

NATURE-BASED TOURISM: EXPERIENCES AT THE VOLUNTEER POINT PENGUIN COLONY IN THE FALKLAND ISLANDS

Helen M. Otley

*Falklands Conservation, PO Box 26, Stanley, Falkland Islands FIQQ 1ZZ, UK
(heleno@southcom.com.au)*

Received 29 March 2005, accepted 30 November 2005

SUMMARY

OTLEY, H.M. 2005. Nature-based tourism: experiences at the Volunteer Point penguin colony in the Falkland Islands. *Marine Ornithology* 33: 181–187.

A study was conducted of nature-based tourism, including visitor numbers and use of six visitor attractions, at Volunteer Point, the site of the largest King Penguin *Aptenodytes patagonicus* colony in the Falkland Islands, from November 2001 to March 2002. Of the 1070 visitors to Volunteer Point, 57% were overseas tourists, 24% were local residents of the islands and 19% were from the British military base, suggesting that Volunteer Point is one of the key land-based sites in the archipelago. Overseas tourists generally stayed for more than three hours at Volunteer Point; island residents and military personnel remained for less than two hours. All visitors spent time at the King Penguin colony, with a mean visit duration of 63 minutes, as compared to the Gentoo Penguin *Pygoscelis papua* colony, with 50% of visitors and a mean duration of only 19 minutes. The penguin colonies at Volunteer Point received less visitor exposure in terms of visitor person–hours than did a penguin colony on the Antarctic Peninsula. Volunteer Beach was the second most popular attraction at Volunteer Point. The popularity of non-wildlife attractions highlights the need for visitor management to incorporate the entire site and not just wildlife colonies. The pattern of visitor presence was predictable, which may have allowed the penguins to become accustomed to human presence. Fewer than 20% of Gentoo, King and Magellanic *Spheniscus magellanicus* Penguins commuting between the beach and colony areas during daylight hours did so during the hours of the day when the most visitors were present.

Key words: Falkland Islands, penguins, breeding success, nature-based tourism, visitor behaviour

INTRODUCTION

Tourism based on free-ranging animals, remote wilderness and areas of natural beauty is one of the fastest growing sectors of the tourism industry, including in the sub-Antarctic and Antarctic regions, which host ship-based visitors during the four months of the austral summer (Landau 2001). In most regions and habitats, many efforts have been made to control or reduce the effects of nature-based tourism on the environment and wildlife (e.g. Green & Higginbottom 2000, Burger 2002).

Within the sub-Antarctic and Antarctic regions, the Falkland Islands are among the most easily accessible sites where sub-Antarctic wildlife can be viewed. Each year, the Falkland Islands receive up to 75 visits by cruise vessels, which land their passengers near colonies of seabirds and marine mammals (Ingham & Summers 2002). Land-based visitors, including overseas tourists, military personnel from a British base on East Falkland Island and local residents of the Falkland Islands are also able to access wildlife areas using four-wheel drive vehicles and light aircraft. The study of land-based visitors in the Falkland Islands provides an ideal opportunity to assess the effects of nature-based tourism in a sub-Antarctic setting—including effects on wildlife breeding success and departure and return to colony areas, disturbance to vegetation and formation of walking trails—by investigating visitor numbers and behaviour. As the sub-Antarctic and Antarctic regions become more accessible to a greater range of visitors, an understanding of the activities and effects of tourists at sub-Antarctic sites is vital.

This study describes the number and types of visitors and their use of six visitor attractions at Volunteer Point, a popular wildlife site in the Falkland Islands, during the austral summer of 2001/02. To investigate the effects on the three species of penguin breeding at Volunteer Point, the colony breeding success of the King *Aptenodytes patagonicus* and Gentoo *Pygoscelis papua* Penguins and the timing of King, Gentoo and Magellanic *Spheniscus magellanicus* Penguins arriving and departing from colony areas to the sea were investigated.

METHODS

Study site

The study was conducted at Volunteer Point, East Falkland (51°29'S, 57°50'W), the site of the main breeding King Penguin colony in the archipelago. The colony, located at Volunteer Beach, was exterminated by sealers in approximately the 1870s, but birds began breeding again during the 1970s, and there is now a breeding population of approximately 700 pairs (Clausen & Huin 2002). There are three Gentoo Penguin colonies in the area: one colony with 1020 breeding pairs is located at Volunteer Beach, 500 m from the King Penguin colony. A second Gentoo Penguin colony of 420 breeding pairs is located at the tip of Volunteer Point (Lagoon Sands), and a third colony of 530 breeding pairs is located at Cow Bay, five kilometres to the north of Volunteer Beach (Clausen & Huin 2002; Fig. 1). The dune area behind Volunteer Beach is also home to burrowing Magellanic Penguins.

Because of the exposed nature of the landing site for small watercraft, visitors to Volunteer Point are land-based tourists rather than ship-based tourists; they travel overland in four-wheel drive vehicles. Since the beginning of tourism in the Falkland Islands in the early 1990s, Volunteer Point has been a popular tourist site, although actual visitor numbers before 2001/02 are not known. The popularity is attributable to the presence of three penguin species at Volunteer Beach and the site's close proximity to both Stanley (c. 2500 residents) and the Mount Pleasant British Military Complex (c. 2000 personnel). Since the area was opened to tourists, the penguin colonies at Volunteer Beach have been well visited, but far fewer (c. 10 people per summer) visit the colonies at Cow Bay and Lagoon Sands.

Volunteer Point is open from the first week of November until late March, during which period all three species of penguins present at the site breed. Before 2001, tourism at Volunteer Point was not controlled. By 2001, a voluntary "countryside code of visitor behaviour" had been established on the Falkland Islands, and a specific visitor management system had been implemented at Volunteer Point, focusing on Volunteer Beach, where visitors spend most of their time. In 2001/02 the management system involved establishing a car park 300 m from the King and Gentoo Penguin

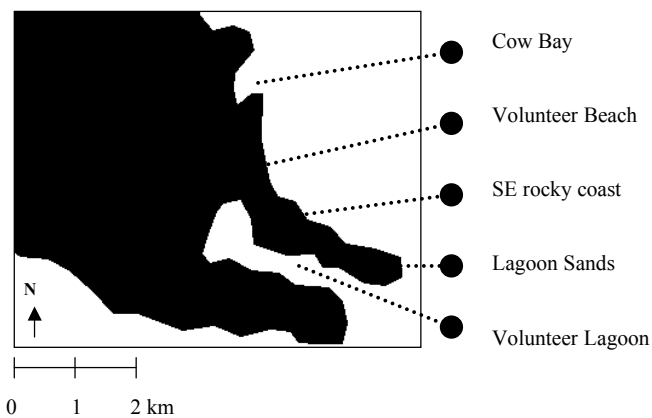


Fig. 1. Location of Volunteer Beach, site of the King *Aptenodytes patagonicus*, Gentoo *Pygoscelis papua* and Magellanic *Spheniscus magellanicus* Penguin colonies, and Volunteer Lagoon, the south east rocky coastline and the two seldom-visited Gentoo Penguin colonies at Cow Bay and Lagoon Sands.

colonies and identifying the recommended six-metre approach distance to penguin colonies with a ring of white rocks around colony areas. A warden was present at the site to educate visitors about behaviour that would reduce disturbance to breeding birds. Volunteer Point has six separate attractions (Fig. 1):

- King Penguin colony at Volunteer Beach
- Gentoo Penguin colony at Volunteer Beach
- Volunteer Beach, a two-kilometre long beach with a variety of shorebirds, sea lions, seal and dolphin species to be seen, and a dune area with burrowing Magellanic Penguins
- Volunteer Lagoon, which is used by bathing King Penguins
- Rocky coastline south of Volunteer Beach with breeding Rock Cormorants or Shags *Phalacrocorax magellanicus* and Crested Caracaras *Polyborus plancus*
- The car park where information can be obtained from the warden

There were no defined routes between the visitor attractions.

Study methods

The warden was present at Volunteer Point to record details about the visitors—including numbers of adults and children (<15 years old) and departure and arrival times—for 140 of the 150 days that the site was open. The origins of visitors (resident of the Falkland Islands, military personnel or overseas tourist) was determined. Between December and March, one person was randomly selected from each separate group of visitors, and that visitor's movements were recorded in five-minute blocks for his or her entire stay. Overnight campers were not selected. The location of each person could be observed almost entirely unobtrusively from the car park. Visitors were not aware of their involvement in this study. On days when more than 40 people were present, time was insufficient to record visitor movements.

The level of King and Gentoo Penguin exposure to visitors per month was calculated by multiplying the number of people by the average visitor duration (based on 20–28 visitors) at each colony each month, following Cobley & Shears (1999).

Breeding success at the Gentoo Penguin colonies at Volunteer Beach, Cow Bay and Lagoon Sands was assessed from population counts of incubating adults during November 2001 as compared with counts of chicks present towards the end of January 2002

TABLE 1
Monthly variation in the number of days with visitors, percent of the total number of visitors, visitors followed and mean \pm SD visitor person-hours per day recorded at King and Gentoo Penguin colonies^a

Month	Days with visitors	Percentage of total visitors	Visitors followed	Mean visitors per day	King Penguin colony		Gentoo Penguin colony	
					Mean stay duration \pm SD (h)	Visitor-hours per day	Mean stay duration \pm SD (h)	Visitor-hours per day
November	60	11	0	6.7	0.9 \pm 0.6	5.9	0.3 \pm 0.2	1.9
December	58	26	27	15.7	0.9 \pm 0.6	13.9	0.3 \pm 0.2	4.4
January	77	29	28	12.7	1.4 \pm 1.2	17.6	0.4 \pm 0.2	4.7
February	71	19	20	10.4	1.2 \pm 1.0	12.2	0.2 \pm 0.1	2.1
March	52	14	21	9.6	0.8 \pm 0.4	7.2	0.2 \pm 0.2	2.0

^a Visitor movements were not recorded in November, and the mean December stay duration was used to calculate November person-hours per day.

before fledging occurred. Annual breeding success before 2001/02 for the three colonies was obtained from Pütz *et al.* (2001), with estimates made since 1990/91 at Volunteer Beach, since 1993/94 at Cow Bay and since 1997/98 at Lagoon Sands.

Any physical damage to the ground, such as trampling of Magellanic Penguin burrows and development of walking tracks was noted. To determine the timing of penguins travelling between the sea and colony areas, beach counts were conducted to record the number of King, Gentoo and Magellanic Penguins exiting and entering the sea along a 650-m length of Volunteer Beach between sunrise and sunset on one day in each of the months of November, December, January and February.

All results are reported as mean ± standard deviation unless otherwise indicated.

RESULTS

Level of land-based tourism

From November 2001 to March 2002, 1072 people (977 adults and 95 children), visited Volunteer Point in 203 separate groups. Of these visitors, 57% were overseas tourists, 24% were residents of the Falkland Islands and 19% were military personnel.

Most visits (60%) occurred during December and January, but there were more days with at least one visitor in January and February than in other months (Table 1). The percentages of overseas tourists, local residents and military personnel differed significantly between the months ($\chi^2_8 = 91.77, P < 0.001$). The numbers of overseas tourists and military personnel peaked in January, but significantly more local residents visited during December (Fig. 2). The maximum number of visitors on a single day was 59 in late

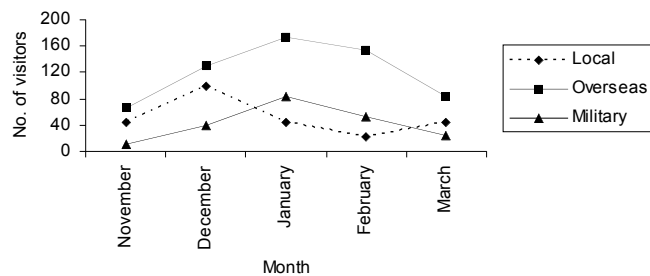


Fig. 2. Monthly variation in the total number of local residents of the Falkland Islands, overseas tourists and military personnel visiting Volunteer Point.

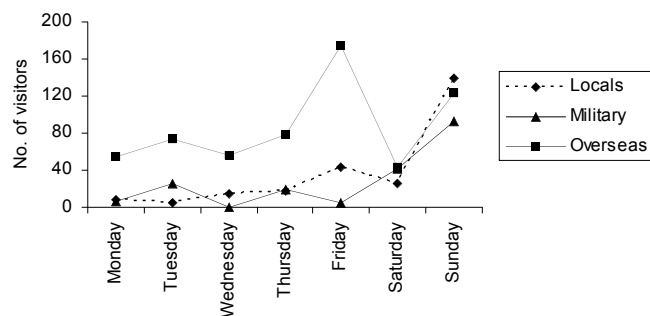


Fig. 3. Weekly variation in the total number of local residents of the Falkland Islands, overseas tourists and military personnel visiting Volunteer Point during November 2001–March 2002.

January. Within each month, particular days of the week were significantly more likely to host a particular user group ($\chi^2_{12} = 214, P < 0.001$) than were others: most island residents and military personnel visited Volunteer Point on a Sunday; overseas tourists visited mostly on a Friday (Fig. 3).

The mean arrival time of visitors was 11h40 ± 105 minutes, and the mean departure time was 14h40 ± 95 minutes, with the earliest visitors arriving at 08h00, and the latest visitors departing at 20h00. In addition, 40 people stayed overnight at Volunteer Point, camping at Volunteer Beach.

The mean visit durations of overseas tourists, island residents and military personnel were significantly different ($F_{2,180} = 5.80, P < 0.005$), with military personnel having the shortest visits (mean: 2 hours, 21 mins ± 52 minutes). Island residents stayed for slightly longer (mean: 2 hours, 46 mins ± 78 minutes). For military personnel and local residents alike, the mean visit duration did not differ significantly between the months ($F_{4,16} = 0.23, P = 0.916$ and $F_{4,25} = 1.14, P = 0.359$ respectively; Fig. 4). The duration of visits by overseas tourists varied significantly between months ($F_{4,127} = 3.52, P < 0.001$), with a mean visit duration of 4 hours, 4 mins ± 64 minutes in December and of 2 hours, 36 minutes ± 67 minutes in March (Fig. 4).

Site usage

The movements of a total of 96 people (20–28 people per month) were recorded; no records were made during November, and one person from 55% of all parties in the other four months was observed (Table 1). Of the people whose movements were recorded, 72 were overseas tourists, 13 were military personnel and 11 were island residents. Because of the low number of military personnel and island residents followed, no comparison of site usage between the three user groups was possible.

The most popular site was the King Penguin colony, with all visitors choosing to visit it for a mean duration of 63 ± 53 minutes. Of the followed visitors, 54% went to the Gentoo Penguin colony at Volunteer Beach, but their stays there were shorter (mean: 18 ± 11 minutes). Volunteer Beach was the second most popular site, with 55% of visitors walking along it for a mean duration of 43 ± 26 minutes. Volunteer Lagoon was visited by 34% of people, who spent 27 ± 22 minutes on average at the site. One quarter of visitors walked to the southeast along the rocky coastline for a mean time of 99 ± 49 minutes. All visitors began their tour of Volunteer Point from the car park, and the mean time spent in the car park was 40 ± 38 minutes.

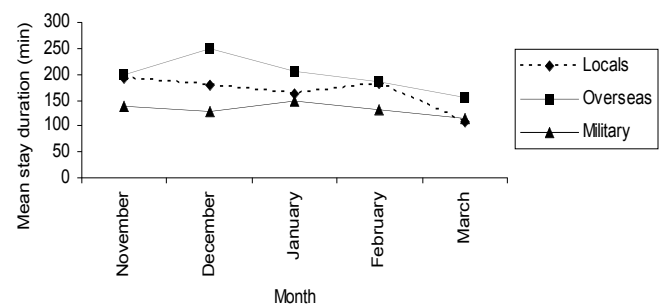


Fig. 4. Monthly variation in the mean stay duration of local residents of the Falkland Islands, overseas tourists and military personnel visiting Volunteer Point during November 2001–March 2002.

The King Penguin colony was observed by visitors for a minimum of 5.9 visitor-hours per day on at least 52% of days in the month (Table 1). The highest visitation period occurred in January, with 17.6 visitor-hours per day occurring on 77% of the days in the month. The Gentoo Penguin colony at Volunteer Beach received less attention, with a maximum visitor exposure of 4.4 visitor-hours per day during 24 days in January (Table 1).

In general, few people contravened any of the visitor guidelines at Volunteer Point during 2001/02. The most frequent contraventions were approaching the colony inside the six-metre ring of white rocks or following commuting King Penguins. Most overseas tourists and island residents already had a good background knowledge and understanding about how to behave around penguin colonies; military personnel required more guidance and information from the warden.

Potential effects on breeding success and commuting behaviour of penguins

Mean Gentoo Penguin breeding success at the colonies at Volunteer Beach over 11 years, at Lagoon Sands over nine years and at Cow Beach over six years was, respectively, 0.95 ± 0.3 chicks, 0.87 ± 0.3 chicks and 0.92 ± 0.3 chicks per breeding pair. The annual breeding success at the three colonies over 6–11 years was not significantly different ($F_{2,17} = 0.10$, $P = 0.908$).

On the dune area at Volunteer Beach adjacent to the car park, visitors accidentally trampled a number of Magellanic Penguin burrows

directly between the car park and the beach. No other physical disturbances, such as formation of walking tracks, were noted.

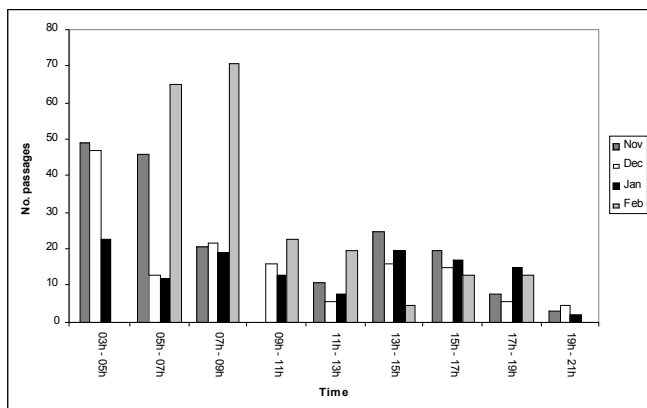
During each monthly sunrise to sunset count, 120–200 King Penguin, 750–2200 Gentoo Penguin and 180–2300 Magellanic Penguin passages between Volunteer Beach and colony areas were recorded. Most penguin passages occurred before 09h00 and after 17h00 [Fig. 5(a,b,c)]. In contrast, visitors were present at Volunteer Point mostly between 11h00 and 15h00 [Fig. 5(d)]. A monthly mean of $8\% \pm 3\%$ of Gentoo Penguins, $15\% \pm 6\%$ of Magellanic Penguins and $17\% \pm 8\%$ of King Penguins seen walking across the beach between sunrise and sunset commuted between 11h00 and 15h00.

The route taken by penguins often intersected with the path of a visitor, and when this occurred, Gentoo and Magellanic Penguins alike scrambled rapidly away. On the other hand, commuting King Penguins, which attracted considerable attention from visitors, tended to continue, but on a deviated path, often eventually returning to the safety of the colony or the sea.

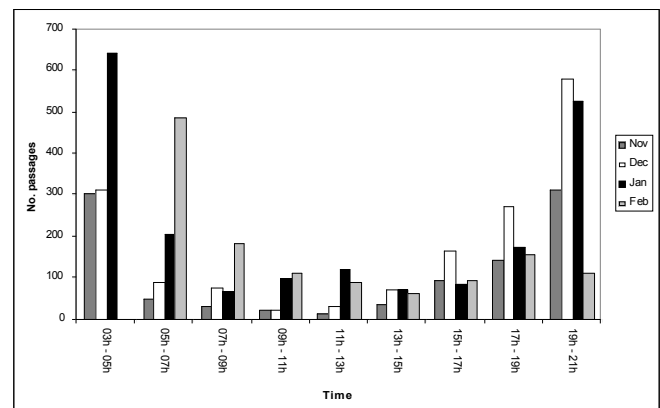
DISCUSSION

Level of land-based tourism

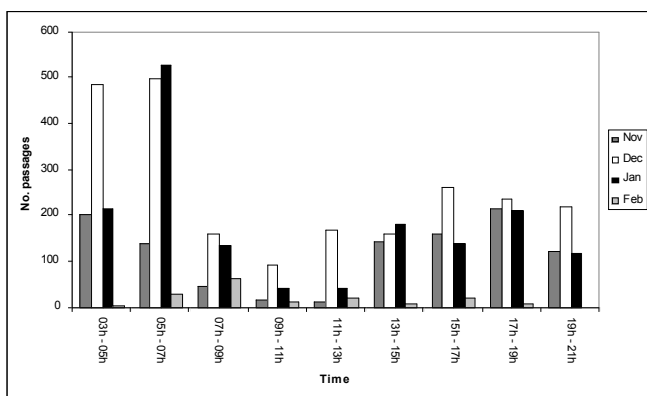
Despite the many challenges associated with visiting the sub-Antarctic and Antarctic region, the number of tourists to the region has increased over the last decade, with 14 000 ship-based visitors to Antarctica and 3000 visitors to the sub-Antarctic island of South



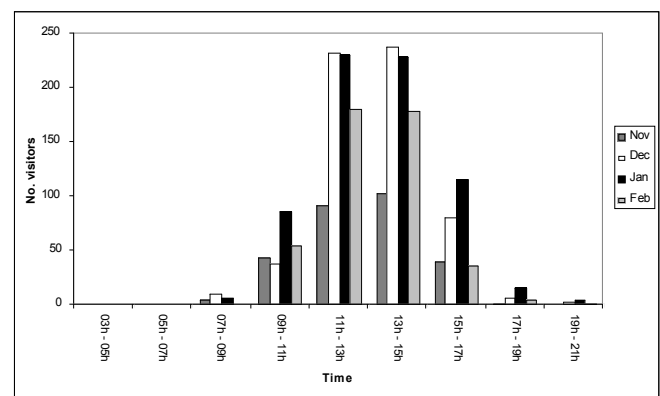
(a) King Penguin



(b) Gentoo Penguin



(c) Magellanic Penguin



(d) Visitors

Fig. 5. Total number of passages of (a) King Penguins *Aptenodytes patagonicus*, (b) Gentoo Penguins *Pygoscelis papua*, and (c) Magellanic Penguins *Spheniscus magellanicus* from Volunteer Beach to colony areas, and (d) number of visitors present in two-hour intervals between 03h00 and 21h00 during November 2001–February 2002.

Georgia in 2000/01 (Landau 2001, Ingham & Summers 2002). The Falkland Islands represents a special case of sub-Antarctic tourism in that it receives both ship-based and land-based visitors. At sites where ship-based tourists can be landed in the Falkland Islands, between 1000 and 8000 people typically visit a wildlife colony each summer (Ingham & Summers 2002); less is known about the level of land-based tourism. During 2001/02, Volunteer Point received 1070 visitors, and although no detailed records of visitor numbers are available at other land-based tourist sites, the archipelago is thought to be one of the most popular land-based visitor sites (J. Fowler, pers. comm.).

The land-based tourists to Volunteer Beach were suspected to be mostly “novice generalist” tourists who do not necessarily act to reduce disturbance to wildlife. Sub-Antarctic and Antarctic sites that are more remote are visited by “expert specialists” who have greater knowledge about low-impact behaviour (Duffus & Dearden 1990). However, few people of any user group at Volunteer Point contravened visitor guidelines. Some differences in the use of Volunteer Point were identified between island residents, military personnel and overseas tourists, noticeably in the duration of visits. Although there is no requirement for visitors in the Falkland Islands to be accompanied by guides (as at other sub-Antarctic and at Antarctic sites), the warden system, with visitors being given information about appropriate behaviour before setting off to the penguin colonies, appeared to be effective.

Site use

At most nature-based visitor sites, the pattern of usage is non-random, with some attractions receiving a disproportionate amount of attention from visitors (e.g. Higham 1998, Patterson *et al.* 1998). In a study of ship-based tourists at five sites around the Falkland Islands, visitors allocated between 10% and 60% of their time ashore at the key wildlife site, using the remainder of their time to explore the surrounding area (Ingham & Summers 2002). Visitors to Volunteer Point in 2001/02 spent approximately 50% of their visit at the penguin colonies and 25% of their visit on Volunteer Beach and the nearby rocky coastline, with the remaining time spent at the car park. The fact that visitor activities do not focus entirely on the key wildlife attraction at each site indicates the need for visitor management in the Falkland Islands to encompass entire sites and not just wildlife colonies.

As compared with one site on the Antarctic Peninsula, the penguins at Volunteer Point received far fewer visitors. A Gentoo Penguin colony at Port Lockroy received between 38 and 91 visitor-hours daily each summer month (Cobley & Shears 1999), which is far higher than the maximum rate of 17.6 visitor-hours per day at the King Penguin colony and 4.7 visitor-hours per day at the Gentoo Penguin colony at Volunteer Beach. However, the values calculated for the penguin colonies at Volunteer Beach are based on visitor behaviour on days with only low-to-moderate numbers of visitors. Land-based tourism at Volunteer Beach could be characterised as being frequent, low-level tourism; ship-based sub-Antarctic and Antarctic tourism results in irregular, but moderate-to-high numbers of visitors. This difference may lead to significantly different levels of environmental impact, particularly on wildlife.

Effects on penguins

Effects of a human presence at seabird colonies can be broad-ranging: from trampling of burrows, birds spending increased time on defensive behaviour or delaying return to colony areas, to

elevated heart rates and production of stress hormones. All may affect breeding success (Burger & Gochfeld 1993, Woehler *et al.* 1994, Nimon & Stonehouse 1995, Giese 1996, Simeone & Schlatter 1999, Yorio *et al.* 2001, McClung *et al.* 2004).

Some seabird species breeding in tourist areas become habituated to a visitor presence, in that no significant differences in breeding success, behaviour or levels of stress hormones are detected between individuals at well-visited to seldom-visited areas (Acero & Aguirre 1994, Culik & Wilson 1995, Burger & Gochfeld 1998, Burger & Gochfeld 1999, Nisbet 2000, Cobley *et al.* 2000). This lack of a significant difference is particularly true when the frequency, duration and type of intrusion from visitors is regular and predictable (Yorio & Boersma 1992). There were more visitors at Volunteer Point on Fridays and Sundays than on other days during the week, but because visitors were generally present only during the middle of the day, penguins breeding at Volunteer Beach may have become habituated to the visitor presence. Habituation may explain the lack of a difference in the breeding success of the Gentoo Penguin colony at Volunteer Beach as compared with the nearby but seldom visited colonies at Lagoon Sands and Cow Bay.

The effect of visitors on the breeding success of Magellanic Penguins at Volunteer Point was not determined because of the difficulty of investigating breeding activity within their deep burrows. Some accidental trampling of Magellanic Penguin burrows occurred, particularly in the area between the car park and the beach. Elsewhere, trampling has been identified as a problem for burrowing penguin species: 18% more Magellanic Penguin burrows had collapsed at a well-visited colony in Chile as compared with a less-well-visited colony (Simeone & Schlatter 1999).

Although the numbers of chicks close to fledging in the King Penguin colony at Volunteer Point have been recorded annually since 1981, no other colonies of this species exist in the Falkland Islands for comparison. However, some long-term visitors to Volunteer Point observed that breeding King Penguins demonstrated less defensive behaviour at an approach distance of six metres during 2001/02 when the ring of white rocks was in place than in previous years when the minimum approach distance was not marked (R.J. Ingham & T. Smith, pers. comm.). A reduction in animal responses to tourists after the erection of a fence has also been noted for South American Fur Seals *Arctocephalus australis*, and for waterbirds at a southern Californian wetland (Ikuta & Blumstein 2003, Cassini *et al.* 2004). Because of the positive effects of marking the approach distance at the Volunteer Beach penguin colonies, marking has also been undertaken at other penguin colonies in the Falkland Islands during subsequent seasons.

At Volunteer Point, visitor numbers peaked in December and January during the crèche period for Magellanic and Gentoo Penguins, when birds do not defend a territory (Otley *et al.* 2004, 2005). However, December and January is the peak mating and incubating period for King Penguins, when defence of their territory is vital (unpubl. data). For this reason, it is possible that King Penguins in the Falkland Islands are more susceptible to human disturbance than are Gentoo and Magellanic Penguins. However, this hypothesis requires further investigation.

As well as the potential for disruption of activities at the breeding site, there is also potential for disruption of commuting penguins and birds moulting in areas away from the colony (van Heezik

& Seddon 1990, Wilson *et al.* 1991, Martin *et al.* 2004). At some Yellow-eyed Penguin *Megadyptes antipodes* colonies in New Zealand, the afternoon peak in visitors coincided with the return of breeding birds to burrows, and visitor-induced delays in the feeding regime have been suggested as one explanation of lower chick masses at one well-visited site as compared with chick masses at an unvisited site (Wright 1998, McClung *et al.* 2004, Seddon *et al.* 2004). At most colonies studied, Gentoo and Magellanic Penguins commute to and from the sea generally around dawn and dusk; King Penguins commute throughout the day (Williams & Rothery 1990, Le Maho *et al.* 1993, Challet *et al.* 1994, Scolaro & Suburo 1995, Robinson & Hindell 1996, Radl & Culik 1998). Similar trends were also observed for the three species in this study. However, to investigate the effects of visitor presence on the timing of commuting, observations are also required at seldom-visited penguin colonies in the Falkland Islands. Fewer than 20% of Gentoo, King and Magellanic Penguins seen commuting between the beach and colony areas during daylight hours did so during the peak period of visitors (i.e. 11h00–13h00). That some individuals choose to commute when tourists were present might indicate their lack of concern for human presence. It is suggested that the probability of visitors to Volunteer Point significantly disturbing penguins commuting between the sea and colony areas is low.

ACKNOWLEDGMENTS

Special thanks go to Smith Brothers for allowing access to the site, to G. and J. Smith for safety communications and to D. Christie, T. McKeown and R. Harris, who assisted with fieldwork. Transport and logistics assistance provided by D. Broughton, N. Huin, T. Smith, S. Halford, P. Watts and D. Eynon was greatly appreciated. Earlier drafts of this paper were improved by R.J. Ingham, B. Stonehouse, D. Summers and two anonymous referees. The project was supported by the Rotterdam Zoo and the Mount Pleasant Complex Charity.

REFERENCES

- ACERO, J.M. & AGUIRRE, J.M. 1994. A monitoring research plan for tourism in Antarctica. *Annals of Tourism Research* 21: 295–302.
- BURGER, J. 2002. Tourism and ecosystems. In: Douglas, I. (Ed). *Encyclopaedia of global change*. Vol. 3. Causes and consequences of global environmental change. Chichester: John Wiley & Sons. pp. 597–609.
- BURGER, J. & GOCHFELD, M. 1993. Tourism and short-term behavioural responses of nesting masked, Red-footed and Blue-footed Boobies in the Galapagos. *Environmental Conservation* 20: 255–259.
- BURGER, J. & GOCHFELD, M. 1998. Effects of ecotourists on bird behaviour at Loxahatchee National Wildlife Refuge, Florida. *Environmental Conservation* 25: 13–21.
- BURGER, J. & GOCHFELD, M. 1999. Role of human disturbance in response behaviour of Laysan Albatross (*Diomedea immutabilis*). *Bird Behaviour* 13: 23–30.
- CASSINI, M.H., SZTEREN, D. & FERNADEZ-JURICIC, E. 2004. Fence effects on the behavioural responses of South American Fur Seals to tourist approaches. *Journal of Ethnology* 22: 127–133.
- CHALLET, E., BOST, C.A., HANDRICH, Y., GENDER, J.P. & LE MAHO, Y. 1994. Behavioural time budget of breeding King Penguins (*Aptenodytes patagonicus*). *Journal of Zoology, London* 233: 669–681.
- CLAUSEN, A.P. & HUIN, N. 2003. Status and numerical trends of King, Gentoo and Rockhopper Penguins breeding in the Falkland Islands. *Waterbirds* 26: 389–402.
- COBLEY, N.D. & SHEARS, J.R. 1999. Breeding performance of Gentoo Penguins (*Pygoscelis papua*) at a colony exposed to high levels of human disturbance. *Polar Biology* 21: 355–360.
- COBLEY, N.D., SHEARS, J.R. & DOWNIE, R.H. 2000. The impact of tourists on Gentoo Penguins at Port Lockroy, Antarctic Peninsula. In: Davison, W., Howard-Williams, C. & Broady, P. (Eds). *Antarctic ecosystems: models for wider ecological understanding*. Christchurch: New Zealand Natural Sciences. pp. 319–323.
- CULIK, B. & WILSON, R.P. 1995. Penguins disturbed by tourists. *Nature* 376: 301–302.
- DUFFUS, D.A. & DEARDON, P. 1990. Non-consumptive wildlife orientated recreation. A conceptual framework. *Biological Conservation* 53: 213–231.
- FOWLER, G.S. 1999. Behavioural and hormonal response of Magellanic Penguins (*Spheniscus magellanicus*) to tourism and nest visitation. *Biological Conservation* 90: 143–149.
- GIESE, M. 1996. Effects of human activity on Adélie Penguin *Pygoscelis adeliae* breeding success. *Biological Conservation* 75: 157–164.
- GREEN, R.J. & HIGGINBOTTOM, K. 2000. The effects of non-consumptive wildlife tourism on free-ranging wildlife: a review. *Pacific Conservation Biology* 6: 183–197.
- HIGHAM, J.E.S. 1998. Tourists and albatrosses: the dynamics of tourism at the Northern Royal Albatross colony, Taiaroa Head, New Zealand. *Tourism Management* 19: 521–531.
- IKUTA, L.A. & BLUMSTEIN, D.T. 2003. Do fences protect birds from human disturbance? *Biological Conservation* 112: 447–452.
- INGHAM, R.J. & SUMMERS, D. 2002. Falkland Islands cruise ship tourism: an overview of the 1999–2000 season and the way forward. *Aquatic Conservation: Marine and Freshwater Ecosystems* 12: 145–152.
- LANDAU, D. 2001. Antarctic tourism: what are the limits? Hobart, Australia: World Tourism Convention 2001.
- LE MAHO, Y., GENDER, J.P., CHALLET, E., BOST, C.A., GILLES, J., VERDON, C., PLUMERE, C., ROBIN, J.P. & HANDRICH, Y. 1993. Undisturbed breeding penguins as indicators of changes in marine resources. *Marine Ecology Progress Series* 95: 1–6.
- MARTIN, J., DE NEVE, L., FARGALLO, J.A., POLO, V. & SOLER, M. 2004. Factors affecting the escape behaviour of juvenile Chinstrap Penguins, *Pygoscelis antarctica*, in response to human disturbance. *Polar Biology* 27: 775–781.
- MCCLUNG, M.R., SEDDON, P.J., MASSARO, M., SETIAWAN, A.N. 2004. Nature-based tourism impacts on Yellow-eyed Penguins *Megadyptes antipodes*: does unregulated visitor access affect fledging weight and juvenile survival? *Biological Conservation* 199: 279–285.
- NIMON, A.J. & STONEHOUSE, B. 1995. Heart rate of disturbed penguins. *Nature* 374: 415.
- NISBET, I.C.T. 2000. Disturbance, habituation, and management of waterbird colonies. *Waterbirds* 23: 312–332.
- OTLEY, H., CLAUSEN, A., CHRISTIE, D. & PÜTZ, K. 2004. Aspects of breeding biology of the Magellanic Penguin in the Falkland Islands. *Waterbirds* 27: 396–405.
- OTLEY, H.M., CLAUSEN, A.P., CHRISTIE, D.J. & PÜTZ, K. 2005. Aspects of the breeding biology of the Gentoo Penguin *Pygoscelis papua* at Volunteer Beach, Falkland Islands, 2001/02. *Marine Ornithology* 32: 167–171.

- PATTERSON, D.L., HOLM, E.J., CARNEY, K.M. & FRASER, W.R. 1998. Effects of tourism on the reproductive success of Adélie Penguins at Palmer Station: preliminary findings. Unpublished report to Polar Oceans Research Group, Montana State University, Montana.
- PFEIFFER, S. & PETER H.U. 2004. Ecological studies toward the management of an Antarctic tourist landing site (Penguin Island, South Shetland Islands). *Polar Record* 40: 1–9.
- PÜTZ, K., INGHAM, R.J., SMITH, J.G. & CROXALL, J.P. 2001. Population trends, breeding success and diet composition of Gentoo *Pygoscelis papua*, Magellanic *Spheniscus magellanicus* and Rockhopper *Eudyptes chrysocome* Penguins in the Falkland Islands. *Polar Biology* 24: 793–807.
- RADL, A. & CULIK, B.M. 1999. Foraging behaviour and reproductive success in Magellanic Penguins (*Spheniscus magellanicus*): a comparative study of two colonies in southern Chile. *Marine Biology* 133: 381–393.
- ROBINSON, S.A. & HINDELL, M.A. 1996. Foraging ecology of Gentoo Penguins *Pygoscelis papua* at Macquarie Island during the period of chick care. *Ibis* 138: 722–731.
- SCOLARO, J.A. & SUBURO, A.M. 1995. Timing and duration of foraging trips in Magellanic Penguins *Spheniscus magellanicus*. *Marine Ornithology* 23: 231–235.
- SEDDON, P.J. SMITH, A., DUNLOP, E. & MATHIEU, R. 2004. Assessing the impact of unregulated nature-based tourism in coastal Otago: pilot study to quantify visitor numbers, attitudes and activities at the Sandyfly Bay Wildlife Refuge, Otago Peninsula, Summer 2002/2003. Unpublished report. Zoology Department, University of Otago.
- SIMEONE, A. & SCHLATTER, R.P. 1998. Threats to a mixed-species colony of *Spheniscus* penguins in southern Chile. *Colonial Waterbirds* 21: 418–421.
- VAN HEEZIK, Y. & SEDDON, P.J. 1990. Effect of human disturbance on beach groups of Jackass Penguins. *South African Journal of Wildlife Research* 20: 89–93.
- WILLIAMS, T.D. & ROTHERY, P. 1990. Factors affecting variation in foraging and activity patterns of Gentoo Penguins (*Pygoscelis papua*) during the breeding season at Bird Island, South Georgia. *Journal of Applied Ecology* 27: 1042–1054.
- WILSON, R.P., CULIK, B.M., DANEFIELD, R. & ADELUNG, D. 1991. People in Antarctica: how much do Adélie Penguins care? *Polar Biology* 11: 363–370.
- WOEHLER, E.J., PENNEY, R.L., CREET, S.M. & BURTON, H.R. 1994. Impacts of human visitors on breeding success and long-term population trends in Adélie Penguins at Casey, Antarctica. *Polar Biology* 14: 269–274.
- WRIGHT, M. 1998. Ecotourism on Otago Peninsula: preliminary studies of Hoihos (*Megadyptes antipodes*) and Hookers Sealion (*Phocarctos hookeri*). *Science for Conservation* 68. Wellington, New Zealand: Department of Conservation.
- YORIO, P. & BOERSMA, P.D. 1992. The effects of human disturbance on Magellanic Penguin *Spheniscus magellanicus* behaviour and breeding success. *Bird Conservation International* 2: 161–173.
- YORIO, P., FRERE, E., GANDINI, P. & SCHIAVINI, A. 2001. Tourism and recreation at seabird breeding sites in Patagonia, Argentina: current concerns and future prospects. *Bird Conservation International* 11: 231–245.
-