THE SUNBIRD

Journal of the
QUEENSLAND ORNITHOLOGICAL SOCIETY
Birds Queensland

Volume 41 Number 2 December 2011

SUNBIRD 41(2) DECEMBER 2011

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THE SUNBIRD

Volume 41 No.2 ISSN 1037-258X December 2011

MONITORING DISTURBANCE OF SHOREBIRDS AND SEABIRDS AT BUCKLEY'S HOLE SANDSPIT IN NORTHERN MORETON BAY

DAVID A. MILTON, DAWN BECK, VICKI CAMPBELL & SANDRA B. HARDING

ABSTRACT

Human disturbance of roosting shorebirds and seabirds was examined daily for a lunar month (March 2009) at a popular recreation beach in Moreton Bay, eastern Australia. The number of birds roosting at the site varied with tide height. On tides > 2 m, up to 580 birds of 36 species used the site. Birds were disturbed over three times more often during weekend high tides (0.80 ± 0.20 vs 0.23 ± 0.05 disturbances.h^{-1} ± s.e.). The most common causes of disturbance were people walking alone or with pets (49.3 ± 0.6 %). Birds took flight in response to close approach by people. Flight initiation distances were low for the most common causes of disturbance (29.7 ± 1.8 m) and similar to those found in studies of other highly disturbed coastal areas. There was no detectable difference in flight initiation distances among bird species. The strength of the bird reaction varied among causes of disturbance and with speed of approach. Birds took flight or left the site on all disturbances by high speed threats such as jet skis, running pets or planes. Flight times following disturbance were mostly short (< 3 min) and appear to be below thresholds when flight costs become a concern. The results suggest that shorebirds and seabirds can adapt to short periods of intense disturbance through becoming conditioned to the activities and having a network of alternate roosts available.

INTRODUCTION

Many populations of migratory shorebirds and seabirds throughout the world are declining (Delany and Scott 2006). They face a range of threats to their populations during staging (Rogers *et al.* 2010) and on the breeding and non-breeding grounds (Chan and Dening 2007, Fujita *et al.* 2009, Zockler *et al.* 2010). These threats vary from extensive habitat loss and degradation of coastal and inland freshwater habitats (Nebel *et al.* 2008) to regular and persistent disturbance at feeding and roosting sites (Burger *et al.* 2004, Kyne 2010). The close proximity of large shorebird and human populations in coastal areas leads to regular conflicts in habitat use and may limit the use of the site by shorebirds and seabirds (Barter 2002, Masero 2003, Rogers *et al.* 2006a, Chan and Dening 2007). This conflict is most obvious in the East Asian-Australasian Flyway (EAAF) that extends from Eastern Russia through eastern and south-eastern Asia to Australia and New Zealand. Almost a quarter of the entire human population live within 50 km of the Yellow Sea coast where the majority of Arctic-breeding shorebirds in the Flyway have their final staging period (Barter 2002).

Almost 90% of the migratory shorebirds in the EAAF spend their non-breeding season in Australia (Bamford *et al.* 2008). One of the most important sites in Australia for migratory shorebirds is Moreton Bay. Moreton Bay supports an estimated 40,000 shorebirds during the non-breeding season (September – April), including internationally-significant numbers of eight species (Bamford *et al.* 2008). It lies east of Brisbane, a city of about 2 M people and in the region in Australia with the fastest-growing human population.

In Moreton Bay, human recreational use of intertidal areas is restricted by mangroves and soft sediments along most of its western margin (Milton unpubl. data). Thus daytime human recreational activity is concentrated in areas where the sediments are firmer and sandier. One area with high recreational use is the firm sandy beach at the southern end of Bribie Island in northern Moreton Bay. This beach, Buckley's Hole sandspit, also supports a large high tide shorebird roost of up to 4,000 shorebirds and terns.

The Queensland Wader Study Group (QWSG) has been monitoring shorebird populations at high tide roosts in Queensland since 1992 (Milton and Driscoll 2007). Counts are undertaken each month on the spring high tide. Shorebirds are concentrated in fewer locations at these tides and this

enables a larger proportion of the population to be counted. During these monthly surveys, actual and potential human disturbance is recorded to account for its influence on the number of birds counted. An analysis of the QWSG data showed that Buckley's Hole sandspit was the most disturbed high tide roost in Moreton Bay (Fuller *et al.* 2009). However, the monitoring of disturbance at roosts on spring tides may not be representative as the birds have fewer roosting choices at these times (Kyne 2010).

In response to concerns by the QWSG counter about the level of disturbance at Buckley's Hole sandspit, we decided to undertake a more intensive study of disturbance across the lunar cycle. The pre-departure period for migratory shorebirds and terns is the period when energy conservation is most important. We undertook the study in March 2009. The aims of this study were to (1) examine the intensity of human disturbance of shorebirds across the lunar tidal range; (2) identify the periods and activities that had the greatest disturbance impact on the shorebird and seabird populations; (3) assess whether disturbances recorded during spring-tide monitoring were representative of overall disturbance; (4) assess whether this level of disturbance was reducing the attractiveness of the roost for birds and (5) make recommendations to mitigate or reduce impacts of disturbance on the roosting birds.

METHODS

Two observers made daily records of the numbers of each shorebird and tern species and human activity at Buckley's Hole sandspit (27.095° S, 153.1622° E) during March 2009. Bird and human activity was monitored during a four-hour period, two hours either side of daytime high tides. Anecdotal observations indicated that disturbance was negligible during the night. Counts of all shorebirds, terns, other waterbirds and raptors on the sandspit were made each day within 30 min of high tide. These counts were treated as the maximum count for that tidal cycle, and equivalent to the regular monitoring surveys (Milton and Driscoll 2007). Observations were made with telescopes (20 – 60x magnification) from cover among vegetation on the public road verge adjacent to the sandspit (50 m away). All human activities on the sandspit or in the adjacent waters (<100 m) were recorded during the four hour period. Disturbances were identified as those activities that caused a change in the behaviour of the birds present (Burger 1986). Human activities that failed to elicit a response from the birds were also recorded. The responses of the closest individuals of each species of shorebird and

seabird to the cause of disturbance were recorded. If all individuals of a species failed to respond in a similar manner, these details were also noted. Estimates of the distance at which birds changed their behaviour to people were recorded for all stimuli. These distances were calibrated daily against the distances between known features of the environment.

Disturbances (stimuli) were grouped into five categories based on the behavioural reactions of the birds. The categories were scored on a 1 – 5 scale, with 5 being the most severe response. Flying off and leaving the site was scored as a 5. The other categories were: 1 – Looked alert with increased vigilance; 2 – walked away; 3 – Flew low for a short distance (< 50 m) within the site; 4 – Undertook extended high flight (> 50 m) before resettling at the site. Approach speed of each stimulus was scored on an ordinal scale with walking or similar speed approach scored 1, jogging or moderate speed scored 2 and running by people or unrestrained dogs, fast-moving boats, planes or jet skis scored a 3. Bird reaction among different types of stimuli and intensity were compared with t-tests with Bonferroni adjustment for multiple comparisons. The number of stimuli each day were compared to tide height by a Kendall's rank correlation test.

For the most abundant species, the flight initiation distance was examined with a three-way ANOVA with species, the source of disturbance and approach speed as main effects. Skewness was examined by comparing the third moment with the square-root of the sample size (Sokal and Rohlf 1981). We examined heteroscedasticity with Bartlett's test of homogeneity of variance. Data for each species were appropriately transformed when they failed to meet parametric assumptions.

Waterbird numbers (including shorebirds and seabirds) and disturbance have been monitored at Buckley's Hole sandspit since it formed and began being used as a high tide roost in mid-2005. The numbers of roosting birds were counted each month on the daytime high tide of the Saturday closest to the spring high tide. Disturbance events that occurred during the count were recorded during each survey. The seasonal and interannual trends in the proportion of count disturbed were compared with tests of proportions after adjusting for differences in duration among counts (Walpole 1974). The relationship between tide height and number of disturbances was compared with a Spearman's rank correlation (Sokal and Rohlf 1981).

Volunteers from the QWSG have been recording the number of disturbances that cause birds to fly during high tide roost counts made throughout Moreton Bay since 1992 (Milton and Driscoll 2007). We examined these data to assess the regional significance of disturbance at Buckley's Hole sandspit with a test of proportions (Walpole 1974).

RESULTS

Usage patterns

A total of 150 counts were made of shorebirds, seabirds and raptors at Buckley's Hole sandspit between September 2005 and October 2010. Of these counts, birds flew after being disturbed by people on 43 (27.2%) of surveys. This made Buckley's Hole sandspit the most disturbed roost in Moreton Bay (Figure 1). The proportion of spring tide counts with disturbance was significantly higher at Buckley's Hole sandspit than all other high tide roosts monitored, except the two next most disturbed roosts, Dunwich and Nudgee Beach (Figure 1; $P<0.05$). Despite this disturbance, up to 4014 shorebirds and seabirds of 55 species were counted during monitoring surveys (Table 1). The number of species per survey varied between one and 29. Bar-tailed Godwit and Red-necked Stint were the most abundant species at the site. Shorebirds and seabirds were present in similar proportions to those found during previous monitoring surveys. The highest total count in the present study was 573 birds and this was similar to the recent counts made during monitoring surveys.

The percentage of monthly high tide monitoring surveys at Buckley's Hole sandspit when birds were disturbed increased between 2005 and 2010 and was highest in 2009 (Figure 2a). Other Moreton Bay roosts showed a similar trend in disturbance. Disturbance was also highest during spring (August – October) and mid-summer (January – February) at both Buckley's Hole sandspit and elsewhere in Moreton Bay (Figure 2b). It was lower at Buckley's Hole sandspit during spring tides in autumn (including March) compared with the overall disturbance seen during this study (33%), but these differences were not significant ($P>0.2$).

Shorebirds and seabirds used the Buckley's Hole sandspit on most days during the study, but the numbers varied with tide height. Up to 100 seabirds, mostly terns and Silver Gull roosted at the site at high tide each day. In contrast, shorebirds were mostly absent on high tides less than 2 m. On tides greater than 2 m, the numbers of birds counted increased substantially (Figure 3).

Table 1. The overall pattern of counts at Buckley's Hole sandspit by waterbirds and raptors during surveys made during this study (n = 33) and on spring high tides since monthly monitoring began in 2005 (n = 150).

Common name	Scientific name	Study		Long-term	
		mean ± se	n	mean ± se	n
Australian Wood Duck	*Chenonetta jubata*	–		2.8 ± 0.5	4
Pacific Black Duck	*Anas superciliosa*	5.0 ± -	1	3.0 ± 2.0	2
Australasian Darter	*Anhinga novahollandiae*	–		1.0 ± -	1
Little Pied Cormorant	*Microcarbo melanoleucos*	2.7 ± 2.1	3	2.6 ± 0.5	48
Little Black Cormorant	*Phalacrocorax sulcirostris*	–		1.9 ± 0.5	16
Pied Cormorant	*Phalacrocorax varius*	2.0 ± 1.4	2	3.1 ± 0.6	40
Australian Pelican	*Pelecanus conspicillatus*	1.0 ± -	2	3.4 ± 0.5	45
Eastern Great Egret	*Ardea modestus*	–		1.0 ± -	11
Intermediate Egret	*Ardea intermedia*	3.0 ± -	1	2.0 ± 1.0	2
Striated Heron	*Butorides striata*	1.0 ± -	1	1.0 ± -	2
White-faced Heron	*Egretta novaehollandiae*	1.7 ± 0.5	7	1.4 ± 0.1	32
Little Egret	*Egretta garzetta*	–		1.6 ± 0.4	5
Australian White Ibis	*Threskiornis molucca*	3.2 ± 1.6	5	3.1 ± 0.4	45
Straw-necked Ibis	*Threskiornis spinicollis*	–		2.0 ± 1.0	2
Eastern Osprey	*Pandion cristatus*	1.3 ± 0.5	4	1.3 ± 0.1	29
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1.0 ± -	2	1.1 ± 0.1	11
Whistling Kite	*Haliastur sphenurus*	1.0 ± -	5	1.2 ± 0.1	54
Brahminy Kite	*Haliastur indus*	1.0 ± -	1	1.2 ± 0.1	28
Swamp Harrier	*Circus approximans*	–		1.3 ± 0.3	3
Beach Thick-knee	*Esacus gigantea*	–		1.2 ± 0.2	5
Australian Pied Oystercatcher	*Haematopus longirostris*	2.0 ± 1.4	2	10.4 ± 1.6	70
Sooty Oystercatcher	*Haematopus fuliginosus*	1.0 ± -	2	1.0 ± -	5
Black-winged Stilt	*Himantopus himantopus*	9.6 ± 7.7	15	12.1 ± 2.2	46
Grey Plover	*Pluvialis squatarola*	–		1.0 ± -	1
Red-capped Plover	*Charadrius ruficapillus*	8.7± 8.2	20	5.3 ± 0.7	65
Double-banded Plover	*Charadrius bicinctus*	–		2.0 ± 0.6	3
Lesser Sand Plover	*Charadrius mongolus*	27.2 ± 15.4	6	44.2 ± 8.3	32
Greater Sand Plover	*Charadrius leschenaultii*	34.5 ± 35.2	11	47.2 ± 6.0	62
Black-fronted Dotterel	*Elseyornis melanops*	–		1.0 ± -	2
Masked Lapwing	*Vanellus miles*	2.8 ± 1.5	4	2.6 ± 0.3	18
Black-tailed Godwit	*Limosa limosa*	2.0 ± -	1	6.2 ± 2.24	16
Bar-tailed Godwit	*Limosa lapponica*	118 ± 67.7	20	207 ± 15.4	103
Whimbrel	*Numenius phaeopus*	2.4 ± 1.9	9	2.0 ± 0.3	29
Eastern Curlew	*Numenius madagascariensis*	2.0 ± 1.0	3	1.3 ± 0.1	21
Terek Sandpiper	*Xenus cinereus*	–		1.7 ± 0.3	3
Grey-tailed Tattler	*Tringa brevipes*	–		15.3 ± 13.8	3
Ruddy Turnstone	*Arenaria interpres*	1.0 ± -	1	2.3 ± 0.7	10
Asian Dowitcher	*Limnodromus semipalmatus*	–		1.0 ± -	1

Common name	Scientific name	Study mean ± se	n	Long-term mean ± se	n
Great Knot	*Calidris tenuirostris*	27.2 ± 17.2	13	60.9 ± 6.5	76
Red Knot	*Calidris canutus*	–		8.1 ± 1.8	17
Sanderling	*Calidris alba*	–		1.5 ± 0.5	4
Red-necked Stint	*Calidris ruficollis*	29.8 ± 15.0	16	106 ± 17.5	72
Sharp-tailed Sandpiper	*Calidris acuminata*	13.0 ± 4.2	2	11.7 ± 2.1	12
Curlew Sandpiper	*Calidris ferruginea*	6.4 ± 9.1	9	45.9 ± 8.3	59
Broad-billed Sandpiper	*Limicola falcinellus*	–		2.0 ± -	1
Little Tern	*Sternula albifrons*	43.9 ± 37.1	15	67.5 ± 9.1	68
Gull-billed Tern	*Gelochelidon nilotica*	15.2 ± 13.3	10	11.1 ± 1.5	55
Caspian Tern	*Hydroprogne caspia*	7.7 ± 5.1	26	8.4 ± 0.6	126
White-fronted Tern	*Sterna striata*	–		1.3 ± 0.3	3
Black-naped Tern	*Sterna sumatrana*	–		1.0 ± -	1
Common Tern	*Sterna hirundo*	28.9 ± 43.7	9	24.4 ± 6.1	43
Lesser Crested Tern	*Thalasseus bengalensis*	3.0 ± -	1	4.4 ± 1.7	13
Crested Tern	*Thalasseus bergii*	23.7 ± 16.1	21	57.5 ± 5.1	132
Silver Gull	*Chroicocephalus novaehollandiae*	12.2 ± 8.2	27	21.5 ± 1.7	138

Response to disturbance

There were 73 disturbances of roosting birds at Buckley's Hole sandspit during the daily monitoring in March 2009. There were a further 55 potential disturbance events that did not cause detectable reaction from the roosting birds. The strength of the most common reaction of the birds varied among sources of disturbance (Table 2). Birds reacted by flying or leaving the site for all disturbances by jet skis. However, the number of jet ski disturbances were low compared to people walking alone or with their dogs, or raptors. People with pets, along with raptors had the greatest overall impact on bird behaviour during the study when the intensity of reaction and frequency were taken into account (Table 2).

Disturbances occurred throughout the day and there appeared to be no period when they were reduced (Figure 4a). There was a peak at mid-day, but this was not statistically significant ($P>0.3$). The timing of disturbances varied throughout the month with a mean of 3.5 times as many disturbances on each weekend high tide compared with week days (0.80 ± 0.20 vs 0.23 ± 0.05 disturbances.$h^{-1} \pm$ s.e.; Figure 4b). Even during the week, the birds were disturbed at least once per high tide cycle. Tide heights were similar on weekends and during the week (2.03 ± 0.07 vs 1.95 ± 0.08). There was no relationship between tide height and the number of disturbances ($r_s = 0.1$; $P>0.5$).

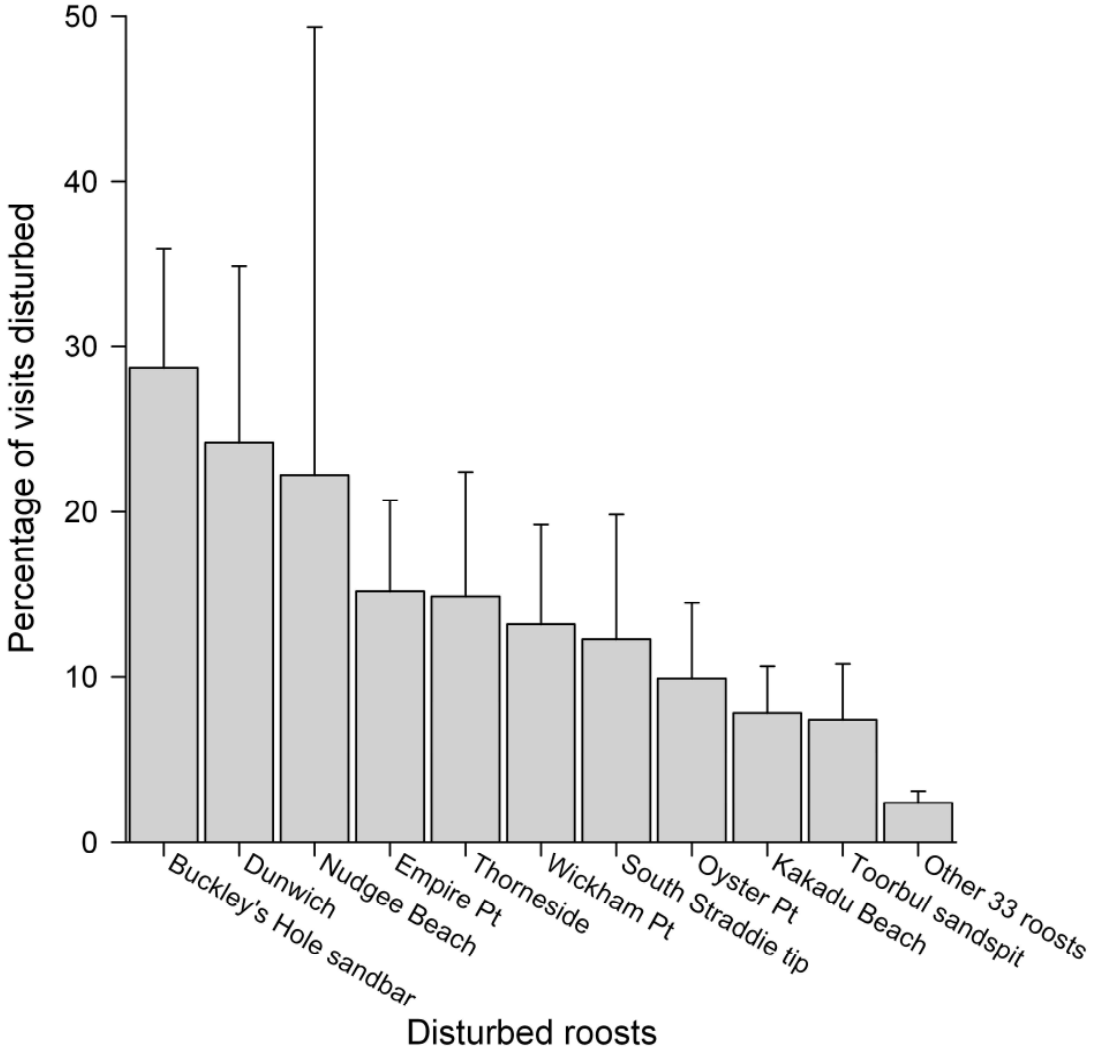

Figure 1. The mean percentage of monthly monitoring survey visits to high tide roosts in Moreton Bay on spring high tides that were disturbed (± 95% confidence limit). Sample sizes for all sites were > 100.

Species-specific responses

We focussed our species-specific analysis on the disturbance events that caused the birds to fly around for extended periods or leave the site completely. There were sufficient data for 10 species of shorebirds, five species of terns and the Silver Gull to assess the species-specific responses to disturbance (N > 12). Approach distance varied most among the sources of disturbance ($F_{4, 416}$ = 92.7; P<0.001), followed by approach speed ($F_{2, 416}$ = 8.1; P< 0.001). There were no significant differences among species ($F_{15, 416}$ = 0.7; P>0.79) nor were interactions between species and approach speed or sources of disturbance significant (all P> 0.3). Planes and boats caused birds to take flight at significantly greater distances than other sources of disturbance (both P<0.001; Figure 5). There were no significant differences

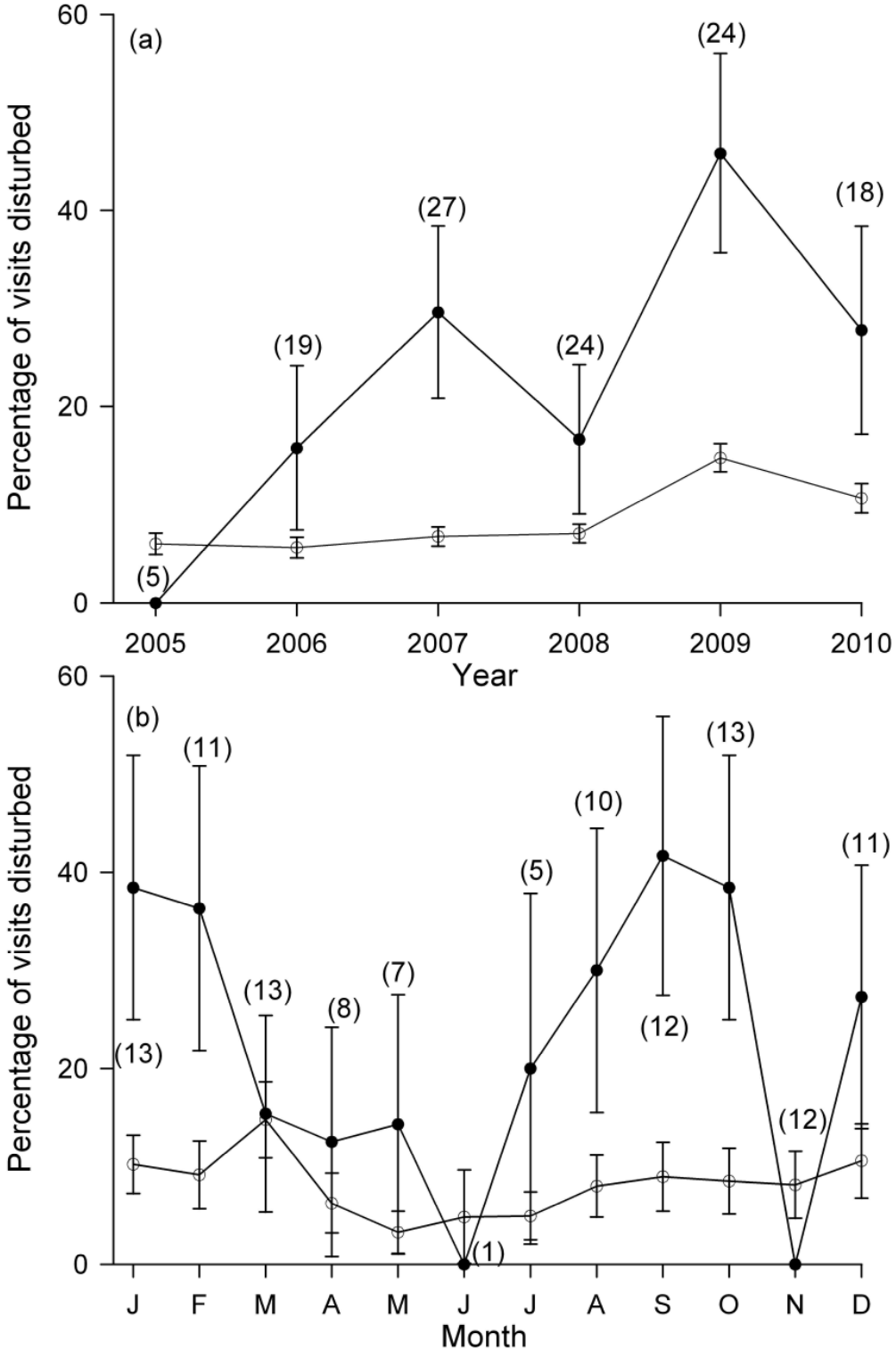

Figure 2. The mean percentage (± 95% confidence limit) of monthly monitoring survey visits to Buckley's Hole sandspit (closed symbols) and other Moreton Bay (open symbols) high tide roosts on spring high tides that were disturbed (a) each year and (b) each month from 2005 to 2010. Sample sizes for Buckley's Hole sandspit are given in parentheses. Sample sizes for the Moreton Bay sites are all > 100.

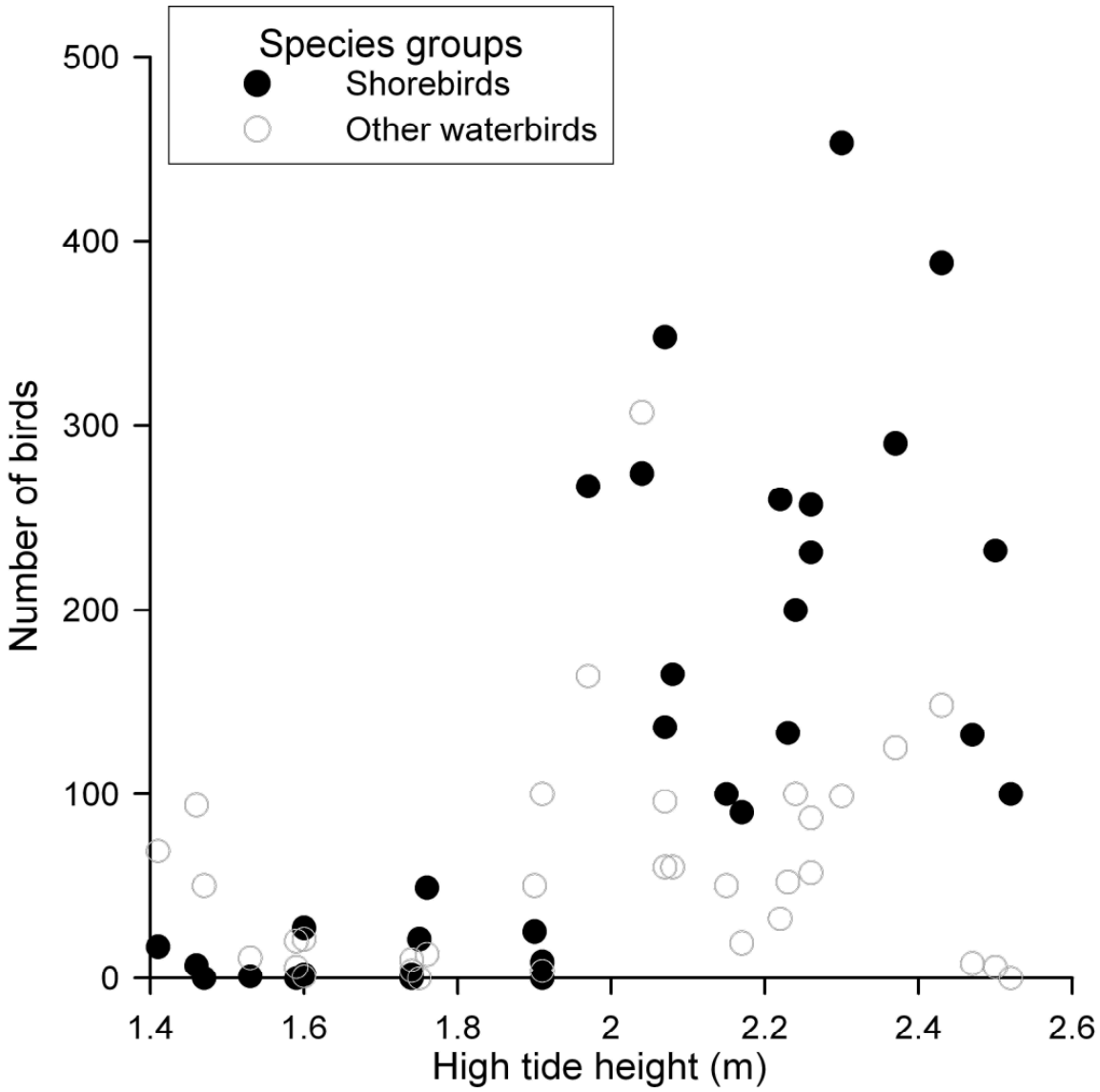

Figure 3. The number of shorebirds and other waterbirds counted at Buckley's Hole sandspit in relation to high tide height during March 2009.

between flight initiation distances for raptors, people or dogs (all $P>0.5$). All species took flight at greater distances as the speed of approach increased (all $P<0.001$; Figure 5). Birds allowed walking or slow-moving approaches to within a mean distance of 22.9 ± 1.3 m before they took flight, whereas a fast-moving source of disturbance caused flight at a mean distance of 73.2 ± 7.1 m from the birds.

Table 2. The percentage of disturbance events that caused an identifiable behavioural response in shorebirds and seabirds at Buckley's Hole sandspit during high tides. The percentages reflect the most common response by the species present.

Disturbance	Response					
	No reaction	Looked alert	Walked away	Flew short distance	Flew in circles	Flew away
Walker n = 78	75	0	3	18	1	3
Pet n = 25	32	0	4	20	16	28
Fisher n = 39	86	1	5	5	0	3
Boat/Canoe n = 26	80	0	4	12	0	4
Jet ski n = 18	72	0	0	0	11	17
Plane n = 5	60	0	0	0	20	20
Raptor n = 27	29	0	4	11	52	4
TOTAL	**146**	**1**	**7**	**27**	**22**	**16**

There were no differences among species, sources of disturbance or approach speed in the time birds took to return to the site after a disturbance caused flight (all $P<0.3$). The mean time that birds returned to roost was approximately 3 – 4 min, if they remained at the site. The mean tide height at which birds left the site following disturbance was lower (1.86 ± 0.04 m) than when disturbance caused birds to undertake prolonged local flights (1.99 ± 0.02 m) ($P< 0.05$). However, the range of tide heights when the birds left the site varied widely from 1.41 to 2.24 m.

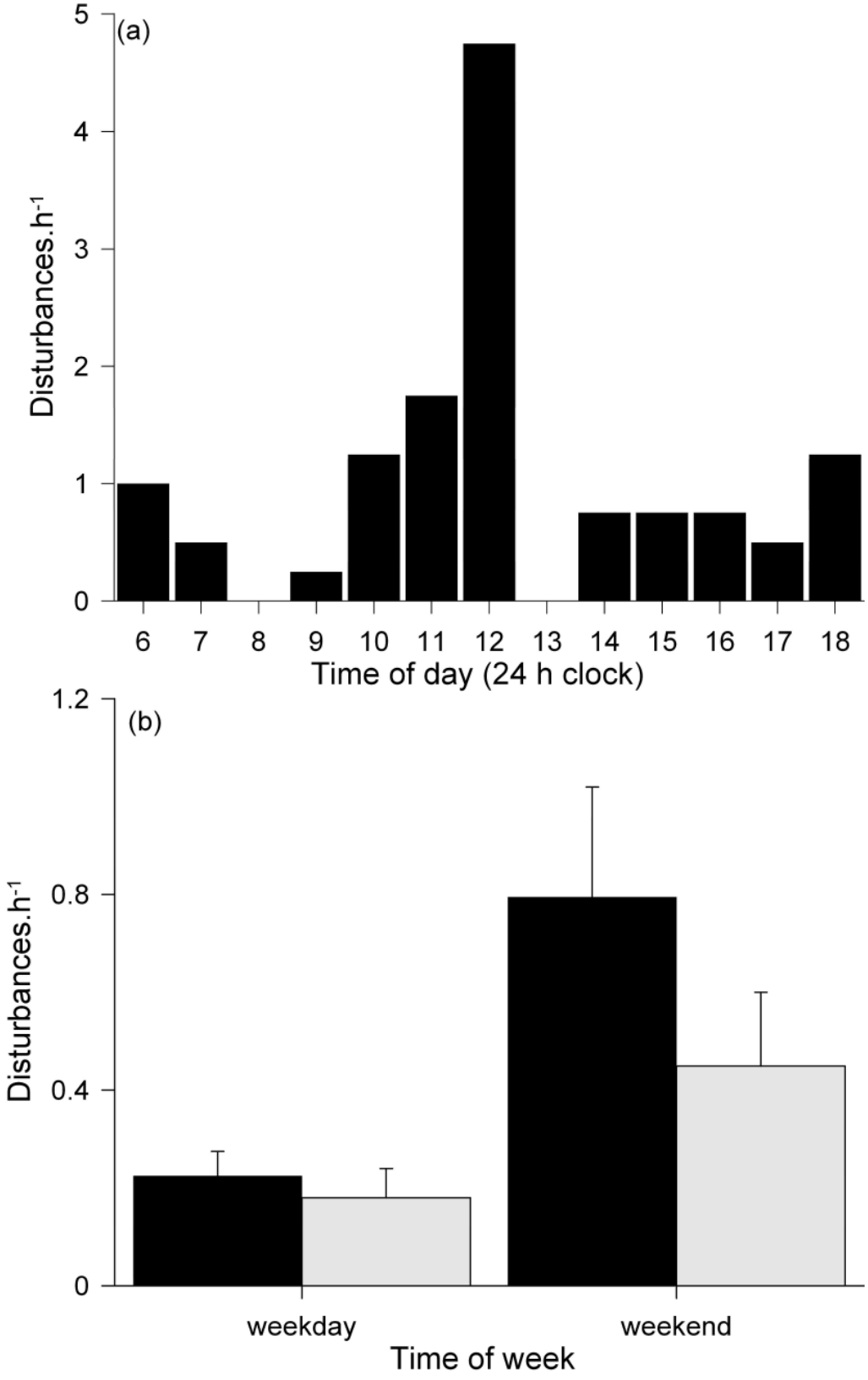

Figure 4. Frequency of (a) disturbance throughout the day and (b) mean week-day and weekend (± se) disturbance that caused either any detectable behavioural reaction (black) or flight (shaded).

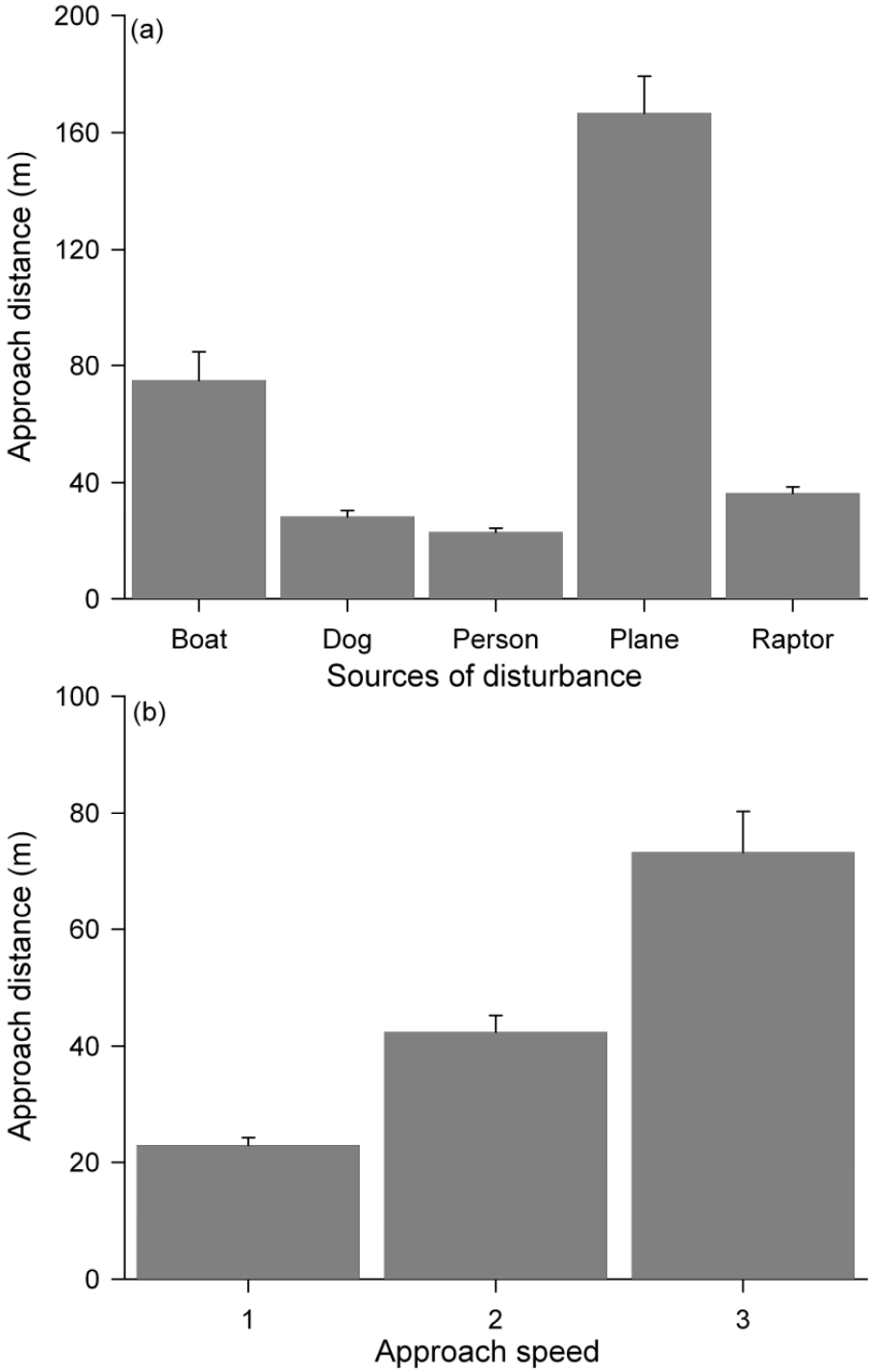

Figure 5. The mean (± se) flight reaction distance (in m) of shorebirds and seabirds to (a) different sources of threat and (b) threats at different approach speeds (1 = slow; 2 = moderate; 3 = fast; see text for definitions).

DISCUSSION

Lunar and tidal effects on disturbance

Disturbance at Buckley's Hole sandspit varied throughout the lunar cycle with tide height. Disturbance was on average over three times higher on weekends than during the week. On weekends, the birds had fewer alternate roosts to choose from within close proximity of their feeding grounds (Zharikov and Milton 2009) due to increased human activity in the region. Buckley's Hole sandspit was heavily used by birds on tides > 2 m and thus is a "core" roost (Colwell *et al.* 2003*)* in this part of Moreton Bay. There is little feeding habitat adjacent to Buckley's Hole sandspit and most shorebirds fly in from mainland feeding sites about 2 km away (Milton pers. obs.). The nearest alternate spring tide roosts – Kakadu Beach and Toorbul – were also disturbed more frequently than most other roosts in Moreton Bay. However, they are also between 5 and 7 km north of Buckley's Hole sandspit. Thus, leaving Buckley's Hole sandspit for an alternate roost would be energetically expensive (Rogers *et al.* 2006b, Stillman *et al.* 2007). If shorebirds that use Buckley's Hole sandspit had to regularly commute longer distances to alternate roosts, their energy use could be sufficient to reduce body condition and increase mortality (Durell *et al.* 2005).

Shorebird and seabird response to disturbance

Most studies of the effects of disturbance have focussed on feeding or nesting shorebirds and seabirds (Fitzpatrick and Bouchez 1998, Nisbet 2000, Gill *et al.* 2001, Goss-Custard *et al.* 2006, Weston and Elgar 2007, Yasue *et al.* 2008). In roosting shorebirds and seabirds, the choice of available suitable habitat is much more limited (Rogers *et al.* 2006a). Thus, the energetic costs of flight for birds roosting at high tide are probably much greater than during low-tide. Rogers *et al.* (2006a) found that Great and Red Knot tended to choose roosts that were close to feeding areas and recent experience had shown to have low risk of predation or disturbance. Zharikov and Milton (2009) also found that the distance to feeding areas was an important criterion in roost selection by shorebirds.

In this study, we found no differences among species of shorebird or seabird in their flight initiation distance to a potential disturbance threat. All species perceived faster approaching potential threats as more threatening. The different flight initiation distances recorded among sources of disturbance appear to be confounded by approach speed. The larger reaction distance found for aircraft and boats reflected their consistently greater approach

speed. We did not detect a difference in bird reaction to pets or people walking alone. This contrasts with the results of a previous study in Moreton Bay (Kyne 2010) that found people with pets were the major sources of disturbance to roosting shorebirds. However, the approach speed of the potential disturbance was not recorded in that study. Our observations suggest that unleashed pet dogs mostly run on beaches and thus approach birds at higher speed than if the animal was leashed. Thus, the birds may be reacting to the speed of approach rather than the source of the threat.

Predicting the population consequences of disturbance to birds is complex and must account for the trade-off between the risk of predation by the disturber and the energetic cost of flight. At Buckley's Hole sandspit, the energetic costs of flight to alternate roosts is high, especially on tides > 2 m, when closer roosts are unavailable. Birds were more likely to leave the site on lower tides when they knew of alternate roosts nearby (Gill *et al.* 2001). Other studies have found that 1 – 2 flights.h^{-1} (Goss-Custard *et al.* 2006) or more than 10 min.h^{-1} flight (Rogers *et al.* 2006a) are likely to lead to an energy deficit in shorebirds. The median number of flights.h^{-1} during our study was about 0.7, with a total time in flight of < 5 min. This suggests that under most environmental conditions, net energy intake should exceed flight costs from disturbance (Rogers *et al.* 2006a, Goss-Custard *et al.* 2006). This conclusion is supported by the fact that shorebirds continue to use Buckley's Hole sandspit despite increasing disturbance rates.

The behavioural response by shorebirds to disturbance at high tide roosts varies in relation to the trade-off between the magnitude of a perceived predation risk (Frid and Dill 2002) and the energetic costs of a flight response (Ydenberg and Dill 1986, Stillman and Goss-Custard 2002, Rogers *et al.* 2006a). Our flight initiation distances when birds took flight were similar to those found in other high use recreational areas (Fitzpatrick and Bouchez 1998, Blumstein *et al.* 2003). This suggests that conditioning to human approaches may have increased the tolerance of birds (Fitzpatrick and Bouchez 1998, Nisbett 2000, St Clair *et al.* 2010) as approach distances in shorebirds remote from urban areas are much higher (Paton *et al.* 2000, Lord *et al.* 2001). By the end of the non-breeding season when this study was undertaken (March), the shorebirds and terns may be more tolerant of humans as migratory species try to minimise their energy expenditure in preparation for departure (Stillman and Goss-Custard 2002, Yasue 2006).

Regional context

Buckley's Hole sandspit is the most disturbed of the existing shorebird high tide roosts in Moreton Bay, with birds being disturbed at about one in three spring tide visits. This level of disturbance was substantially higher than that recorded at the majority of spring tide roosts regularly monitored in Moreton Bay. At most roosts, birds were put to flight on average only once in 12 visits on spring tides. The data from Buckley's Hole sandspit suggests that there is an increasing trend in the frequency of disturbance and that it may be higher in early spring (September – October) when the birds have recently returned from breeding grounds. However, the data from other roosts suggest that the overall level of disturbance in Moreton Bay is similar throughout the non-breeding season.

While the levels of disturbance at Buckley's Hole sandspit are high in a regional context, they are lower than reported in other studies of roosts and feeding areas near urban areas elsewhere (Pfister *et al.* 1992, Burton *et al.* 1996, Burger *et al.* 2004, Rogers *et al.* 2006a). For example, Burger *et al.* (2004) reported shorebirds were regularly disturbed for > 40 $min.h^{-1}$ each tidal cycle in Delaware Bay, northeastern United States. In the United Kingdom, disturbance at different sites was so high as to cause shorebirds to abandon their preferred roosts (Pfister *et al.* 1992, Burton *et al.* 1996). In each study, the disturbance was sufficient to cause the majority of birds to leave the site. This has not been the case at Buckley's Hole sandspit, with birds mostly relocating within the same area or flying around and returning within five minutes.

Taken together, these results suggest that management of disturbance at high tide roosts such as Buckley's Hole sandspit needs to focus on reducing the speed of approach by people, pets and vessels. The public education to move slowly and to leash dogs when approaching a high tide roost has proved successful elsewhere (van Polanen Petel and Bunce 2008). This is unlikely to be effective for jet skis without some restrictions on access to the nearby waters. However, at Buckley's Hole sandspit, the birds currently tolerate short periods of intense disturbance during spring tides. The short approach distances and the short flight times when disturbed suggest that birds are conditioned to this disturbance. This may also contribute by reducing energy use when suitable alternate roosts are energetically expensive to reach. The trend in increasing disturbance rates on weekends (Figure 2) suggests that compliance action by local government to manage disturbance will be needed in the near future.

ACKNOWLEDGMENTS

We thank the following volunteers who undertook disturbance monitoring at Buckley's Hole sandspit: Chris Bell, Frank Bigg, Leanne Bowden, James Butler, Lyn Cole, Ken Cowell, Peter and Jean Crow, Alex Ferguson, Lesley Games, Greg Miller, Dawn Muir, Bernice Starkey, Floss Wainright, Dez Wells and Ivell and Jim Whyte. We thank Yuri Zharikov and Danny Rogers for constructive comments on an earlier draft of the manuscript.

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THE SUNBIRD SUPPLIES AN EXCELLENT SERVICE IN THE ORNITHOLOGICAL LITERATURE

DAVID ROUNSEVELL & MERRIAN KUERSCHNER

ABSTRACT

The Sunbird is an Australian journal of ornithology published annually by Birds Queensland since March 1970. Its 3537 pages of original text currently span 138 issues over 42 years. The 39 volumes covering 1970 to 2010 contain significant scientific, social and historical articles written by 566 authors about birds and people in Queensland. This is the first summary of its detailed history and current status available to Birds Queensland members and others.

The journal is widely read, subscriber-funded and produced by volunteers. Articles are refereed independently to be accepted for publication. From December 2008 [Volume 38(2)] onwards it has been published digitally in the Informit e-Library (www.informit.com.au) and earlier issues will be available online soon. In future many more people will be able to search the entire journal. It is a legacy and a resource for Birds Queensland members and others, past, present and future which we trust will endure, given continuing submission of manuscripts. This editorial, which takes its title from one *Sunbird* author's comment in 2011, tracks *The Sunbird*'s path through various editorial policies and production milestones.

INTRODUCTION

Details of publication history of *The Sunbird* are collated here as a resource for Birds Queensland members and as a reference for authors and others who use the journal. Its 42 year history of publication is covered to permit some reflections during a current change in editorship. Historical details and publication policies of Editors and Assistant Editors are tabulated in Table 1. These sketch the paths of volunteers who have worked to produce the journal and will provide a road map for those interested in archiving collections of original copies of *The Sunbird*.

A far-sighted editorial in the inaugural March 1970 issue of *The Sunbird* recorded the scope and aspirations of founding members of Queensland

Ornithological Society (now incorporated and operating as Birds Queensland).

"With this, the first issue of The Sunbird*, a new era in Queensland ornithology has begun. The first issue of any new journal always elicits interest, but in the case of* The Sunbird *a certain historical note has been struck as this is the first journal devoted entirely to ornithology ever to be produced in Queensland.*

*Over recent years the interest in birds both at an amateur and professional level, has increased greatly in Queensland. This is most heartening, and no doubt due, in part, to the overall interest of people in the natural environment and what makes it tick. The Queensland Ornithological Society, although recently formed, has already begun to make an effort to find out what ticks with birds in Queensland, and through the pages of future "*Sunbirds*" and other means, will be spreading this knowledge as widely as possible.*

Any journal is only as good as the material it contains, and perusal of the pages of this first issue of The Sunbird *will show the broad spectrum that we hope to keep covering. In future issues, reviews, abstracts, and illustrative material will all find a place. Articles and notes on all aspects of bird study and/or conservation in Queensland will be required for future issues of the journal, and with four issues each year we will be able to publish a large amount of material. Let us have a contribution for the next issue, and also, let us hear your criticisms and comments."*

Table 1. *The Sunbird* publication history, 1970-2011.

Editors Assistant Editors	Year	Volumes. Issues(pages*)	Printing cost (postage) $**	Comments
Dane Panetta Denise Elias	2011-12	**41**.2(43)		Price $50 with BQ membership. Institution $36.30 Overseas $ 33.00
David Rounsevell Merrian Kuerschner	2010-11	**40**.2(72)	2069 (785)	Index to Vols. 1-39 (Peter Crow)
Christine McGrath	2009-10	**39**.2(62)	2053 (666)	Colour photographs standard
Dawn Muir	2008-9	**38**.2(30)	-	First online access 38(2)
	2007-8	**37**.2(104)	-	
	2006-7	**36**.2(100)	-	
	2005-6	**35**.2(45)	-	Second colour photograph
	2004-5	**34**.2(79)	3380	
	2003-4	**33**.3(120)	3838	ISSN registration Aug. 2003
	2002-3	**32**.3(68)	-	
(J D MacDonald memorial issue)	2001-2	**31**.3(112)	-	

Editors Assistant Editors	Year	Volumes. Issues(pages*)	Printing cost (postage) $**	Comments
Peter Britton	2000-1	**30**.3(92)	-	
Don Muir, Phillip Major,	1999-0	**29**.3(72)	-	First colour photograph
Ian Gynther,	1998-9	**28**.3(56)	3367	
Jeremy Thompson,	1997-8	**27**.4(108)	5114	
Regina Migala,	1996-7	**26**.4(120)	3620	
Merrian Kuerschner	1995-6	**25**.4(96)	3778	
	1994-5	**24**.4(96)	1859	All text digital by computer
	1993-4	**23**.4(116)	3624	Final text typed (costing $2745)
	1992-3	**22**.4(112)	3096	
	1991-2	**21**.4(116)	1240	Recycled materials first used
	1990-1	**20**.3(88)	1860	Floppy discs first used
	1989-0	**19**.1(24)	1092	
Neil McKilligan	1988-9	**18**.4(106)	1478	
Anita Smyth	1987-8	**17**.4(108)	2436	
Dawn & Don Muir	1986-7	**16**.4(88)	1563	
	1985-6	**15**.4(88)	1443	
Greg Roberts	1984-5	**14**.4(84)	1679	A5 format
	1983-4	**13**.4(84)	886	
Chris Corben	1982-3	**12**.4(48)	393	
Kees Hulsman	1980-1982	**11**.4(76)	360	Volumes synchronised with years
John Pearson, Peter Woodall				
John Pearson	1979-0	**10**.4(80)	-	
L. & R. Hall	1978-9	**9**.4(60)	888	
Les Hall	1977-8	**8**.4(98)	1050	
Gordon Beruldsen, Kees Hulsman				
Graham Leach	1976-7	**7**.4(112)	886	Price 75 cents
Kees Hulsman,	1975-6	**6**.4(100)	883	Instructions to authors formalised
Ali Lloyd				
David Gravatt	1974-5	**5**.4(100)	-	First photographs (B+W)
Carole (Bevege) Bristow	1973-4	**4**.4(89)	Off-set printing	Cover design by Naoko Kikkawa.
	1972-3	**3**.4(96)	-	*'Sunbird* only' subscriptions begin.
	1971-2	**2**.4(86)	-	Price 50 cents
	1970-1	**1**.4(103)	-	Quarto sheets copied on Gestetner
		41.138(3537)		

*The number of pages per Volume does not include contents and index pages.
**Costs tabled at the Birds Queensland AGM. Other amounts from BQ Newsletters, meeting minutes, or receipts.

DESCRIPTION

Policy

Queensland Ornithological Society Inc. objectives are to promote the scientific study and conservation of birds by all means possible, with particular reference to the birds of Queensland. The editorial scope of *The Sunbird* encompasses all aspects of ornithology and the conservation of birds in Queensland and adjacent northern regions of Australia, including Papua New Guinea. Articles not originating from Queensland but containing information of relevance to Queensland birds can be submitted.

Publisher

The publisher is Birds Queensland of PO Box 3784, South Brisbane BC, Qld 4101 (www.birdsqueensland.org.au), which is the author's copyright holder. Birds Queensland is the business name of Queensland Ornithological Society Inc. The journal is published electronically in the Informit e-Library (www.informit.com.au). Online publication is by RMIT Publishing (www.rmitpublishing.com.au) by agreement with Birds Queensland (full content provider) since December 2008.

Registration

In August 2003 *The Sunbird* was registered as a serial publication (ISSN 1037-258X) with the Australian ISSN Agency in the National Library of Australia, Canberra. *The Sunbird* is the registered journal name shown on the cover and on the leading page of the text (above the ISSN number) within each issue. However, the article can be dropped viz. *Sunbird* and the name shortened, for brevity, including in text. In 2010 *The Sunbird* was listed by the Australian Research Council in a list of journals in the field of Zoology (0608).

Format

The cover illustration of an Olive-backed Sunbird (the Birds Queensland logo) was designed by artist Naoko Kikkawa. It was created in 1973 when the journal was first printed commercially. Current volumes of *The Sunbird* are produced yearly as two issues (June-July and December) and posted to subscribers.

A Volume Index of bird species and authors' names is included with the last issue of each year. Since December 2008, from and including Volume 38(2), all issues are also published online at *Informit.com*. It is planned to add the earlier volumes by 2013.

Indices
An index is published in two parts as a combined supplement for each *Sunbird* Volume. The parts comprise alphabetically arranged lists of the names of authors and of bird (English) names. In 2010 Peter Crow prepared two additional supplements to Volumes 1-39 (1970-2009) of *The Sunbird*. The *Sunbird Index* of named birds and an *Author Index* are cumulative indices based on volume indices and are currently available online at the Birds Queensland website to assist researchers.

Subscribers
Since October 1972 an annual subscription to *The Sunbird* has enabled non-members and institutions to subscribe without the requirement to join the Society. The Birds Queensland library grows whenever sister ornithological societies choose to exchange issues of their journals for issues of *The Sunbird* as an alternative to regular subscriptions. By the end of 1995 there were 35 *Sunbird* only subscribers.

In 2011 single issues of *The Sunbird* cost $6.60 each to non-members. Institutional subscriptions are $36.30 and overseas subscriptions cost AUD$33.00. Current institutional subscribers are libraries of museums, universities and research organisations, approximately half of which are in Australia, with the balance in the United Kingdom, the United States of America and the Federal Republic of Germany.

Authors
Publication of articles is free of charge and authors hold copyright to their articles. Authors receive one free copy of an issue containing their article (or a digital PDF). Extra reprints requested are charged at cost. Simple notes to guide intending authors are provided at the inside back cover of printed and online issues and on the Birds Queensland website. Photographs in articles, in black and white or colour, are encouraged as part of the lasting record they create.

Names of 566 individual authors appear in Vols 1-39, some more often than others. People writing about birds have sustained *The Sunbird* now for over 40 years.

Referees

All submitted articles are independently refereed. Referees review articles by checking and authenticating their content, providing constructive criticism and recommending publication or otherwise. Referee assistance and comments are voluntary and sought by the Editor. Where possible, referees are acknowledged personally and thanked for this service. They make significant and important contributions to peer review of *Sunbird* articles, whether as experts or generalists.

Birds Queensland

The Queensland Ornithological Society Inc. (or Birds Queensland) Newsletters have recorded the occasional comments of members and small details about *The Sunbird* for posterity. During the early years the September *Sunbird* issue always contained the Annual Bird Report by members of the Society. This was a very popular issue and usually sold out. It was also customary in the early years to let the membership know of articles that were either proposed or in production. *Sunbird* Editors often placed a call for material in the monthly Newsletter of the Society. Broadly speaking, some outstanding and consistent contributions from a few club members have found their way onto the pages of *The Sunbird*, but articles from non-Birds Queensland authors are the life blood of the journal. Past editorial frustrations around insufficient copy fuelled occasional exhortations to members. Like all parents, members chose to praise, support, ignore or parade *The Sunbird* in writing preserved in BQ Newsletters. The late 70s and early 80s was a particularly difficult period. A shortage of submissions caused production delays and issues consistently arrived late. Pleas were made in the Newsletter for members to submit or solicit manuscripts from all and sundry.

In 1993 a questionnaire put to the membership included questions relating to *The Sunbird*. The findings are summarised as follows. Most respondents read the journal and found articles to interest and inform them. Surprisingly few contributed articles. A slightly smaller percentage of respondents wanted *The Sunbird* to continue appearing at its existing frequency and a small minority wanted to discontinue publication. *The Sunbird* was much more important to members outside the Brisbane region than to those from within it.

In 2002 a committee of Birds Queensland authors formed to produce the special issue [Vol 32 (2)] to the memory of J D (Jim) MacDonald, the first President of QOS.

Digital access

By agreement between Birds Queensland and RMIT Publishing Pty Ltd., in 2008 *The Sunbird* was made became available online at the *Informit.com* site beginning with Vol 38(2). Volumes 1 (1) -38 (1) are being scanned also for online access. Institutions such as Universities that subscribe to this e-Library can now provide access for their staff and students to search and use for research and teaching. Other potential users include the growing number of people connected online around the globe.

Continuity

Volume 11 covered both 1980 and 1981 to synchronise volume numbers thereafter with year of publication.

Four issues per Volume were published from March 1970 to December 1997 (the only exceptions being 1989 with one issue and 1990 with three issues). Three issues per Volume were published regularly from the beginning of 1998 until the end of 2004 and from then on two issues were published. In some years articles were published as combined double issues (Table 2).

Table 2. *Sunbird* double issues published to 2011.

Year	Volume	Issues combined
2002	32	2+3
1982	12	2+3
1980+1981	11	3+4
1979	10	3+4
1978	9	1+2 and 3+4

The quantity of text per issue averaged 26 pages over 42 years. Since 1998 the number of issues published per Volume has reduced each time the cost of production of hard copies has exceeded $3000 p.a. But for Jeremy Thompson, who in 1994 initiated the adoption of computers that eliminated paid typing, a contraction in the number of issues per Volume might have started earlier. The timely advent of online publishing has freed *The Sunbird* from increasing production costs.

Appearance
Libraries that intend to bind volumes will find a description of issue dimensions useful.

Volumes 1-3 were typed on Quarto sheets copied ("Gestetnered") and hand-stapled between tan cards. Volume 4 was produced by offset printing in 1973 when the familiar cover designed by Naoko Kikkawa was adopted. The first two issues of Volume 1 were reprinted and back issues were available for 50 cents each, plus postage (then approx. 5c).

Volumes 4 - 13 were typeset (165 mm x 228 mm) pages printed, bound and stapled on the fold in a tan wrap-around cover. In 1984 the current smaller A5 format was adopted.

In 2000 between issues 30(2) and 30(3), because of a supply difficulty, the colour of *Sunbird* wrappers was changed from coffee brown to the current mid-grey.

Back issues
Back copies of *The Sunbird* are rare or unavailable. If you no longer need your *Sunbirds* and are happy to donate them, please contact the Birds Queensland Secretary (secretary@birdsqueensland.org.au). If you do return them, institutions and others can repair the gaps in their *Sunbird* collections, should they wish to, by contacting Birds Queensland.

EDITORIAL COMMENT

Over 20 years ago, in February 1990 Graham Leach (*Sunbird* Editor 1975-1976), in a short history of Queensland Ornithological Society 1969-1990, expressed a vision for *The Sunbird*:

> *"One of our lasting contributions to ornithology is our journal,* The Sunbird. *The first issue appeared in 1970. It included reports of studies on the Letter-wing Kite, Banded Rail, Pallid Cuckoo and six passerines: ten foundation members were authors. Like most journals produced by ornithological groups,* The Sunbird *has had a chequered progress. David Gravatt (Editor, Vols. 2-5) succeeded in establishing a thriving journal with high editorial standards. At times since, the journal has had difficulties in maintaining content and schedules. My observation is that editors who have actively canvassed papers, even bludgeoned potential authors into writing, have seen a successful journal emerge; those who have taken a more passive*

> *position, waiting for scripts to be submitted, have seen the journal slip ever further behind schedule. Maintaining* The Sunbird *has been, and will continue to be, a demanding task for the Society, but we must continue to accept the challenge - it is a journal for making information on Queensland ornithology available to both an Australian and an international community."*

An Editor's perennial concern, the gathering of copy to build the next issue, echoes through Graham's comment, leavening the aspiration to communicate widely about birds in Queensland. Founders of Queensland Ornithological Society created the vision. Their foresight led to an accumulation of a valued collection of original recorded information about birds in Queensland. This body of knowledge was used several decades later during the production of the seven-volume *Handbook of Australian, New Zealand and Antarctic Birds* by Birds Australia which took the next 16 years, until 2006. As a corollary, most pre-existing *Sunbird* articles are systematically cited in the major ornithological work of our region, and we can see how much more there is to record and know about birds in Queensland.

The continued viability of publication for *The Sunbird* is an important consideration for the future. Changes in format, reader access, audiences, technologies and rising costs have helped or hindered the existence of the journal at different points in time. The move to online publication of *The Sunbird* and a plan to make available past issues scanned for online access both allow Graham's vision to communicate widely to be better realised. Especially given continuing submission of manuscripts, *The Sunbird* can have a bright future because more people will value it and share its vision.

ACKNOWLEDGMENT

Our thanks go to referees and authors who support publication of *The Sunbird*. We are grateful for the advice and opinions of Editors, Assistant Editors and members of Birds Queensland. We have tried to provide a reliable publication record for *The Sunbird* by carefully checking information available to us. This article is a sketch and any errors of omission are ours alone.

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Book Review

Capturing the Essence
Techniques for Bird Artists
By William T. Cooper

Published by CSIRO Publishing, 2011, Hardback, 128 pages
http://www.publish.csiro.au

Beautifully presented, this detailed yet accessible book will appeal to both beginner and experienced wildlife artists. So stunning are the images, and clear and friendly the text, the book may well compel bird or wildlife enthusiasts to take up painting or sketching who have never considered doing so. For those who will not venture to creating artwork, the tips from an artist skilled in field observation and capture of wildlife characteristics can help build upon a toolbox of field recording techniques for subsequent species identification. Part A introduces materials, presents a superbly illustrated lesson on bird anatomy, describes principles of drawing and painting, and presents detail on sketching in the field. This includes tips on developing ideas for paintings (which might be sparked by habitat elements as much as the birds themselves), and the recording of habitat and prey details to enhance authenticity of a painting. Part B gives three detailed lessons, from sketch to completed work, of a watercolour, an acrylic and an oil painting, including alterations and additions made along the way to enhance the work. Aside from its insight into wildlife art, this book is a truly lovely collection of sketches and paintings of birds and various habitat elements by an acclaimed artist.

Denise Elias

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