disperse from their natal areas (Darby and Seddon 1990; McKinlay 2001). The yellow-eyed penguin breeding season extends from late September to early March throughout its range, and detailed studies of breeding biology have been conducted on mainland South Island (Richdale 1957; Darby and Seddon 1990). Subsequent studies indicate a two-week lag in egg-laying, hatching and fledging for the subantarctic (Moore 1990; Moore 1992a, 1992b; Amey and Moore 1995). All observations in the current study were made during the guard phase of chick rearing, when at least one adult remains at the nest during the day while the other is at sea foraging (Darby and Seddon 1990; van Heezik 1990).

2.3 Measuring behaviour

Beach observations of yellow-eyed penguins at Sandy Bay, Enderby Island were conducted on 10 days from 9 December 2008 to 9 January 2009. All counts commenced

at 5am (0500h) and ended at 10pm (2200h) NZDST (NZST plus 1 hour)¹ and were conducted regardless of weather conditions. Landing and departure times were recorded using a Casio digital watch in whole minutes (0000h). Concurrent monitoring of yellow-eyed penguin nests indicated the stage of breeding activity required for interpreting the beach count data. All observations were made using Pentax 10 x 42 magnification binoculars or by eye for closer distances. Adult and juvenile yellow-eyed penguins were distinguished from one another by identifying the yellow band on the crown of adults.

Seven anticipated yellow-eyed penguin landing behaviours were identified by Ellenberg as part of a similar research project based on the New Zealand mainland (U. Ellenberg, unpublished data). A written description of these behaviours is given in Table 3.

Table 3. Anticipated landing behaviours for the observations of yellow-eyed penguins at Sandy Bay, Enderby Island.

Code	Behaviour	Description
R	Resting	Loafing (resting on the stomach), or in a corpulent (standing) posture
P	Preening	Preening feathers, shaking head and/or stretching flippers out
SP	Social Preening	Preening in close proximity to at least one other bird, or allopreening
I	Interacting	Vocalisations, fighting or territorial behaviour
W	Walking	Walking at a regular pace
A	Alert	Scanning or frequent head turning
WA	Running Highly Alert	Running, stumbling, hopping or tobogganing at a fast pace

Using a modified Ellenberg datasheet, each yellow-eyed penguin landing or departing was given a unique code, and the time of first sighting (in the surf, on the landscape or from landing) was recorded. For landing penguins, each individual was observed using the instantaneous scan sampling technique (Altmann 1973; Martin and Bateson 1996) by observations every 15 seconds over 2.5 minutes. At the cessation of the 2.5 minute observational period, the time at which the individual was no longer visible (time under vegetative cover, time of departure, or time of departure if disturbed) was also recorded. The number of people and sea lions in the vicinity of the individual was also recorded per unit of landing penguin observations, at the end of each 2.5 minute observation period. Six behavioural categories (3 human, 3 sea lion) were used for humans and sea lions, and are described in Table 4. The survey was continuous from 0500h to 2200h (i.e. 17 hours of complete observation) and was undertaken from a vantage point that afforded visual seclusion from the study species, humans and sea lions.

Table 4. Anticipated human and sea lion behaviours for the behavioural observations of landing yellow-eyed penguins at Sandy Bay, Enderby Island.

Code	Behaviour	Description
S	Standing	People standing within visual range of penguins without movement
AW	Advancing	People advancing towards penguins
LD	Landing/Departing	People landing or departing from the beach by zodiac

¹ The count on 13 December was aborted at 11.30am after the concessionaire did not land on Enderby Island, and the count on 9 January ended at 7.30pm owing to the changeover of the NZSL teams on the island.

R Resting	Resting sea lion, no movement
V Vigilant	Sea lion sitting up on the foreflippers, scanning or awake
T Territorial	Sea lion fighting, movement, vocalisations etc.

Disturbance events were quantified for landing and departing yellow-eyed penguins. Frequent disturbance of landing yellow-eyed penguins has been reported to have negative effects upon breeding productivity and chick fledge weights which may ultimately affect the survival of fledglings in their juvenile year (McClung et al. 2004; Ellenberg et al. 2007; Ellenberg et al. 2008). Disturbances were defined as any event that caused a penguin to not land or retreat upon landing, retreat under vegetative cover during departures or delay departure in any way.

2.4 Timing of cruise ship operations

Six cruise ship operators had landing permits for Enderby Island during the study period, and four landings occurred during the observational period. The timing of cruise ship operations, the number of passengers landed, the number of interactions with penguins and the time spent crossing ‘Penguin Alley’ were recorded in whole minutes. Table 5 indicates the timing of cruise ship operations on Enderby Island. Each landing party contained a representative of the Department of Conservation pursuant to the entry permit issued to the tourist operators and its attached schedules, including the Subantarctic Minimum Impact Code (DOC 2004b; DOC 2008).

Table 5. Timing of cruise ship operations landing at Sandy Bay, Enderby Island during December 2008 and January 2009.

Tourist Vessels	11 Dec 2008	16 Dec 2008	1 Jan 2009	9 Jan 2009
Operator	Quark Expeditions	Zegrahm Expeditions	Heritage Expeditions	Heritage Expeditions
Vessel	‘Kapitan Khlebnikov’	‘Clipper Odyssey’	‘Spirit of Enderby’	‘Spirit of Enderby’
Max. no. of passengers landed	100	100	50	50
Areas used for landings and departures	SB1 & Penguin Alley	SB4	SB1 & Penguin Alley	SB1 & Penguin Alley

2.5 Data analysis

Data were analysed using two-sample two-tailed t-tests, chi-squared test of independence and Fisher’s exact tests for the frequency of landings and departures and for the behavioural data. The significance level was set at $\alpha = 0.05$ for all analyses unless otherwise stated. Data were analysed using Microsoft Excel 2003, SPSS (version 15.0.1) (SPSS Inc. 2006) and GraphPad SoftwareTM (GraphPad 2009) statistical packages.

3. Results

A total of 1126 observations were made during the 157 hours of observation over the 10 days of monitoring. There were two components to the data analyses: a. Assessing the timing of landings and departures, and any delays observed, and; b. Assessing the behaviour of landing yellow-eyed penguins by instantaneous scan sampling, and the frequency of alert behaviours observed. The data collected on 9 and 13 December, and 9 January were not included in the first part of the analysis; however data from 9 January

have been included in the second part of the analysis as the landing behaviour gathered was not thought to be affected by the shortened observation period.

971 observations (479 departures and 492 landings) were used in the first part of the data analysis. Landing behaviour observations for 525 individuals were included in the second part of the analysis based on the completion of the 2.5 minute sampling period.

3.1 Landings and departures

Landings and departures of yellow-eyed penguins from Sandy Bay were characterised by use of the extremities of the sandy beach as well as use of the rock platforms at the eastern end of the bay. Excluding the data collected on 9 January 2009, 38.9% of all landings and departures observed occurred at the western end of Sandy Bay, which comprises the landing area around stream one and stream two (for Sandy Bay 1 (SB1), Penguin Alley (PA) and Sandy Bay 2 (SB2)). 34.7% of landings and departures observed occurred at the eastern end of Sandy Bay, which comprises the landing areas around stream three and stream four (Sandy Bay 3 (SB3) and Sandy Bay 4 (SB4)), with the remaining 26.5% of landings and departures observed to occur at Sandy Bay East (SBE) at the two rock platforms.

All observations included in the analyses were of landing and departing adult yellow-eyed penguins. No juveniles were seen during the observations, though juveniles were seen landing and loafing at Sandy Bay during non-observational periods (M.J. Young and L.S. Argilla, unpublished data).

Figure 6 indicates the numbers of yellow-eyed penguins seen on each observation day.

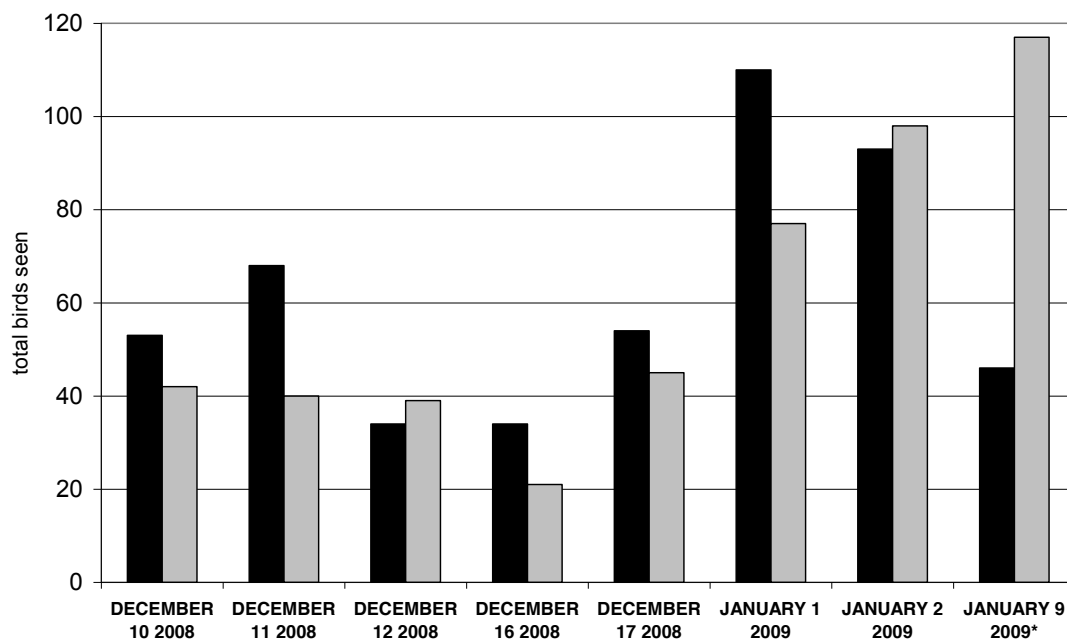


Figure 6. Total numbers of yellow-eyed penguins seen at Sandy Bay, Enderby Island, over eight days of observations from December 2008 to January 2009 (from 0500 hours to 2200 hours²). Black bars indicate the total number of landing penguins (Birds In), and grey bars indicate the total number of departing penguins (Birds Out).

²Observations ended at 1930 hours on 9 January 2009.

The number of penguins seen on consecutive days with and without tourists present were not significantly different to one another; however the total number of penguins seen per day markedly increased during the observational period, as indicated by Figure 6. Total numbers of penguins seen per day compared on consecutive days using two-tailed two-sample t-tests indicated that differences were not significant (with the exception of 16 and 17 December 2008); this suggested that tourist presence or absence had no observed effect on the total number of individuals sighted per day.

3.1.1 Yellow-eyed penguins per hour

Landing and departure data were pooled across seven of the complete observation days to give an indication of the overall presence of yellow-eyed penguins at their landing sites per hour. Figure 7 is a graphical representation of this. Yellow-eyed penguins per hour graphs per sampling day are included as an appendix. Overall, 33.9% of all landings and departures took place from 5am to 10am, 11.1% from 10am to 6pm, and 55.0% taking place from 6pm to 10pm.

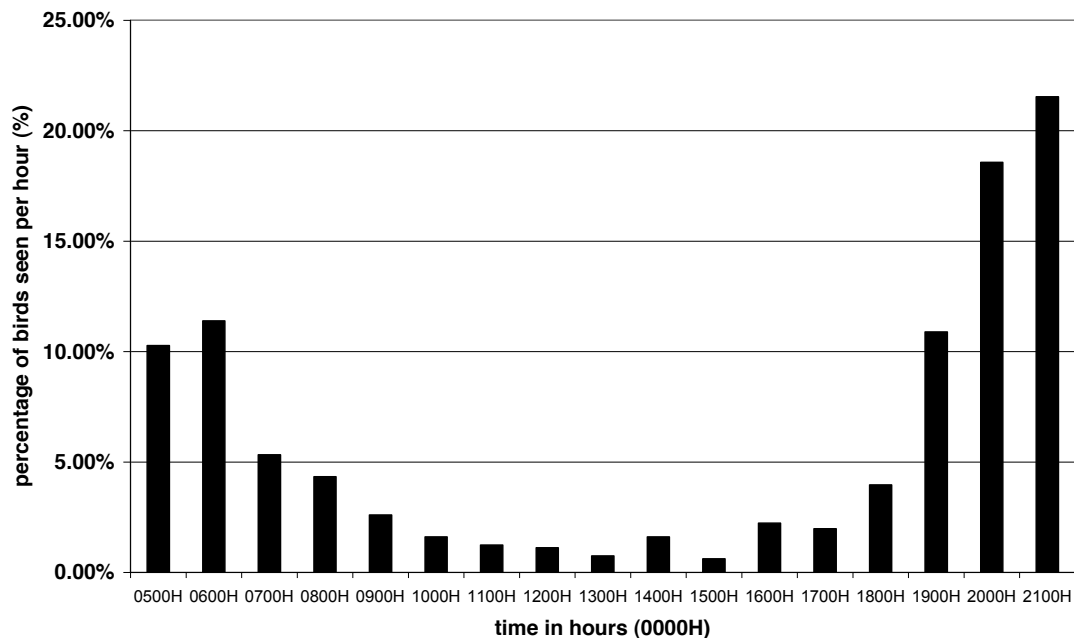


Figure 7. Percentage of yellow-eyed penguins observed per hour over seven sampling days, from 10 December 2008 to 2 January 2009, at Sandy Bay, Enderby Island during a 17-hour observation period.

To determine whether the overall yellow-eyed penguin landing and departure events were influenced by the presence or absence of tourists, a chi-squared test of independence was used to compare the frequency of landings and departures on days when tourists were absent (observed) and present (expected). To meet the test's guidelines, the landings and departures were pooled, and 80% of the hourly frequency data was above 5 penguins observed per hour. The numbers of landing and departure events were not significantly different for events for each time of day when tourists were present were compared with corresponding times of day when tourists were absent (Chi-square test of independence, $X^2 = 23.48 < \text{Critical } X^2 = 26.29$ ($\nu = 16$, $\alpha = 0.05$)).

3.1.2 From first sighting in the surf

At mainland sites exposed to unregulated tourism, landing yellow-eyed penguins have been observed to scan the beach whilst surfing into the shallows, which may be a vigilant behaviour that allows for the birds to evaluate their landing options (M.J. Young, pers. obs.). It was not possible to sight birds in the surf at all of the identified landing areas owing to their distance from the observation point. In total, 68 penguins were seen scanning the landing site by surfing into the beach, and 59 of these observations were made in the surf adjacent to Penguin Alley, SB1 and SB2, representing 33.1% of all birds landing at this western end of the beach. The time taken from this first sighting in the surf to landing averaged 2.3 minutes (range 0 – 35 minutes). Six penguins returned to sea following their initial landing, with one bird making three unsuccessful landings and departures before successfully walking up the beach on the fourth landing. Observations of disturbances that may have caused these returns included territorial behaviour by subantarctic skuas (*Catharacta skua*) and northern giant petrels (*Macronectes halli*), the presence of a conspecific, and a group of tourists advancing towards a landing penguin.

3.1.3 Exposure time during landings

The time taken from landing on the beach or rock platform to concealment under vegetative cover differed significantly depending on the landing site. Data were pooled based on the distance of the landing site to vegetative cover and were compared using a two-way ANOVA with interactions (unbalanced design) in SPSS 15.0.

SB1, PA and parts of SB2 where penguins were seen landing are but a few hundred metres from cover, whereas penguins landing on the beach at SB3 and SB4, and on the two rock platforms at SBE had a greater distance to cover on foot before reaching the edge of the vegetation. The two-way ANOVA found the interaction effect between tourist presence and site was not statistically significant ($F < 1$, $p = 0.954$), however overall differences between the three pooled sites were statistically significant ($p < 0.001$). Tukey's Honestly Significant Difference (HSD) and Tamhane T2 posthoc tests indicated that the mean exposure time for penguins landing at SB1, PA and SB2 was significantly different to SB3 & SB4 and SBE.

Table 8 indicates the mean observed exposure times for yellow-eyed penguins, at Sandy Bay. Figure 9 illustrates the observed exposure times as a box plot, indicating the spread of landing times observed.

Table 8. Mean exposure times during landings (from observation of first landing to time under vegetative cover), pooled for sections of Sandy Bay, Enderby Island³.

Activity	Exposure time in minutes		
	SB1, PA & SB2	SB3 & SB4	SBE
Overall	6.51 <i>n</i> = 154	19.15 <i>n</i> = 145	17.64 <i>n</i> = 112
Without tourists	6.93 <i>n</i> = 86	19.56 <i>n</i> = 71	18.38 <i>n</i> = 61
With tourists	5.99 <i>n</i> = 68	18.76 <i>n</i> = 74	16.76 <i>n</i> = 51

³ This includes data on birds that landed prior to 10pm but were not concealed under vegetative cover until after 10pm.

Boxplot of exposure time (in minutes) for yellow-eyed penguins at pooled landing areas at Sandy Bay, Enderby Island, December 2008 to January 2009.

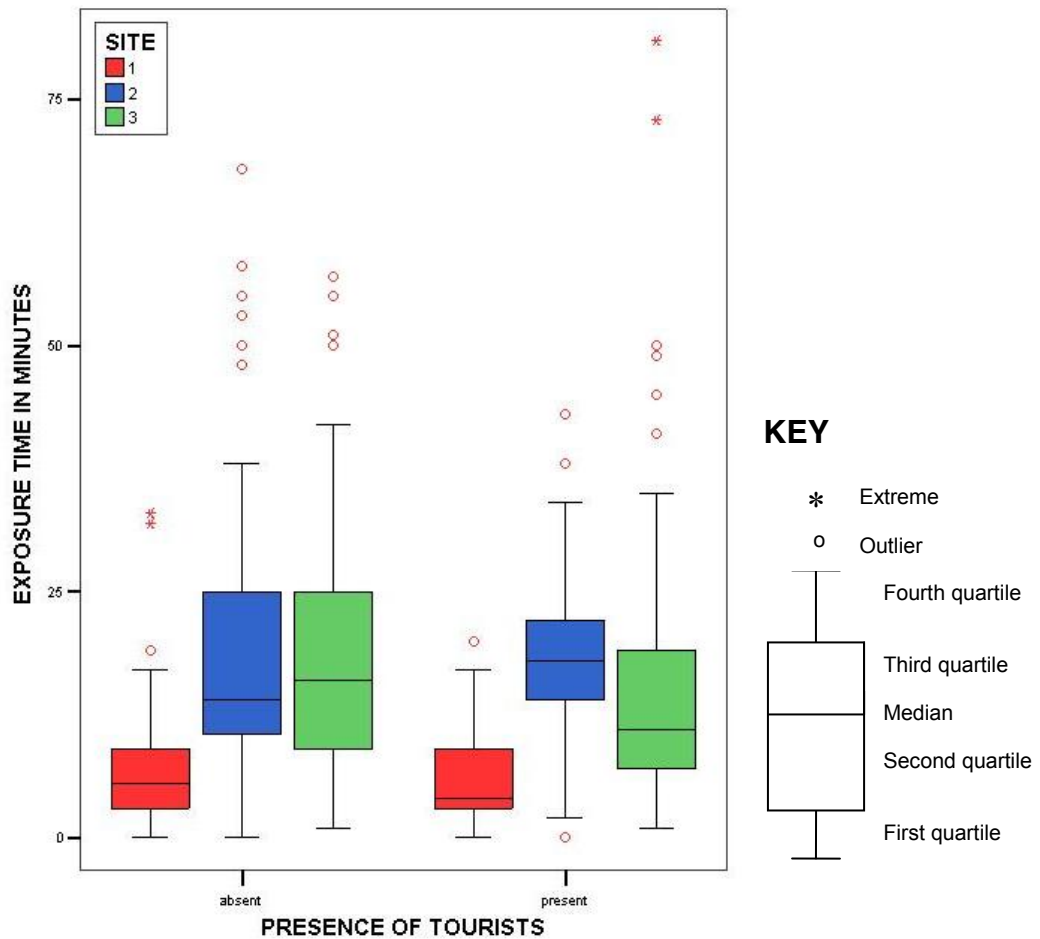


Figure 9. Exposure time for yellow-eyed penguins at Sandy Bay, Enderby Island on days when tourists were present or absent for the pooled landing areas. Site 1 (red) represents SB1, PA & SB2; Site 2 (blue) represents SB3 & SB4; and Site 3 (green) represents SBE.

Restful behaviours such as loafing were observed to occur in open spaces during the observational period. Seven adult penguins lay down to loaf on the sand dune at the eastern end of the beach following their behavioural observations, and some were observed still loafing in the same position the following morning. All of these observations were from 16 December through to 9 January 2009, and included days when tourists were present.

3.1.4 Disturbances

Natural disturbances such as territorial behaviour by subantarctic skuas, northern giant petrels, and New Zealand sea lions were all observed to disturb landing yellow-eyed penguins ($n = 10$), and of these individuals six were observed to scan the beach from the surf prior to landing. Returning to sea after landing occurred on each occasion.

Departing yellow-eyed penguins were more frequently disturbed ($n = 39$), with disturbances including boat activity (2), tourist activity (6), sea lion activity (14), giant petrels (3), researcher commuting (1) and unknown causes (13). Responses to disturbance included retreat and freezing. 2.0% of landings and 8.5% of the departures involved a disturbance of some sort.

3.2 Landing behaviour

Humans were present for 31 yellow-eyed penguin landings (range of number of humans present 1-14), and NZ sea lions were present for 267 yellow-eyed penguin landings (range of number of sea lions present 1 – 50+ (i.e. the harem)). Only four of the seven yellow-eyed penguin behaviour categories were observed during landings (walking (W), preening (P), alert (A), and running highly alert (WA)). The other three behaviours were observed regularly during departures but were not quantified (M.J. Young and L.S. Argilla, pers. obs.).

3.2.1 Mean behaviour

Figure 10 illustrates the overall mean behaviours observed during the 2.5 minute sampling periods per pooled area throughout the observation period at Sandy Bay. Generally, birds landing on the beach spent more time walking than preening, whereas birds landing on the rock platforms spent more time preening. Alert behaviours were more pronounced in SB1, PA and SB2.

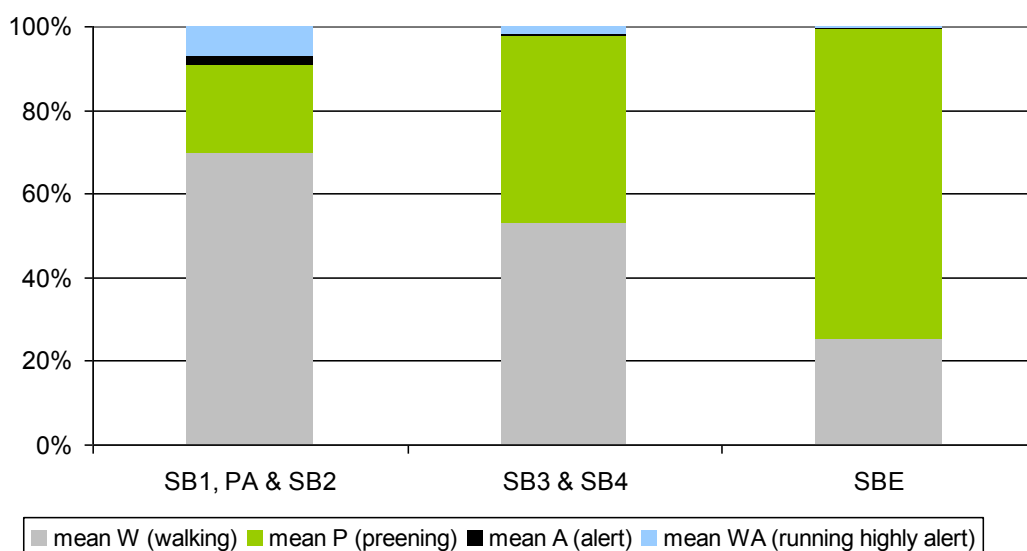


Figure 10. Proportion of landing behaviours observed during the observational period at Sandy Bay, Enderby Island. Column 1 represents the pooled observations for Sandy Bay 1 (SB1), Penguin Alley (PA) and Sandy Bay 2 (SB2) at the western end of Sandy Bay; Column 2 represents the eastern end of the bay (Sandy Bay 3 (SB3) and Sandy Bay 4 (SB4)); and column 3 represents Sandy Bay East (SBE) at the eastern end of the bay.

3.2.2 Alert behaviour

The frequency of alert behaviours (A, alert, and WA, running highly alert) were compared using a two-tailed Fisher's exact test in the presence and absence of humans, NZ sea lions, and for the eastern and western parts of the beach. Both tourist and researcher presence was pooled into the broader 'human' category. The results of these tests are summarised in Table 11.

Alert behaviours were significantly higher in the presence of humans. To detect any secondary interactions with the presence of NZ sea lions, the human presence analysis was also considered in the absence and in the presence of NZ sea lions. As NZ sea lions were always present on the beach at Sandy Bay, the number of sea lions in the vicinity of a landing penguin were recorded (to within approximately 50m of a penguin's visual

range). Alert yellow-eyed penguin behaviours were significantly elevated regardless of the presence or absence of sea lions in their visual range when humans were present. Excluding the behavioural observations that contained humans, alert behaviours were significantly elevated when sea lions were within visual range of landing penguins when compared with observations when sea lions were not visible.

For Sandy Bay beach only, alert behaviours were significantly higher for the western end of the beach in comparison with the eastern end. These results were found to be significant in both the presence and the absence of sea lions.

Figure 12 indicates the proportion of behaviours observed for landing penguins at the western and eastern extremities of Sandy Bay beach. The difference in frequencies of alert behaviours observed between the western and eastern ends of the beach were statistically significant as indicated in Table 11.

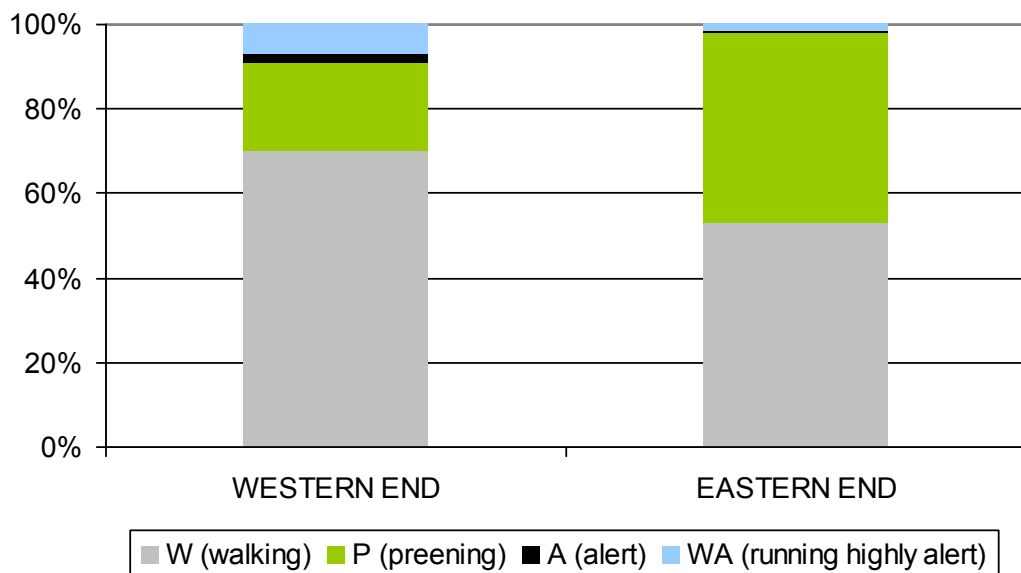


Figure 12. Proportion of behaviours observed for landing yellow-eyed penguins at the western and eastern extremities of Sandy Bay beach, Enderby Island during the 2.5 minute observation period.

Table 11. Alert behaviour frequency and associated statistical tests for yellow-eyed penguins observed landing at Sandy Bay, Enderby Island.

Row effects	n	Column effects			Frequency of behaviours				Two-tailed Fisher's exact test
		Not alert	Alert	Row Total	P	W	A	WA	
Without people	250	211	39	250	162	49	20	19	Significant at >0.0001
With people	3030	2879	151	3030	1847	1032	25	126	
<i>Column Total</i>		3090	190	3280					
Without sea lions	2210	2148	62	2210	877	1270	19	43	Significant at >0.0001
With sea lions	2290	2154	136	2290	1482	832	28	108	
<i>Column Total</i>		4302	198	4500					
Humans without sea lions present	120	102	18	120	94	8	6	12	Not significant at 0.8624
Humans with sea lions present	130	109	21	130	68	41	14	7	
<i>Column Total</i>		211	39	250					
Overall, western end of beach	1620	1466	154	1620	1130	336	40	114	Significant at >0.0001
Overall, eastern end of beach	1660	1624	36	1660	879	745	5	31	
<i>Column Total</i>		3090	190	3280					
Sea lions present, western end of beach	1060	953	107	1060	746	207	22	85	Significant at >0.0001
Sea lions present, eastern end of beach	1230	1203	27	1230	674	529	4	23	
<i>Column Total</i>		2156	134	2290					
Sea lions absent, western end of beach	560	513	47	560	384	129	18	29	Significant at >0.0001
Sea lions absent, eastern end of beach	430	421	9	430	205	216	1	9	
<i>Column Total</i>		934	56	990					

3.3 Researcher disturbance

Five researchers were present for the duration of the observational period at the western end of Sandy Bay where the research quarters are stationed. The NZSL research team on Enderby Island were recorded to be present during 4.9% of all penguin landings observed ($n = 24$), and were also present during several penguin departures ($n = 8$). All of the landings and departures observed where researchers were present occurred in Sandy Bay 1 (SB1), Penguin Alley (PA) and Sandy Bay 2 (SB2) and were within a penguin's visual range (to approximately 50m). The activities being undertaken by researchers included: working at the necropsy shed (26), standing outside using the satellite phone or using the mangle (5), and commuting across the beach for research purposes (1).

3.4 Tourist disturbance

The number of zodiacs landing and departing Sandy Bay were recorded for all four landing parties observed during the study period. Group size was only considered when tourists, guides and crew were in close proximity to a landing or departing penguin. Sample sizes for these interactions were small, however when interactions did occur considerable delays in landings and departure or disturbances were recorded.

Tourists were present for eleven yellow-eyed penguin departures and seven landings. Nine of the interactions occurred in Sandy Bay 1 (SB1) and Penguin Alley, with seven interactions occurring in Sandy Bay 3 and 4 (SB3 & SB4), and two interactions on the rock platforms at Sandy Bay East (SBE). The number of people present during these interactions ranged from 1 to 50. For eleven events the tourist or group of tourists advanced towards the yellow-eyed penguin, resulting in eight departures being aborted, and a landing penguin returning to the surf. The individuals and groups that advanced towards yellow-eyed penguins involved guides and crew from some of the cruise ships that landed during the study period. The other interactions included tourists standing near yellow-eyed penguins (4), and the activity associated with the landing and departing of zodiacs from Sandy Bay (3). The number of yellow-eyed penguin interactions observed per cruise ship operator is indicated in Table 13.

3.4.1 Zodiac landings and departures

Landing parties used zodiac inflatable boats to land passengers, guides and crew at Sandy Bay. Generally, the minimum operating time and maximum number of passengers were ferried to and from Sandy Bay. Table 13 indicates the number of operating zodiacs at Sandy Bay during the study period.

Table 13. Number of zodiac landings and departures observed, Sandy Bay, Enderby Island from December 2008 to January 2009.

Tourist Vessels	11 Dec 2008	16 Dec 2008	1 Jan 2009	9 Jan 2009
Operator	Quark Expeditions	Zegrahm Expeditions	Heritage Expeditions	Heritage Expeditions
Vessel	'Kapitan Khlebnikov'	'Clipper Odyssey'	'Spirit of Enderby'	'Spirit of Enderby'
No. of passengers landed	100	100	50	50
Areas used for landings and departures	SB1 & Penguin Alley	SB4	SB1 & Penguin Alley	SB1 & Penguin Alley
Time of first landing at Sandy Bay	8.27am	7.43am	9.02am	8.15am
No. zodiacs landed	29	40	15	11
Time of departure from Sandy Bay	2.21pm	5.11pm	5.28pm	3.35pm
No. of observed interactions with yellow-eyed penguins	5	8	2	3

3.4.2 Time spent crossing Penguin Alley

Specific guidelines for the mode of crossing 'Penguin Alley' at Sandy Bay is listed in the schedules associated with tour operators' entry permits for Enderby Island. The number of crossings and time spent crossing Penguin Alley were recorded in whole minutes. Table 14 indicates the number of times Penguin Alley was crossed and the cumulative period of disturbance associated with these crossings.

Table 14. Penguin Alley crossings by tourists at Sandy Bay, Enderby Island from December 2008 to January 2009.

Activity	11 Dec 2008	16 Dec 2008	1 Jan 2009	9 Jan 2009
Operator	Quark Expeditions	Zegrahm Expeditions	Heritage Expeditions	Heritage Expeditions
Vessel	'Kapitan Khlebnikov'	'Clipper Odyssey'	'Spirit of Enderby'	'Spirit of Enderby'
No. times PA crossed	56	17	35	40
Cumulative period of disturbance (in minutes)	230 mins	46 mins	155 mins	175 mins
Time of first crossing	8.35am	8.38am	9.19am	8.46am
Time of last crossing	2.18pm	5.00pm	5.19pm	3.29pm

4. Discussion

Relatively few human induced disturbances of yellow-eyed penguins were observed during the study period at Sandy Bay. This is largely due to the timing of tourist ship landings and research work occurring between 8am and 6pm, and tendency for groups to disperse over the island on the various guided walks that are offered rather than remaining stationary at Sandy Bay. In addition, the guard phase of yellow-eyed penguin chick rearing appears to be dominated by early departures and late landings as observed in the current study and by Moore (1990). Therefore there are compatibilities between these current observed tourist landing routines, research work routines and the patterns of movements for the guard phase of yellow-eyed penguin breeding season.

Landings and Departures

The landing and departure points for zodiacs coincide with the access points used by yellow-eyed penguins at the eastern and western extremes of the beach. Approximately 61% of the penguins observed utilised the eastern end of the beach. The remaining 39% landing at the western end had much shorter distances to cover in significantly less time. These observations support the contention that the western end of Sandy Bay should be the more favoured landing point for zodiacs. In addition, visual seclusion was afforded by the historic boat shed at the western end of Sandy Bay for landing parties, and for passengers to wait in seclusion upon their return to Sandy Bay. Three of the parties that landed at Sandy Bay during the study period landed at the western end, with the fourth party landing at the eastern end in SB4. Crew from the landing party that landed at the eastern end were present on the beach throughout the day, and this may have caused disturbance to penguins attempting to land. Numbers of sea lions at both of these extremities varied, but generally sea lions were sparse and no harem activity occurred at either end during the study period. Penguins that were observed to be disturbed by any means at the western end of Sandy Bay ran for cover, either returning to sea or into the adjacent vegetation, whereas penguins that were disturbed at other parts of Sandy Bay were more likely to freeze. The close proximity of the vegetation to the landing area at the western end is therefore thought to allow penguins greater opportunity to escape stressful situations should they be presented with them.

Overall, the timing of landings and departures did not appear to be influenced by the presence of tourist parties on the island, nor did the total number of birds seen on consecutive days with and without tourists. Two-sample t-tests indicated differences in total numbers of penguins seen observed on 16 and 17 December were found to be significant, though they possibly were not the result of tourist activity. At two adjacent monitored sites on Enderby Island, a sudden chick mortality event was observed to occur from 14 to 18 December with many early guard chicks found dead in their nests. Necropsies undertaken revealed that starvation was the primary cause of death in 21 of 22 cases (L.S. Argilla and M.J. Young, unpublished data; see appendix for DOC AEC report). Therefore it is likely that the low observed number of adult penguins seen on 16 December may have been due to nest abandonment post-failure, resulting in a higher number of adults either resting onshore or away foraging overnight at sea. Nearly double the number of penguins were seen during beach counts on the consecutive day's monitoring, and counts undertaken a fortnight later doubled the number of penguins seen again. Furthermore, observations of adult penguins utilising open spaces for rest, both at Sandy Bay and around Enderby Island increased substantially from this time, which may be indicative of nest failure and a change of routine.

The mean time taken for yellow-eyed penguins to walk from their landing point to concealment under vegetative cover (exposure time) was consistent throughout the study period and did not appear to be affected by the presence of tourists on the island. Exposure times were considerably less for birds landing at the western end of Sandy Bay than those landing at the eastern end and rock platforms. With the starkness of the coastal sward making up the vast proportion of land to commute across, and in combination with an inability to escape by flight, yellow-eyed penguins are potentially vulnerable to disturbance at Sandy Bay, particularly at the eastern end where commute times are considerably longer and there is little shelter afforded by the vegetation. Burger and Gochfeld (2007) commented that the inability of penguins to flee by flight when ecotourists block penguin commuter paths results in delays that increase an individual penguin's energy demands. Whilst there were no significant overall differences in exposure time between days with and without tourists, several penguins were observed to delay for up to one hour after a natural or human disturbance event. This increased energy demand, in combination with the delay and digestion of chick meals for landing penguins, or retreat back into the water, may have site- and population-level consequences if disturbances were to increase, as has been found on the New Zealand mainland (McClung et al. 2004; Ellenberg et al. 2007). The distances at which disturbances were caused were not recorded; however at Sandy Bay visual contact between humans and penguins may extend for several hundred metres on a clear day. It is acknowledged that small sample sizes in the current study limit the interpretation of delayed exposure events for yellow-eyed penguins at Sandy Bay. It is therefore recommended that future monitoring of landing behaviour at Sandy Bay increase the sample size for both control days and when tourist groups are present on the island, therefore the frequency of these delayed exposure events can be further investigated.

The exposure times reported in the current study for penguins landing at Sandy Bay East rock platforms failed to take into account that some penguins headed directly east through the tussock, rather than heading north in the same direction as the SB4 commuters that walked across the face of the large sand dune and into the rata forest directly behind SB4. Therefore, actual commute times for penguins landing at Sandy Bay East and entering the forest behind SB4 were far longer than reported. The large sand dune at the eastern end of Sandy Bay became a hub of activity for peak landing and departure times. The extra time taken to commute from Sandy Bay East to the forest behind SB4 was thought to be a sea lion avoidance behaviour. Moore (1992a) commented that some individual penguins were observed to change landing areas when disturbed by sea lions. This could well be the case with the landing sites at SB4 and Sandy Bay East, as leucistic penguins were seen landing at both sites on separate nights, though photographs on both occasions indicate that it was the same individual (L.S. Argilla and M.J. Young, pers. obs.).

Behavioural responses to humans and natural disturbance

Disturbances and the frequency of alert behaviours displayed were skewed towards the western end of the beach at Sandy Bay. More birds were seen scanning from the surf at the western end, though this may have been due to observer bias and the close proximity of the observation point. Beach scanning from the surf may also be due to historical interaction with sea lions or other seabirds that may influence individual penguin behaviour at landing sites, especially for timid individuals, and particularly when penguins are landing or departing in groups where a timid individual may influence the overall group behaviour (van Heezik and Seddon 1990). The majority of landing penguins that

were disturbed and returned to sea were observed in the SB1, Penguin Alley and SB2 portion of the beach. The proportion of alert behaviours observed was significantly greater for the western end than the eastern end of Sandy Bay beach, but virtually absent from Sandy Bay East where humans and sea lions were seen infrequently.

Whilst the frequency of alert behaviours were observed to be higher for the western end of Sandy Bay than the eastern end, there were several other factors that may have contributed to this observation. Firstly, as previously mentioned, all observations were made by two researchers stationed at the western end of Sandy Bay, and therefore an element of bias may have been introduced through closer observation by eye than with binoculars for the far end of the beach. The number of subantarctic skuas and occasionally northern giant petrels utilising the area near the necropsy shed (at the front of the boat shed, see Figure 2) was also observed to be higher at the western end of the beach than the eastern end, particularly following a sea lion necropsy. In addition, sea lion numbers were higher at the western end than the eastern end throughout the observational period, so there would be some expected baseline anxiety based on previous experiences with sea lions. Finally, heavy rainfall later in the observational period lead to increased discharge from streams one and two at the western end of the beach, which caused the formation of vertical banks up to a foot high which dissected the beach diagonally. Yellow-eyed penguins are birds of habit, and when observed to come across such an obstacle in their path, their alert behaviours increase. Similar observations have been made on Campbell Island for landing penguins (Amey and Moore 1995). Furthermore, Ellenberg et al. (2008) commented on the range of personalities and stress coping styles exhibited by yellow-eyed penguins studied on the New Zealand mainland. It was also noted anecdotally in this study that there were differences in behaviour between individuals observed in the presence of humans. Several penguins landed and preened within metres of researchers undertaking sea lion necropsies at the necropsy shed, and one penguin spent several days loafing in a tree next to the long-drop toilet, returning to the same spot approximately two weeks later (M.J. Young and L.S. Argilla, pers. obs.). Other individuals that utilised the front yard of the research quarters as part of their commuter route were observed to be highly sensitive to any form of disturbance.

Penguin interactions with human groups occurred throughout the observational period. Researcher presence was constant at low levels during this study, but is not a new phenomenon on Enderby Island. New Zealand sea lion research undertaken by three to six scientists over three months each summer may expose penguins using Sandy Bay and other parts of the island to low and possibly tolerable levels of disturbance depending on the nature of the interaction as discussed by Ellenberg et al. (2008). Burger and Gochfeld (2007) comment on the 'dose-response' observed for emperor penguins, and Ellenberg et al. (2008) comment that yellow-eyed penguins are less likely to tolerate group approaches. The researcher activities observed were all 'outside' activities pertinent to their work, and when a penguin was observed in the vicinity of a researcher, the researcher made an effort to modify their own behaviour rather than elicit a stress response from the individual penguin concerned (M.J. Young, pers. obs.). The majority of penguin interactions with researchers occurred when working at the necropsy shed in the late afternoon. In comparison, tourist presence, whilst controlled for maximum numbers on any one day during the tourist season, exposes individual penguins to approach by much larger groups and for longer periods of time. Tourist group size ranged from one to 50 people before dispersing into smaller groups for guided walks, and little effort was made by these large groups to condense and to not encircle wildlife

when approaching, which led to delays for individual penguins observed (M.J. Young, pers. obs.). Sample sizes for approach group size were too small for analysis in the current study, and it was not considered appropriate to simulate approach distances or group size for naïve penguins in the subantarctic in light of the ‘Minimum Impact Code’ (DOC 2004a, 2008).

Wright (1998) in her pioneer study of tourist and yellow-eyed penguin interactions on the Otago Peninsula commented on measuring the “instantaneous behavioural effects” of ecotourism. The current study was also concerned with such direct behavioural effects, and attempts were also made to gather information on productivity and pre-fledge chick weights from Penguin Alley and a comparative site not exposed to tourism. Unfortunately this was not possible owing to the failure of many nests in the early guard phase. The purpose of this was to determine whether any post-foraging delays observed for adults were having a compounding effect on chick weights as seen on the mainland, as well as direct effects on the site productivity (McClung et al. 2004; Ellenberg et al. 2007). McClung et al. (2004) and Ellenberg et al. (2007, 2008) comment on the medium- to long-term consequences of compounding stressors for yellow-eyed penguins exposed to ecotourism, which may result in lower reproductive output. Enderby Island’s ecotourism does differ significantly from mainland sites owing to the restrictions on the number of people and the number of days that tourists may land on the island, however measures of productivity and chick weights are a valuable resource for interpreting population-level effects.

Management implications

Burger and Gochfeld (2007) discussed spatial restrictions for viewing commuting emperor penguins (*Aptenodytes forsteri*) in Antarctica, and the impact of large tourist group size and group spacing upon recognition, diversion and delay of this species on their commute to the sea when compared with smaller groups. Sample sizes for disturbance groups were too small for comparison; however distance to disturbance has been recorded by Ellenberg et al. (2008) for nest approaches. In the absence of yellow-eyed penguin specific data, it seems reasonable to assume that larger groups of humans will provoke a greater stress response. Holmes (2007) commented on the requirement to scientifically validate approach distance guidelines for wildlife, and that tailoring these guidelines to the most sensitive species at the site will maintain consistency for tour groups. This was not considered for the current study, though the standard approach guideline of five metres for all wildlife in the New Zealand subantarctic clearly requires species-specific validation for yellow-eyed penguins (DOC 2008). A minimum approach distance of 200 metres for yellow-eyed penguins is recommended by the Department of Conservation at Sandfly Bay on the Otago Peninsula where frequent human disturbance occurs (DOC 2009b). This larger distance may be impractical for Enderby Island given that tourist interactions will be much higher for Sandy Bay than Sandfly Bay given the ratio of people to penguins. Regardless, validation of an acceptable distance to approach, consistency of tour group size, tour group routes and “no stopping zones” will assist in the management of wildlife interactions on Enderby Island.

The observations made in the current study served to highlight the ‘problem areas’ at Sandy Bay, and to indicate how effective the current mitigation measures are in reducing stress upon yellow-eyed penguins at this site. Some of the tourist operators conducted single-file crossings of Penguin Alley that took no more than six minutes to ferry 50 people and guides across this short stretch. Return trips however were not as well coordinated and individuals and groups were free to wander backwards and forwards

across Penguin Alley while waiting for zodiacs. One of the major access paths for yellow-eyed penguins is the area where stream two meets the forest vegetation, and this area can be viewed from the sward adjacent to Penguin Alley. Many tourists and guides were observed to encamp on the sward for hours with their cameras, after seeing a penguin attempt to depart from the vegetation in this area. In addition, many penguins were seen to use the bush edge between stream two and Stella Hut as a commuter route, which passes by the preferred human pathway to this historic site. Current close encounters are permitted by the 'Minimum Impact Code', though there were obvious costs to the individual penguins that were the subject of the tourists' enjoyment. It is recommended that the Department of Conservation indicate a suitable flagged route for tourists to cross Penguin Alley, and that guides or crewmen are stationed at its extremities to consolidate groups crossing and to prevent unnecessary movements which may cause disturbance to yellow-eyed penguins. In addition, it is recommended that a similar stipulation be added to the entry permits and attached schedules for crossings through the eastern end of Sandy Bay where the majority of penguins land and commute to and from their nests. Disturbance at the eastern end of the beach may be more detrimental to individuals as there is a lack of vegetative cover and fewer escape opportunities for yellow-eyed penguins.

The results presented here are highly seasonal should be interpreted with caution. The pattern of landings and departures is known to become significantly different for commuting adult yellow-eyed penguins once the post-guard stage of chick rearing commences, when both adults make daily trips to sea to forage (Darby and Seddon 1990), and post-guard chicks are fed generally twice a day (van Heezik 1991). Thus, the recommendations made here are only applicable during the guard phase of chick rearing on Enderby Island from December to mid-January. In addition, during the study period a high proportion of chicks died from starvation, and that adults monitored at nests were in poor body condition (M.J. Young and L.S. Argilla, unpublished data). At this stage it is unclear whether the level of chick starvation observed is an unusual event or whether it is part of a seasonal oscillation as observed on the mainland; further monitoring of productivity on Enderby Island will assist in clarifying this issue. Increasing the number of tourists, and hence increasing the frequency of potential delays for adults returning to their nests to feed chicks may have direct consequences for this population in years of short food supply or other unknown factors that influence productivity. Moore (2001) comments that yellow-eyed penguins "wax and wane" on the New Zealand mainland, with many breeding locations completely disappearing while new areas attract breeding pairs and proliferate. Furthermore, the distribution of nests at mainland sites also appears to fluctuate over time, which directly influences the commuter routes observed during beach counts. Any future changes in the distribution of nests and number of birds seen per section during beach counts should be treated with caution, as this may be part of a larger picture not influenced by tourist and researcher interaction alone.

Collecting baseline information from the yellow-eyed penguin population on Enderby Island is necessary for management to evaluate any future changes in the number and frequency of ecotourist landings, and the current study has collected data for this purpose. Understanding the broader picture by concurrent health screening and nest monitoring of yellow-eyed penguins is valuable, and in a population that has not been studied since 1989 there is considerable value in continuing a low-level study for this site. Every effort was made to minimise disturbance during all aspects of the data collection. Observations were conducted from a vantage point where penguins could not see the observers, and nest monitoring was not conducted at Sandy Bay. Health screening of

adult and juvenile penguins was achieved at Sandy Bay East and other sites away from Sandy Bay, and was thought to be the most invasive of all interactions. Ellenberg et al. (2008) report that yellow-eyed penguins may perceive blood sampling as a negative interaction with humans, though these conclusions are drawn from penguins that were bled several times and visited at the nest frequently as part of a previous highly invasive study. Health screening was conducted as a baseline for disease detection; therefore the merits of the study were thought to outweigh the negative instantaneous effects for the individual sampled (see Amey and Moore 1995). Regardless, human interactions with yellow-eyed penguins should be critically evaluated for their importance to the species' research, recovery and continued prosperity.

5. Recommendations

The Department of Conservation currently plans to increase the number of tourist landings permitted on Enderby Island during the tourist season from the beginning of the 2009/10 season. Provided that the current patterns of tourist dispersal from Sandy Bay continue, and that landings do not coincide with peak penguin commuter times, there should be few negative impacts upon the Sandy Bay yellow-eyed penguin population.

The following recommendations have been made:

- Landings and departures of tourists from Sandy Bay, Enderby Island should be undertaken from 8am to 6pm during December to mid-January to coincide with the least active penguin commuter times.
- Landings should be made in consultation with DOC staff present on Enderby Island (if any). The preferred landing site for tourist zodiacs is on the beach in SB1/Penguin Alley, where the party can congregate behind the boatshed and in the front yard of the research quarters out of visual contact with wildlife. Only in extreme circumstances should zodiacs be landed at the eastern end of the beach, and this should be at the discretion of the DOC representative on Enderby Island.
- Group size for tourists landing on Enderby should be no more than 10 people per guide, and groups should keep close to reduce their visual size when viewing wildlife as instructed in the 'Minimum Impact Code'.
- A marked route should be established for walking across Penguin Alley, and the entire party should cross together without stopping.
- Guidelines for crossing in front of the sand dune at the eastern end of Sandy Bay beach should be established for researchers commuting to Southeast Point and tourist groups circumnavigating the island. These guidelines should have the same weight as the current provision for Penguin Alley in the entry permit and attached schedules. The area should be a 'no stopping zone'.
- Validation of an acceptable distance to approach yellow-eyed penguins is required. Fifty metres is recommended based on current observations, though this estimate is a conservative one.
- Continue to monitor yellow-eyed penguin interactions with ecotourists and researchers at Sandy Bay. Monitoring should be replicated for the post-guard phase of yellow-eyed penguin chick rearing when both adults make forays to and from the nest, as interactions will be considerably higher and with greater consequence for growing chicks at the nest.

6. Acknowledgements

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7. References

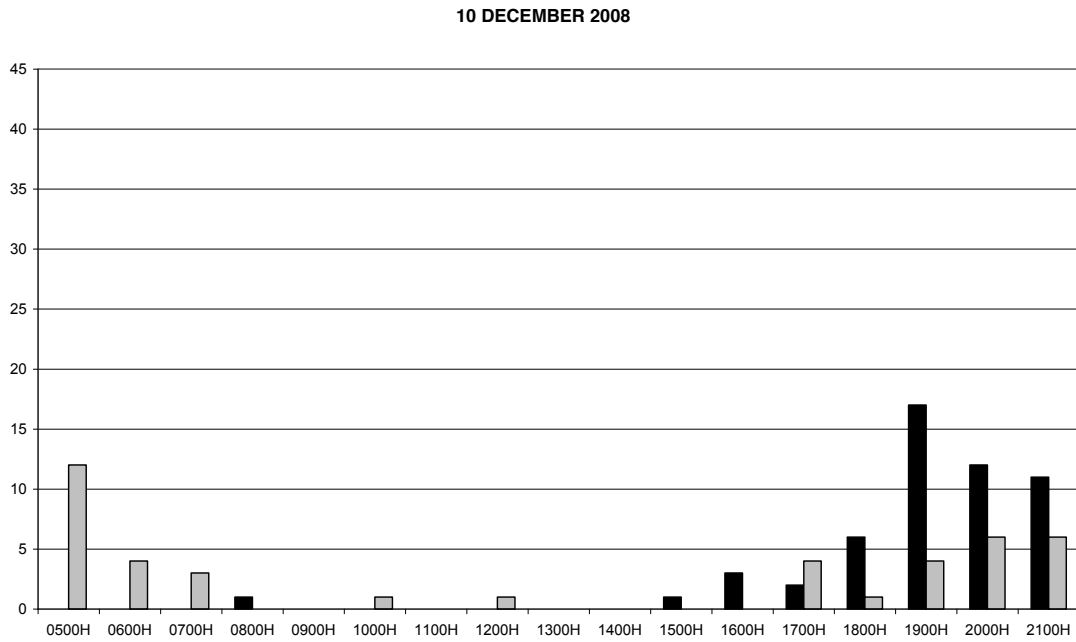
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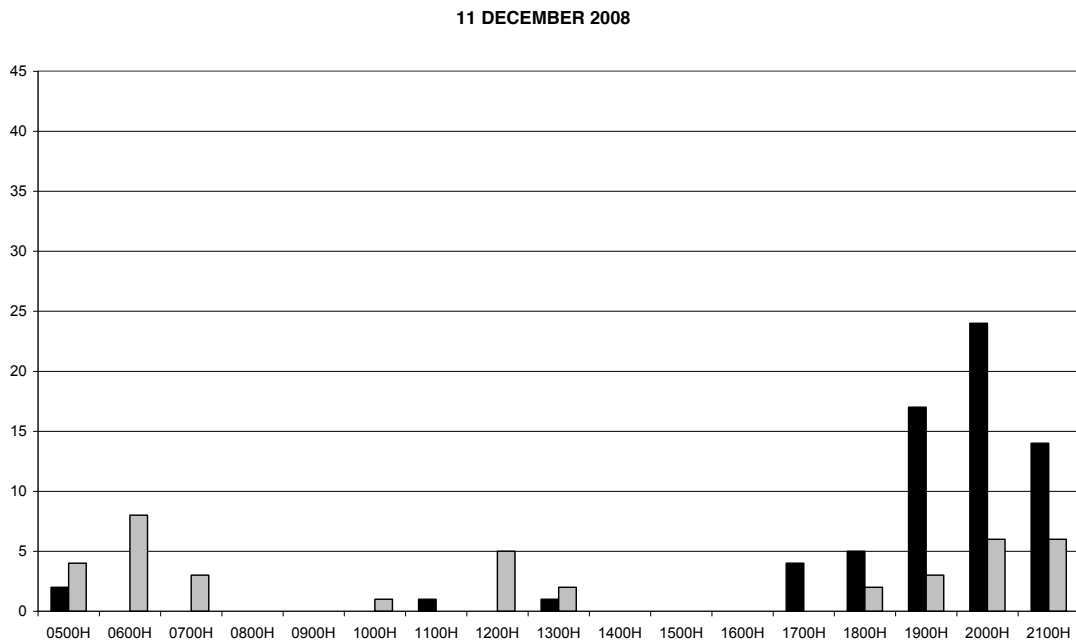
Appendix I – Birds per hour graphs.

Landing birds are the black shaded bars, and departing birds are the grey shaded bars.

IA. 10 December 2008



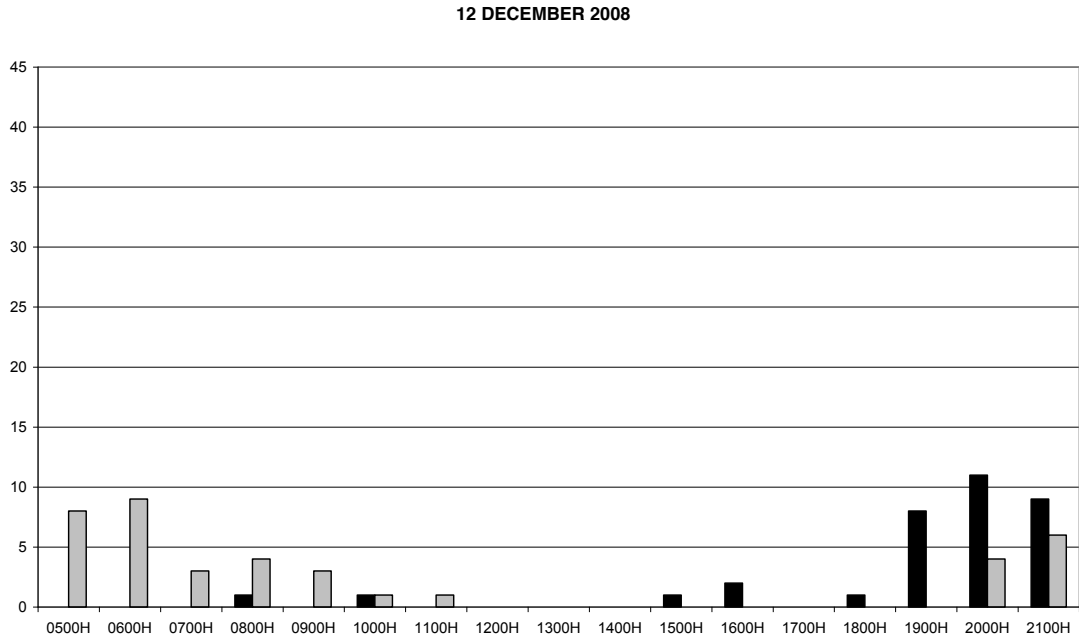
IB. 11 December 2008



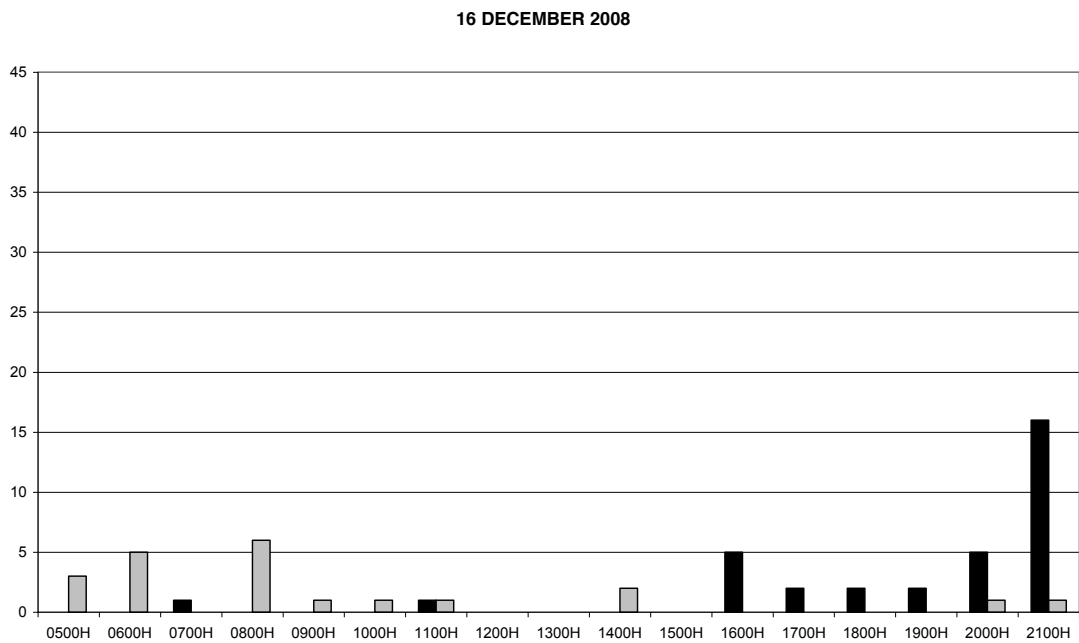
Appendix I – Birds per hour graphs.

Landing birds are the black shaded bars, and departing birds are the grey shaded bars.

IC. 12 December 2008



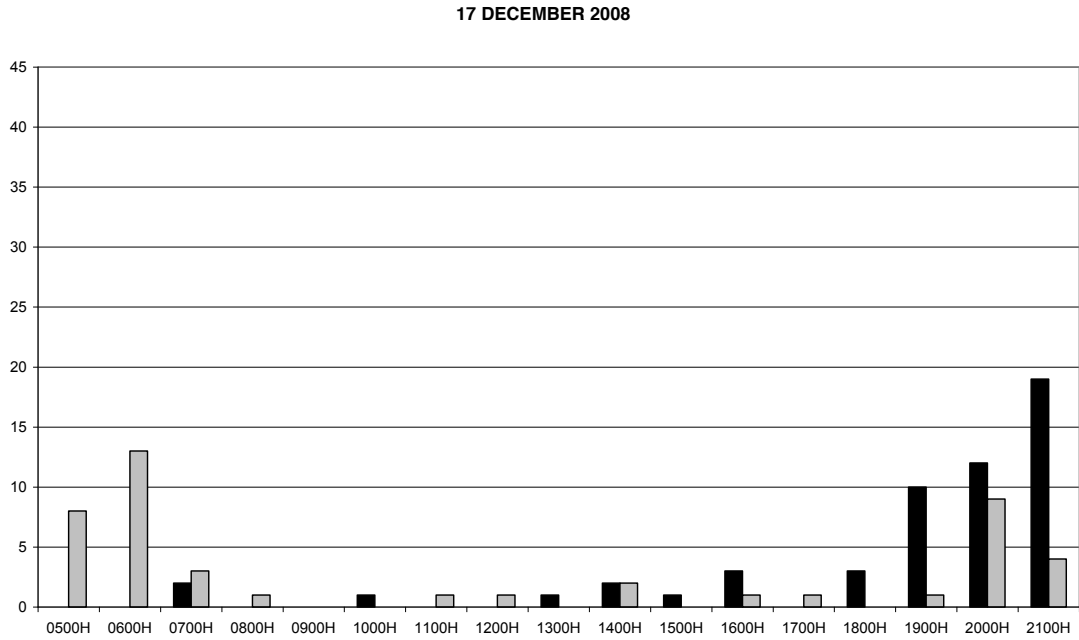
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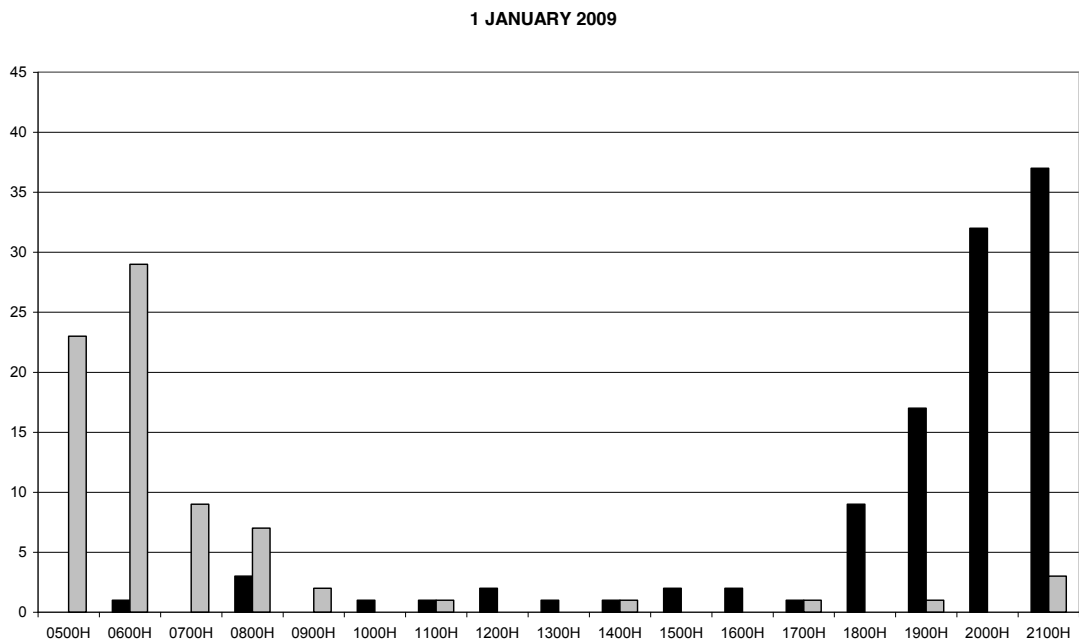
Appendix I – Birds per hour graphs.

Landing birds are the black shaded bars, and departing birds are the grey shaded bars.

IE. 17 December 2008



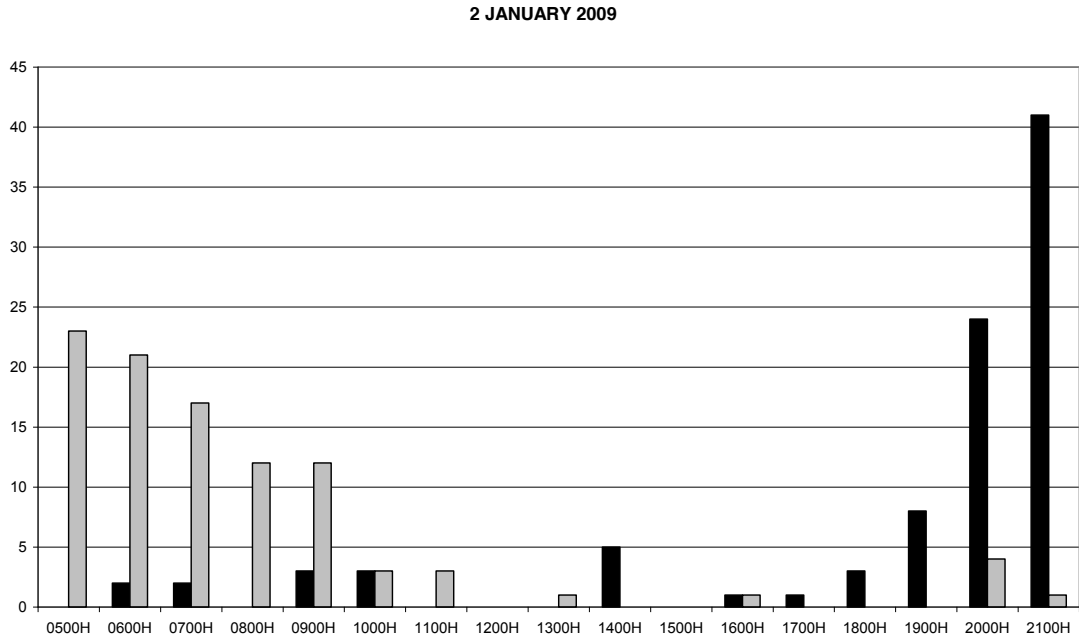
IF. 1 January 2009



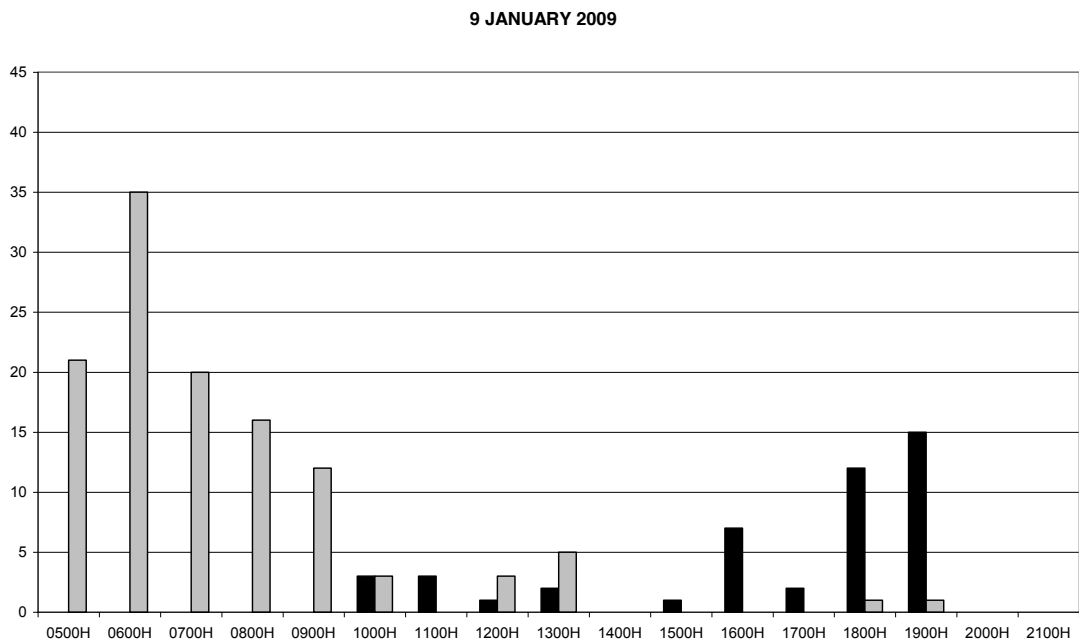
Appendix I – Birds per hour graphs.

Landing birds are the black shaded bars, and departing birds are the grey shaded bars.

IG. 2 January 2009



IH. 9 January 2009⁴



⁴ Observations ended at 1930 hours NZDST.

Appendix II - Report on Stomach Flushing of Penguins on Enderby Island

Melanie Young, Dr. Lisa Argilla, Dr. B.L. Chilvers

Regular nest searches, blood sampling, weighing and measuring of yellow-eyed penguins was undertaken on Enderby Island from the beginning of December 2008 through to January 2009. During this time approximately 50 nests were found, most of these with two young chicks (ranging from about 2 days old to 1 week old). On the 14–18th of December we discovered multiple dead chicks at nests, all of which were necropsied. We then re-checked nests previously located and found that chicks had also died at the majority of these nests. Post mortem examination of all recovered chicks revealed that they were emaciated, had no fat reserves and no food contents in their proventriculus. The provisional diagnosis for cause of death for all of these chicks was starvation. After these dates it became more difficult to find nests, and we would occasionally find a failed nest containing dead chicks. A number of the chicks that were found were too decomposed for a necropsy to be performed, but it is likely that cause of death was probably also starvation. Some chicks have not been relocated between nest checks. One of the chicks that was necropsied on the 22nd of December had a full proventriculus (the front part of a bird's stomach, containing digestive glands – part of the stomach) but no fat reserves and was very thin. Cause of death is unknown at this stage but was likely accidental.

We have also noted that the adult penguins, especially parents whose nests have not yet failed, are quite lean and not at a sufficient body condition to maintain chicks as well as themselves. We have noted that at many of the nests that we have re-checked the chicks have been left alone at the nest during the guard period, possibly as a result of the strain placed upon the foraging requirements of the adults.

Due to the fact that starvation was the likely cause of death, the DOC Animal Ethics Committee was approached by Dr. Louise Chilvers and Dr. Kate McInnes to revise the decision regarding stomach flushing of penguins so we could assess the quality and size of meals that adults were delivering to chicks. Approval was granted for us to go ahead and stomach flush 20 adult penguins. We did a thorough search of all the equipment we had (medical and non-medical) to see if we could find anything suitable to perform the task. We were unable to find any suitable equipment so opted not to go ahead with the procedure.

Multiple samples and records have been kept to document every yellow-eyed penguin that has been handled by us on Enderby Island. Tissue, feather and blood samples will be processed at Massey University and a final diagnosis for cause of death will be made once this is done.

Melanie Young

¹Wildlife Management candidate, Department of Zoology, The University of Otago

²Ranger, Biodiversity Assets, Department of Conservation, Coastal Otago Area Office, Dunedin

Dr. Lisa Argilla

Veterinary Resident in Avian, Zoo Animal and Wildlife Health

New Zealand Wildlife Health Centre, Massey University, Palmerston North

Dr. B.L. Chilvers

Marine Mammal Scientist, Marine Conservation Unit, Department of Conservation, Wellington