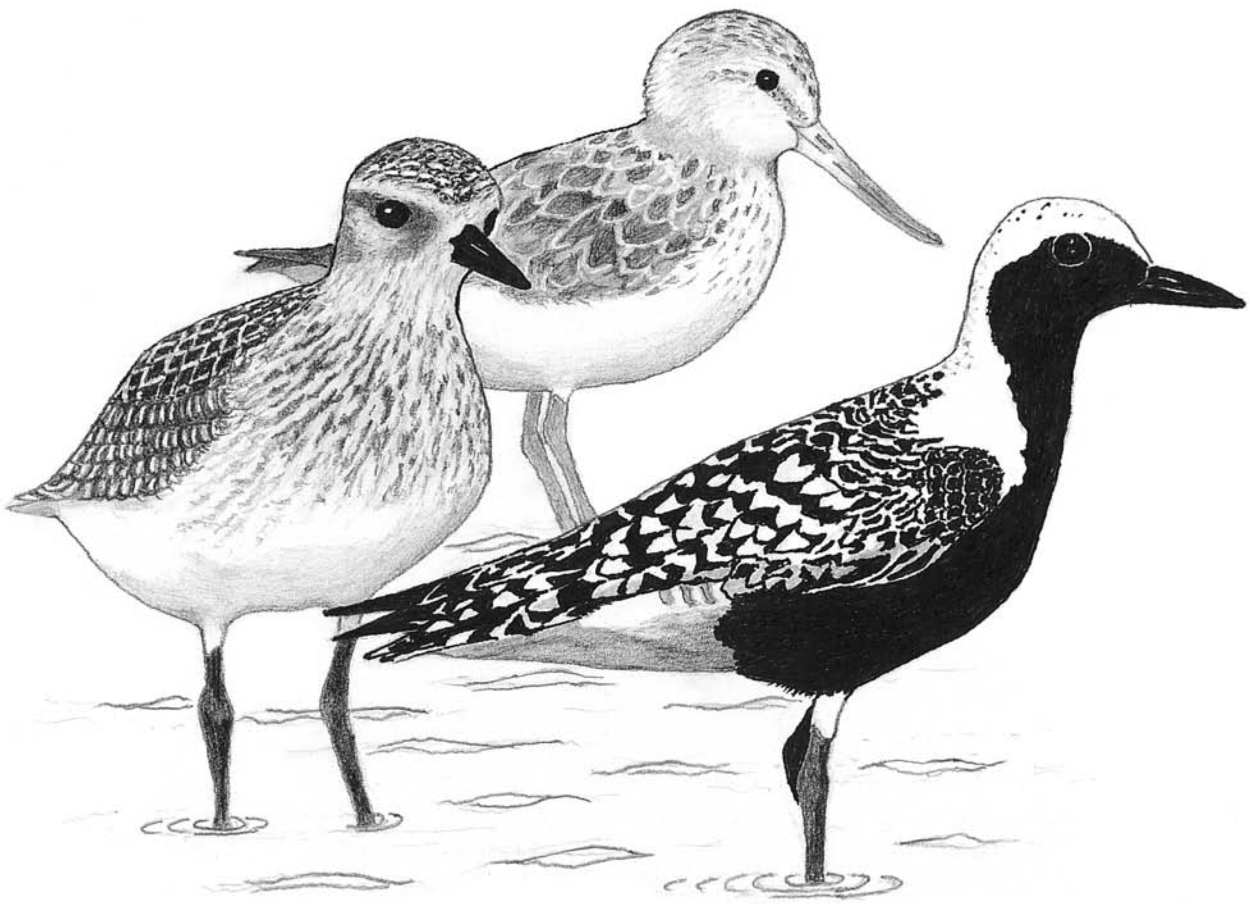
Stilt

The Journal for the East Asian-Australasian Flyway



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MISSION STATEMENT
To ensure the future of waders and their habitats in Australia through research and conservation programmes, and to encourage and assist similar programmes in the rest of the East Asian–Australasian Flyway.

OBJECTIVES

- To monitor wader populations through a programme of counting and banding in order to collect data on changes on a local, national and international basis.
- To study the migrations of waders through a programme of counting, banding, colour flagging and collection of biometric data.
- To instigate and encourage other scientific studies of waders such as feeding and breeding studies.
- To communicate the results of these studies to a wide audience through *Stilt*, the *Tattler*, other journals, the internet, the media, conferences and lectures.
- To formulate and promote policies for the conservation of waders and their habitat, and to make available information to local and national governmental conservation bodies and other organisations to encourage and assist them in pursuing this objective.
- To encourage and promote the involvement of a large band of amateurs, as well as professionals, to achieve these objectives.

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Membership of the AWSG is open to anyone interested in the conservation and research of waders (shorebirds) in the East Asian–Australasian Flyway. Members receive the twice yearly bulletin *Stilt*, and the quarterly newsletter *The Tattler*. Please direct all membership enquiries to the Membership Manager at Birds Australia (RAOU) National Office, Suite 2-05, 60 Leicester St, Carlton Vic 3053, AUSTRALIA.
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EVIDENCE OF REGULAR SEASONAL MIGRATION BY AUSTRALIAN PAINTED SNIPE *ROSTRATULA AUSTRALIS* TO THE QUEENSLAND TROPICS IN AUTUMN AND WINTER.

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We report a series of sightings of Australian Painted Snipe *Rostratula australis* in the marine plain wetlands of tropical Queensland, including two breeding records. Ten records from nine locations were all in the autumn and winter, the period when records of Australian Painted Snipe in south-eastern Australia are extremely rare. Examination of historical records of Australian Painted Snipe confirmed this pattern for coastal Central and North Queensland. We suggest that there may be a regular seasonal migration of a significant part of the Australian Painted Snipe population between south-eastern Australia and wetlands of central and north coastal Queensland, to exploit the favourable seasonal conditions.

INTRODUCTION

The Australian Painted Snipe *Rostratula australis* is a rare endemic shorebird which is mostly found in shallow, muddy wetlands with some dense low cover (Rogers *et al.* 2005). Optimum conditions for Australian Painted Snipe appear to occur as temporary wetlands are drying. The inundation of ephemeral wetlands triggers a surge of production of the benthic organisms on which they feed, and subsequent drying makes this accessible to feeding birds (Rogers *et al.* 2005).

The reporting rate of Australian Painted Snipe in Australia has declined greatly since the 1970s, beyond the decline of waterbirds in general with current rates at about 10% of those before 1970 (Lane and Rogers 2000). A current revision of their status recommends a change from *vulnerable* to *endangered.*

Most historical records are from south-eastern Australia, but there are also scattered records from northern Australia (Marchant & Higgins, 1993). In south-eastern Australia (including south-eastern Queensland), almost all sightings occur between September and March and little is known of the location of Australian Painted Snipe in the autumn and winter months (Threatened Bird Network 2008, Lane & Rogers 2000). Ninety percent of the Australian Painted Snipe records of Birds Australia's Threatened Bird Network in south-eastern Australia were between September and March (Threatened Bird Network 2008). In 2002 the Australian Painted Snipe group of the Threatened Bird Network called for volunteers to survey wetlands in winter to help solve the question of whether Australian Painted Snipe migrated away from south-eastern Australia in winter, or simply became much more cryptic. Despite a determined effort, these surveys failed to find any Australian Painted Snipe (Chris Tzaros pers. comm.).

We conducted a series of surveys of the marine plain wetlands of Central Queensland studying Capricorn Yellow Chats and other wetland birds between March 2003 and December 2008. An outcome of this was ten sightings of groups of Australian Painted Snipe, two of which included breeding records. All these sightings were between March and September, the period when records in south-eastern Australia are rarest. From these observations, it was hypothesized that the apparent rarity in south-eastern Australia could be explained by movement of Australian Painted Snipe to wetlands of coastal central Queensland during the autumn-winter period (March-August).

To verify this pattern of seasonal presence, Queensland records from WildNet (EPA 2009) were examined along with other Queensland records for evidence of the location of Australian Painted Snipe in autumn and winter. The pattern of seasonal occurrence and its relationship to habitat availability in various regions was also examined.

METHODS

Surveys

Central Queensland University and Wetlands International conducted surveys of waterbirds in the Fitzroy Delta, Fitzroy Lagoons and Broad Sound wetlands of Central Queensland from March 2003 to December 2008, a period of nearly six years. These were carried out regularly throughout these years, and surveying effort was similar across the seasons. Surveys of wetlands north to Townsville occurred in May and June 2005, and late September 2008. Incidental sightings of Australian Painted Snipe in the region during this period were also recorded.

Wetlands were surveyed from the margins using binoculars and spotting scopes, and by systematic walking through flooded areas. Some wetlands were surveyed only once or twice while seeking new Capricorn Yellow Chat populations, while others were repeatedly searched during Yellow Chat or waterbird monitoring surveys (Jaensch *et al.* 2004b, Houston *et al.* 2004).

Database Records

Records from Wildnet (EPA Wildlife Database) of Australian Painted Snipe in Queensland were examined. In total 3,037 records were evaluated for evidence of seasonal use of regions of Queensland. Of these, 2,693 were found to be nil records of regular Australian Painted Snipe surveys in south-east Queensland between 1990 and September 1998. Of the remaining 344 records, 78 records dated January 1st (presumably a default date) or with no month were rejected as these provided no information on seasonal presence. Another 15 records dated 23/5/1770 were also rejected, as the date was considered unreliable. Another 29 duplicate entries, with the same date and co-ordinates as others, were deleted from the remaining 251 records, leaving 222 records. Although some Wildnet records were probably repeat sightings of the same group of birds at different dates or nearby locations, it was not possible to accurately assess this, so these records were all retained. However this applies to records from all areas of Queensland, so the comparison of regional data should not be distorted.

Additional records of Australian Painted Snipe in Queensland were obtained from *Painted Snippets* (Threatened Bird Network publication) between 2003 and 2008 (10 records), and *Birding-Aus* (a birdwatchers website) between 2001 and February 2009 (9 records) giving a total of 251 including the survey data.

These were sorted by location and month of sighting and categorised by geographic location and season. Six broad geographical regions were defined based on a north-south gradation and inland-coastal zones (SE for south-eastern Queensland; SW for south-western Queensland; CE for central eastern Queensland; CW for central western Queensland; NE for north-eastern Queensland; NW for north-western Queensland) and two broad seasons (Autumn-winter for March to August and Spring-summer for September to February).

The minimum number of actual birds recorded in Autumn-winter in Queensland since 1977 was plotted. Records of birds or groups of birds at the same site over a few months were assumed to be repeats, and the highest count used. Records without a count (21 of 79) were given a count of one, giving a minimum Autumn-winter total of Australian Painted Snipe in Queensland per year.

RESULTS

Surveys

Ten groups of Australian Painted Snipe were observed during the survey period, ranging from three to seven birds. At least one group was recorded in every year of the surveys (2003-2008) except 2006. Two breeding events were recorded, both on the Torilla Plain in the eastern part of the Broad Sound wetlands, about 125 km north of Rockhampton, and it is possible that breeding also occurred at other sites where immature (sub-adult) birds were recorded.

Sightings occurred in two ways; on six occasions the birds were observed while scanning wetlands by eye or with binoculars; the other four groups were flushed while walking through the wetlands.

1- On 30 April 2003 three male and three female Australian Painted Snipe were seen by four observers in drying freshwater ponds on the Torilla Plain, an extensive marine plain system about 125 km NNW of Rockhampton (Jaensch *et al.* 2004a). A male was flushed from a nest with four eggs, sheltered by freshwater couch *Paspalum distichum*, on a low muddy islet. The ponds had shallow open water, and broad fringing areas of moderately dense couch grass, *Cyperus* and *Eleocharis* sedges and Beetle Grass *Leptochloa fusca*.

2- On 31 March 2004 an adult male Australian Painted Snipe was observed with three downy young at another, more saline location on the Torilla Plain. The young appeared to have recently left the nest, were yellowish with dark streaks, and had long legs and bill. They walked across a 3 m by 2 m open gap in a dense *Schoenoplectus litoralis* swamp, about 90 m long and 60 m wide. The brackish water was about 3 cm deep at this point. The dense *Schoenoplectus* area was surrounded by muddy ground with shorter grasses and Samphire including *Halosarcia pergranulata* and *Halosarcia indica* and this may have been the nesting habitat. Extensive reedbeds are avoided as nesting habitat (Rogers *et al.* 2005).

3- On 11 May 2005 at 16.30 six Australian Painted Snipe were seen in a drying freshwater *Cyperus alopecuroides* swamp about 150 m long and 40 m wide at Wunjunga, about 30 km south of Ayr, on the Burdekin delta. They were resting in water to 10 cm deep in the shelter of tall *Cyperus* clumps, and feeding in the open muddy areas between the clumps. The swamp was located in a grassy plain with some Samphire, and is part of the extensive Wunjunga marine plain wetlands.

4- On 12 May 2005 at 9.00 two Australian Painted Snipe were flushed from the edge of a small muddy pool with a rocky edge on the Goorganga Plain, an extensive marine plain about 10 km east of Proserpine. They were crouched between clods and rocks in very open habitat with short Green Couch grass *Cynodon dactylon.*

5- On 9 June 2005 at 16.15 four Australian Painted Snipe were flushed by three observers 20 m from the edge of a sparsely vegetated, seasonal freshwater lake at Balnagowan, about 30 km east of Rockhampton on the Fitzroy River delta. They were crouched in cattle hoof depressions in very short Green Couch grass *Cynodon dactylon*, in a patch of very sparse *Cyperus scariosus* sedge only 30 cm tall. After being flushed they flew to the edge of the lake and started feeding on the open muddy shore. We concluded that the group comprised one sub-adult female and three males.

6- On 15 June 2005 at 15.00 seven Australian Painted Snipe were seen by two observers between a series of freshwater pools with dense *Cyperus alopecuroides* near Sheepstation Creek, 15 km north-west of Brandon, on the Burdekin delta. Four were flushed from cattle hoof depressions in dry open grassy ground with sparse short sedges, and flew about 30 m to the dense *Cyperus alopecuroides* fringing a nearby pool. Three more were flushed from the muddy edge of another pond, about twenty metres from where the first group were found, and flew to the same pool. We returned to the site in late afternoon, but could not see any Australian Painted Snipe feeding on the open pool edges.

7- On 29 June 2005 at 16.45 six Australian Painted Snipe were flushed by three observers 10 m from the edge of the lake at Balnagowan on the Fitzroy River delta, and about 200 m from where four were seen on June 9 (Wingspan, March 2006). They were crouched in cattle hoof depressions in very open habitat with short Green Couch grass *Cynodon dactylon*, and sparse short *Cyperus scariosus* sedge. After being flushed they flew about 80 m along the lake shore and crouched in hoof depressions in the shelter of some grass tussocks near a group of tall *Cyperus alopecuroides* clumps on the muddy edge. We concluded that the group comprised two sub adult females and four males. After being observed for 25 minutes they flew out into the shallow open water about 10 m from shore and began feeding.

8- On 11 May 2007 at about 16.30 three Australian Painted Snipe were seen by two observers in a shallow, sparsely vegetated, brackish swamp on the Waverley plain, 10 km south of St Lawrence, on the western marine plain of Broad Sound. There were two sub-adult males and one sub-adult female. They were in clay substrate that was subtly hummocky and were moving out to feed from taller *Schoenoplectus litoralis* cover into an area of low, flood killed samphire *Halosarcia pergranulata* and lush Nardoo *Marsilea mutica* with water to 10 cm.

9- On 19 April 2007 two immature Australian Painted Snipe were flushed from the edge of a freshwater wetland at St Lawrence, on the western marine plain of Broad Sound. They were in an area of sparse *Eleocharis* sedge, and flew 60 m along the wetland, from where they flew into the flooded *Melaleuca* swamp upstream.

10- On 3 March 2008 two Australian Painted Snipe, a male and a female, were observed on the edge of a shallow, recently inundated, flooded wetland at Gavial Swamp on the Fitzroy River delta. They were in an area of shallowly flooded, sparse tussocks of dry grass and some sprouting *Eleocharis* sedges; otherwise the site was extensively bare due to drought, then recent rapid inundation by floodwaters.

The series of bird surveys during which these records were obtained was the most comprehensive ever undertaken of the Central Queensland marine plain wetlands, for which few systematic surveys existed (Jaensch *et al.* 2003). The surveys resulted in nine separate records (the two records at Balnagowan were probably the same group) of the occurrence of groups of Australian Painted Snipe in the coastal Queensland dry tropics. The five records in 2005 occurred during the most systematic and widespread survey period. All records were from early March (initiation of breeding in March 2004) to late September, the period when south-east Australian records are rarest.

Database Analysis

Of the 251 records of Australian Painted Snipe in Queensland, one hundred were in the Autumn-winter period (March to August) and one hundred and fifty one in the Spring-summer period (September to February) (Figure 1). Thus, one hundred records were from the seasons when few Australian Painted Snipe sightings are made in south-eastern Australia. Most of these one hundred records (71) were from central and north Queensland, while only twenty nine Autumn-winter records were from south Queensland. In contrast, most Queensland Spring-summer records (96) were from south Queensland, with fifty four records from central and north Queensland. The ratio of Autumn-winter to Spring-summer records has remained consistent since 1970, before which few records are available (Figure 2).

Between October and January most records are from south Queensland, while from March to August there is a dominance of records from central and north Queensland.

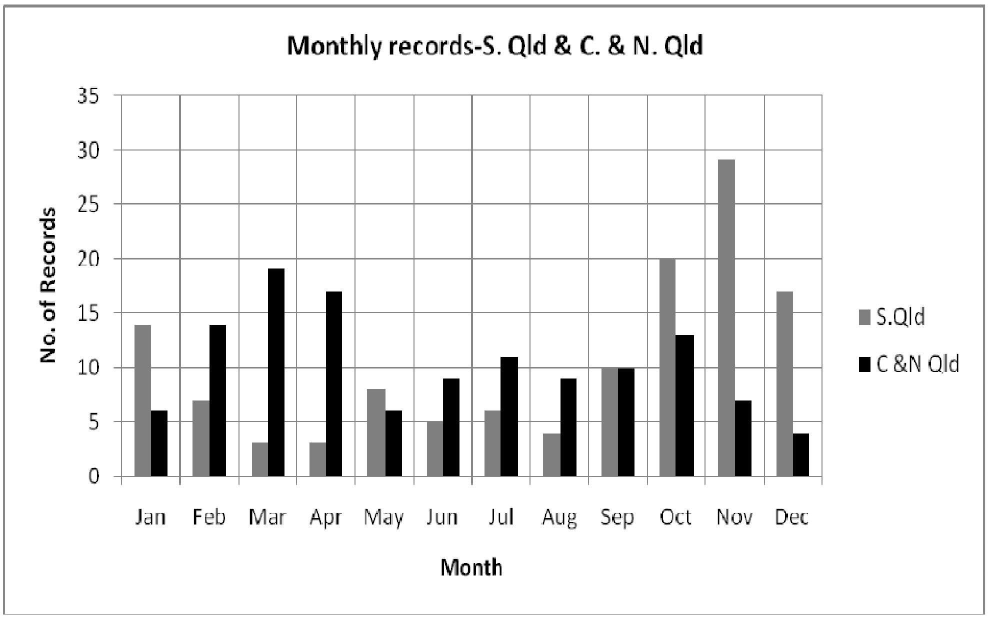

Figure 1: Monthly Australian Painted Snipe records in South Queensland and Central and North Queensland.

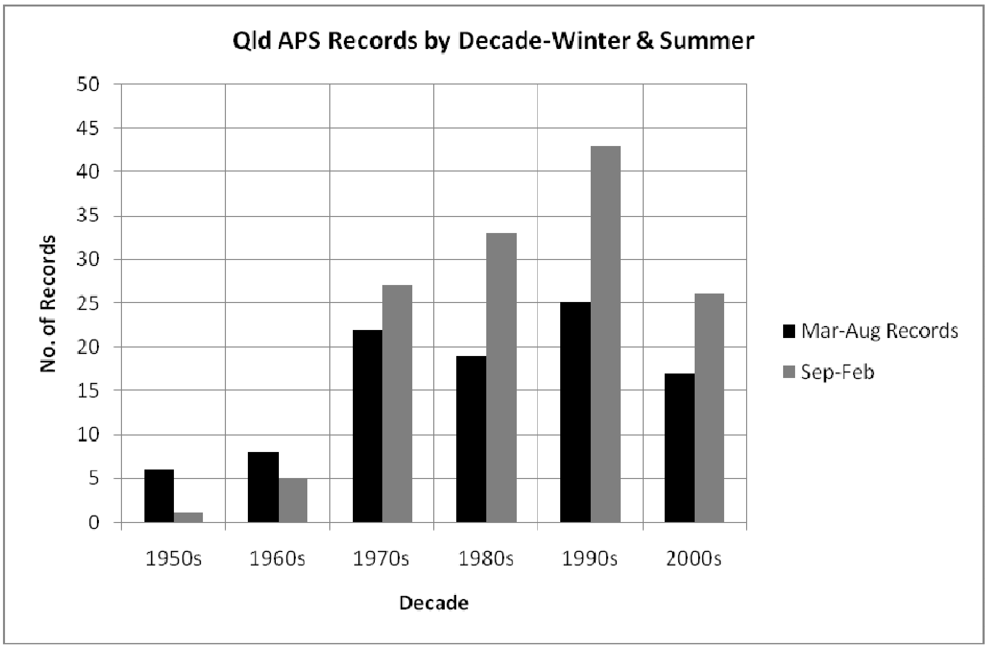

Figure 2: Australian Painted Snipe in Queensland in winter and summer by decade.

February and September are transitional months when the north-south dominance reverses (Figure 1). We can expect the number of records to be higher from Southeast Queensland due to the larger number of observers, greater effort and smaller total area, so it is likely that the central and northern records under-represent actual occurrence more than the south Queensland records do. Australian Painted Snipe are thought to be more easily detectable while breeding (Marchant & Higgins 1993) and the peaks in records correspond to the reported main breeding season in both regions (October to December in south Queensland, the same period as in south-eastern Australia, and February to April in central and northern Queensland).

Seasonal patterns of regional occurrence were examined for each of the six broadly defined regions; South-eastern and South-western Queensland, central Eastern and central Western Queensland and North-eastern and North-western Queensland (Figures 3, 4 & 5). These show that seasonal use of areas of Queensland varies by region with:

- a predominately Spring-summer pattern of occurrence in two regions; South-eastern Queensland with 73% (78) of 107 records and South-western Queensland with 100%

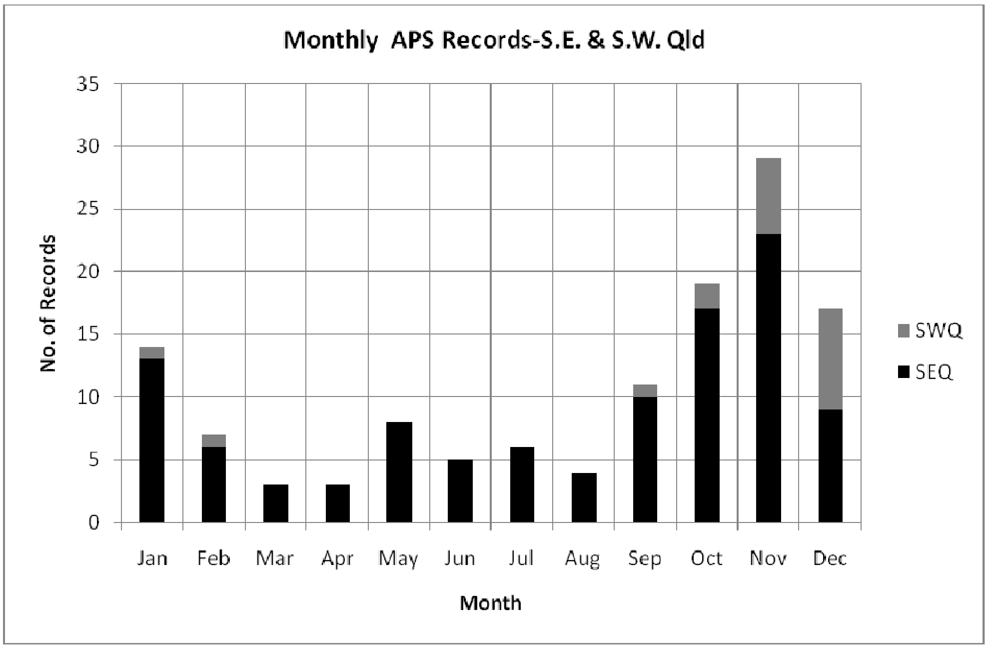

Figure 3: Australian Painted Snipe records in south Queensland by month.

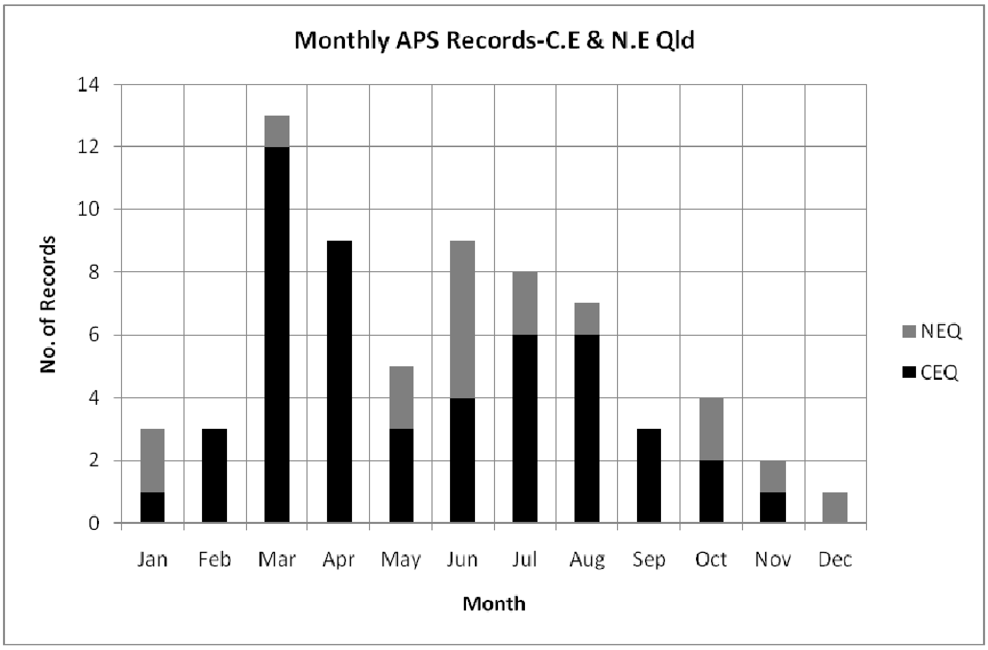

Figure 4: Australian Painted Snipe records in eastern central and north-eastern Queensland by month.

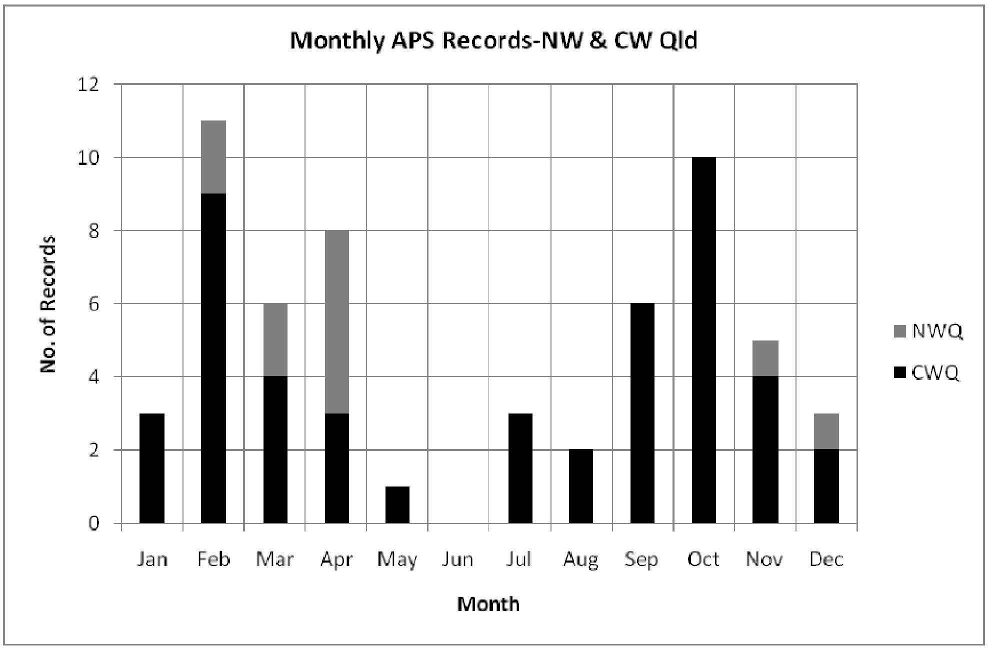

Figure 5: Australian Painted Snipe records in north-western and central western Queensland by month.

(19) of 19 records (Figure 3). This resembles the pattern of occurrence from south-eastern Australia.

- a predominately Autumn-winter pattern in two coastal regions; Eastern central Queensland with 80% (40) of 50 records and North-eastern Queensland with 65% (11) of 17 records (Figure 4).

In contrast, Western central Queensland and North-western Queensland records do not conform to either pattern, with peak records in February-April and September-November. However 20 records from this region are from the March-August period (Figure 5).

To provide an overview of these patterns of occurrence on a state-wide basis, all 251 Queensland_Australian Painted Snipe records with location and seasonal data are shown on a map (Figure 6). February and September records are shown separately as these months appear to be times of transition into and out of Central and North Queensland (Figure 1). Significant points to note are:

- Almost all records from coastal Central and North Queensland are from the March-August period, corresponding to the period in southern Australia when snipe are rarely seen.
- Most records from Southeast Queensland are from the October to January period, corresponding to the period when snipe are usually seen in southern Australia.

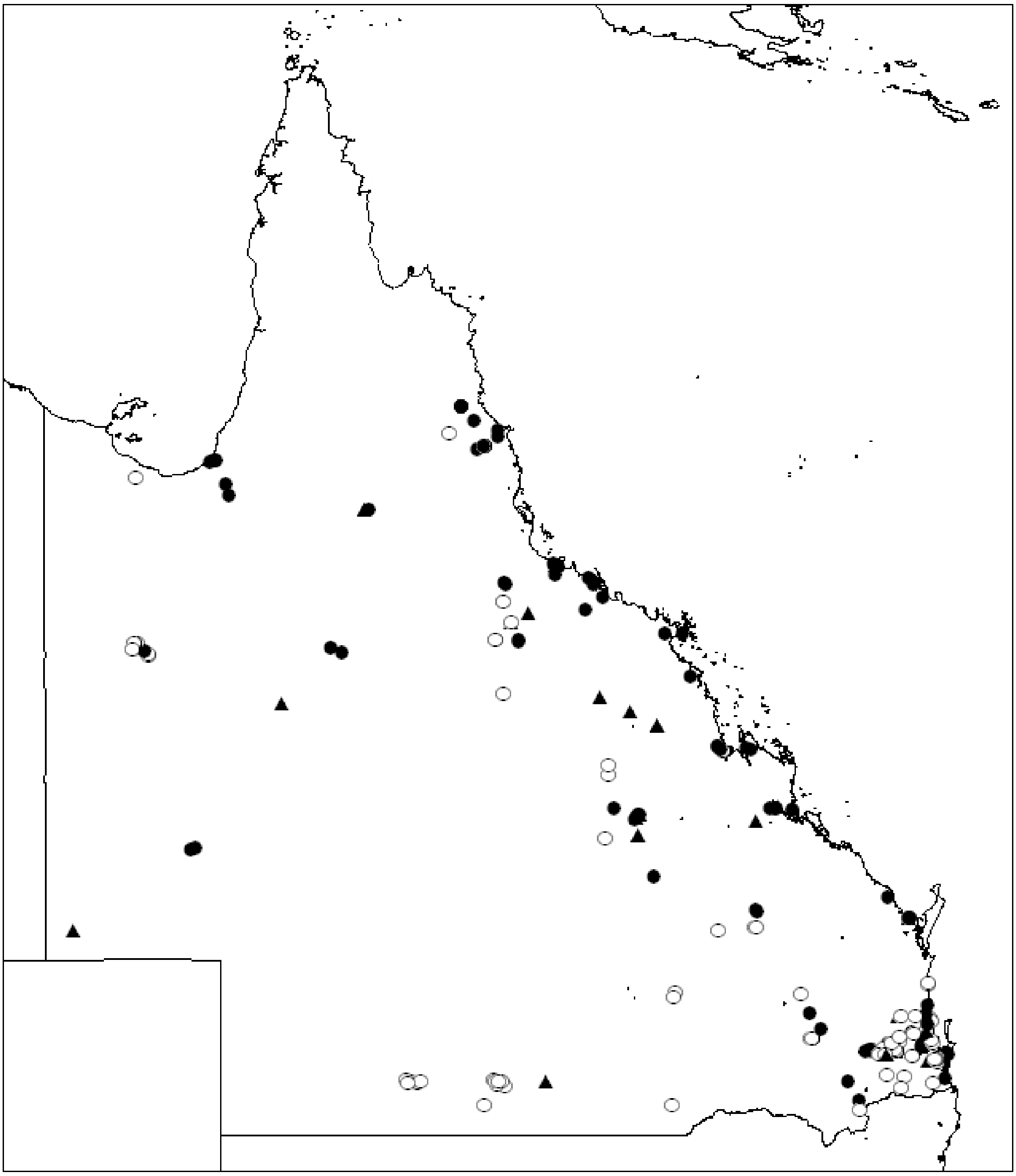

Figure 6: Queensland Australian Painted Snipe records showing areas of Spring-summer dominance in southern Queensland and Autumn-winter dominance in coastal central and northern Queensland.
March-August = black circle, October-January = white circle, February and September =black triangle.

- Almost no records from western South Queensland are from the March-August period.
- Seasonal occurrence in western North Queensland is more opportunistic.

To quantify Australian Painted Snipe abundance (as opposed to records of seasonal occurrence examined in the previous sections), the minimum number recorded between March and August each year since 1977 was plotted. Records without a count (21 of 79) were given a count of one, giving a minimum Autumn-winter total in Queensland per year (Figure 7).

The rarity of this species is demonstrated by the highest winter count (in 2005) of 21 birds. This count resulted from hundreds of hours of surveys within suitable Australian Painted Snipe habitat between Bundaberg and Townsville.

No clear trends in numbers of birds were apparent and the higher counts in later years probably reflected increased search effort. Highest counts in the early 1990s and mid 2000s corresponded to times of greatest survey effort in South-eastern and Eastern central Queensland respectively. The high north Queensland counts in 2004 and 2005, with a peak count of 21 birds in 2005, corresponded to the period of

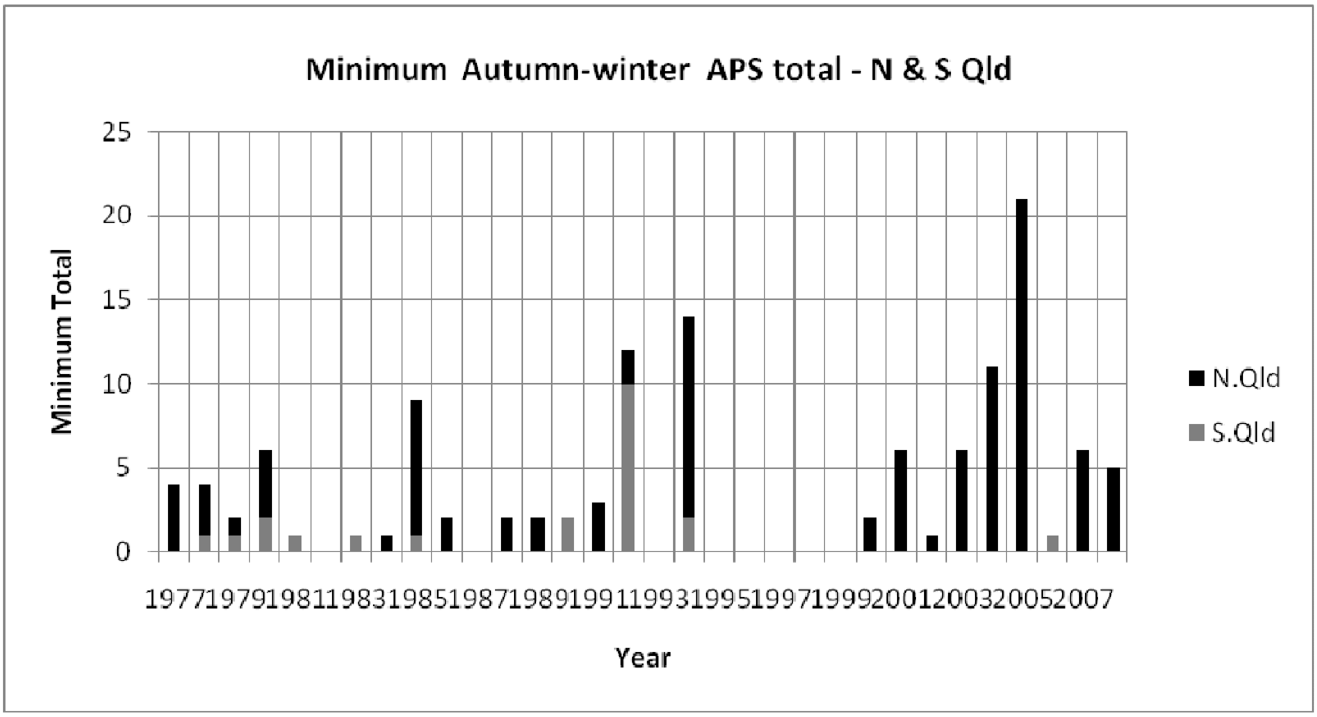

Figure 7: Minimum annual Autumn-winter totals of Australian Painted Snipe in Queensland since 1977. North Queensland includes central Queensland.a

most intensive survey effort in coastal wetlands of central and north Queensland.

The absence of Queensland winter records from 1995 to 1999, a period of regular systematic surveys in Southeast Queensland, demonstrates the unreliability of Australian Painted Snipe occurrence. Between 1991 and 1994 eighteen separate sightings of individuals or groups of birds occurred in south-eastern Queensland. Fourteen of these were in the Spring-summer period, and four in Autumn-winter. These sightings led to a series of regular systematic surveys in Southeast Queensland, which searched 24 sites monthly from 1992 to 1998, another 13 sites for most of those years, and a further 11 sites for at least two years of that period. Despite this intensive survey effort, no further sightings of Australian Painted Snipe occurred in the region until a group of birds recorded at Lake Samsonvale in early 1999.

DISCUSSION

Migration

Based on the strong seasonality in occurrence of Australian Painted Snipe in southern Australia, there has been previous speculation that they are seasonal migrants, and may leave the spring and summer breeding areas of south-east Australia in autumn and winter (Blakers *et al*. 1984). However, the scarcity of autumn and winter records anywhere provided scant evidence of where the 'missing' snipe are over-wintering. The present study provides the first compelling evidence of migration to coastal central and north Queensland based on a preponderance of records, including breeding, during the autumn-winter period in this region. This could only be proved by data from banding or tracking, which would be difficult due to the very low number of annual sightings of the species, difficulty in capturing and the low probability of re-capturing or even sighting banded birds.

One of the reasons why this evidence was overlooked is that previous studies of Australian Painted Snipe have not used the Wildnet EPA database. This is probably due to the nature of the database, where 222 records with useful seasonal information are obscured within 3,037 total records, most of which are nil results from regular Australian Painted Snipe surveys in the 1990s.

Also contributing to the few records from coastal central and north Queensland are the vast scale of wetlands, difficulty in access due to land tenure (many are on private land), and the paucity of birdwatchers and survey effort. The wetlands of tropical coastal Queensland comprise approximately 750,000 ha: Fitzroy River wetlands 265,000 ha, Broadsound-Shoalwater Bay wetlands 335,000 ha and the Burdekin-Townsville coastal wetlands 150,000 ha (Environment Australia 2001). Prior to 2003, waterbird populations in these wetlands had been studied only superficially.

The number of autumn-winter (100) and spring-summer (151) records of Australian Painted Snipe in Queensland may seem to indicate that the autumn-winter records in north Queensland are the same birds that are recorded in south Queensland in spring and summer, with seasonal migration occurring just within the state. It is likely that some birds remained in Queensland in summer during the extended drought period since the early 1990s, when many wetlands in south-east Australia have become unsuitable for Australian Painted Snipe. However, the survey effort is far greater in south-east Queensland, at least tenfold in the Birds Australia Atlas (Barrett *et al.* 2003), with many more birdwatchers and a thorough series of regular monthly surveys targeting all known Australian Painted Snipe sites between 1990 and September 1998, so it is probable that a much smaller percentage of birds in north Queensland is reported. Also, as noted in the previous paragraph, the extent of wetlands in central and north Queensland is far greater than that in southern Queensland, further increasing the lack of equivalence in search effort between these regions.

There are very few breeding records of Australian Painted Snipe from tropical Queensland (Lowe 1963, Jaensch *et al.* 2004a). This paper records two confirmed breeding events, in April 2003 and March 2005. These records support previous suggestions of an autumn breeding period in northern Australia (Rogers *et al*. 2005).

Many of the Australian Painted Snipe seen appeared to be sub-adult, so may have been raised in the south-east breeding season the previous summer, and thus would have been too young to breed. However, immature birds seen in April-June may also have been the result of local breeding in March-May.

There are few bird species that are known to regularly migrate between south-east and north-east Australia and breed in both regions. Most winter migrants to Queensland breed in southern Australia in spring and summer (Ref?). Recent records of breeding Whiskered Terns in the Northern Brigalow Belt (Jaensch *et al.* 2003) and subsequent records at the same site may be another example of a species breeding in both northern and southern Australia.

Habitat attributes

The Australian Painted Snipe found in these surveys were mostly in sparse, open habitats with some cover in the form of grass or sedge tussocks, and in or near shallow muddy pools. Although the male with three very young juveniles found on March 31, 2004 was in a dense sedge bed, it is likely that this was a shelter they had moved to from a nearby nest. All sites were in marine plain wetlands. Where the habitat included open water bodies, the edges where Snipe were feeding included clods, rocks or plant tufts. This ‘lumpy’ shoreline may help to camouflage the shape of feeding birds.

Favourable habitat attributes of coastal central and north Queensland wetlands are thought to include: (i) suitable habitat is always available in the autumn and winter as a consequence of the extensive area of wetlands following the summer-autumn ‘wet’ season and the progressive drying of deeper wetlands; (ii) the high productive pulse of invertebrates as a consequence of seasonal drying and re-wetting; and (iii) the seasonal drying and residual salinity of many of these habitats that prevents dominance by dense emergent vegetation.

All the Australian Painted Snipe sightings from this survey were from coastal Queensland between Rockhampton and Townsville, an area of very seasonal (mostly summer and autumn) rainfall in the Brigalow Belt and Central Queensland Coast Bioregions. The level of wetland inundation varies greatly from year to year, but maximum inundation mostly occurs in February and March, and wetlands then shrink progressively, many drying completely by September in most years (Black *et al*. pers. obs.). This results in a succession of wetlands suited to Australian Painted Snipe, as some dry out and other deeper wetlands become muddy and shallower. Most sites would not retain good conditions for the entire March to September season. The six Australian Painted Snipe observed at Wunjunga Cyperus swamp, about 30 km south of Ayr on 11th May 2005 were not present on 13th June 2005, and by this time the wetland was almost completely dry. Seven Australian Painted Snipe found at Sheepstation Creek, about 25 km north-west of Ayr on 15th June 2005 may have been the same group. The extensive Sheepstation Creek wetlands are more permanent than the ephemeral Wunjunga wetlands, with deep Typha (bullrush) filled channels adjoining shallower sedge swamps.

Productivity of the seasonal wetlands used by Australian Painted Snipe in Central and North Queensland is mainly driven by the surge of invertebrate life after inundation of dried out wetlands. Food supply increases rapidly in the late summer wet season, and decreases as wetlands dry out in spring. Ephemeral wetlands have a great capacity for benthic productivity (Rogers *et al*. 2005, Crome *et al.* 1986) and their temporary nature prevents dominance by Typha rushes and sedges, resulting in open muddy areas ideal for feeding by Australian Painted Snipe (Rogers *et al*. 2005). In contrast, temperature may be a seasonally limiting factor for invertebrate production in southern Australia, so the food supply rises rapidly with warmer conditions in spring and decreases in autumn, even if wetlands are inundated through the winter.

Rainfall in north-east Queensland is also greatest in summer, but this region receives far more winter and spring rain than the dry tropics and many wetlands are active through the entire year. This may explain the greater number of summer records from this area.

In contrast to coastal Queensland, the rainfall of the arid western areas of Queensland is irregular, and occurs as infrequent inundation events without regular seasonality. Wetlands are also filled as a result of remote rainfall in northwestern Queensland in the summer and autumn, but this inundation only occurs in some years. Consequently, use of wetlands by birds tends to be opportunistic and this fits with the pattern observed for Australian Painted Snipe occurrence in these regions.

Implications for population assessment

These observations have implications for determining the conservation status of Australian Painted Snipe. If it regularly occurs in south-east Australia in spring and summer and moves to north-east Australia in autumn and winter then the same birds may be recorded twice, giving the impression that this threatened population is larger than it actually is. Current population estimates of 1500 are based on very few annual sightings and actual population size is unknown, but given that fewer than thirty birds are normally recorded annually for the whole of Australia, it could be considerably lower. This would suggest that endangered status rather than the current vulnerable may be appropriate.

Implications for management

None of the localities of the nine sightings documented above are in formal protected areas, though current land use may not necessarily be a threat to the habitat or birds. However, some of these sites have been heavily grazed in the last two years, with very little cover remaining. As marine plains are prime grazing habitat, it is not surprising that no substantial tracts are in protected areas in Queensland.

There has been a substantial loss of habitat, much of it probably irreversible, for Australian Painted Snipe in south-eastern Australia, particularly in the Murray-Darling basin, formerly considered the core area of occurrence (Rogers *et al.* 2005). Recent extended drought has further diminished habitat availability in the region.

The evidence of regular migration in this paper suggests the need to conserve habitat for Australian Painted Snipe, particularly seasonal and ephemeral wetlands, in north-eastern Australia as well as in south-eastern Australia. Security of habitat is needed at both ends of the migration system. And whereas loss of habitat due to water harvesting may not be a present concern on much of the marine plain system of eastern Queensland, plans for agricultural and other development continue to be put forward.

The very specific ecological niche Australian Painted Snipe favour requires a series of highly productive wetlands throughout the year.

CONCLUSIONS

It is probable that a significant proportion of the eastern Australian population of Australian Painted Snipe migrates to coastal tropical Queensland in the period from February to August and also to inundated wetlands in western Queensland when these are available.

Some of these birds breed in the abundant wetlands available in early autumn. Australian Painted Snipe migration to the region apparently occurs when conditions are optimal for breeding, that is, flooded seasonal wetlands with falling water levels and abundant exposed mud (Marchant & Higgins 1993), and departure apparently occurs when little suitable habitat remains.

ACKNOWLEDGEMENTS

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AMAZING INITIAL RESULTS FROM THE DEPLOYMENT OF ENGRAVED LEG FLAGS ON BAR-TAILED GODWITS *LIMOSA LAPPONICA* IN VICTORIA, AUSTRALIA

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INTRODUCTION

Plain orange leg flags have been used on waders caught and banded in Victoria since December 1990. Individually engraved leg flags (ELFs) have been used on Pied *Haematopus longirostris* and Sooty Oystercatchers *Haematopus fuliginosus* in Victoria since 2003, on Ruddy Turnstones Arenaria interpres in south-east Australia since 2004 and on many species of migratory waders in north-west Australia since 2005. The prime purpose of using ELFs was to facilitate the resighting of birds in the field in order to determine survival rates, i.e. without the need to recapture them. This has been very successful, with up to 80% of individuals being sighted again.

An added bonus has been an ever increasing flow of sightings of ELF birds overseas as flag-sighting enthusiasts and photographers became aware of such birds. These records are technically recoveries – because the band number of each individual bird is known. They have greatly increased the value of each sighting over that of a bird carrying a plain flag, because the banding date etc. is known.

In 2009 it was therefore decided to extend the use of ELFs in Victoria, initially starting on species with high resighting rates such as Bar-tailed Godwit *Limosa lapponica* and Red Knot *Calidris canutus*. The prime purpose of using ELFs on these species in Victoria was to gain more detailed information on migratory movements. Resighting for survival rate estimates would be particularly difficult in Victoria with most Bar-tailed Godwit and Red Knot occurring in relatively inaccessible areas such as Corner Inlet and Swan Island/Mud Islands.

This note records the initial most successful results which have derived from the ELF program on Bar-tailed Godwits. It only deals with the movements away from marking areas. The authors are those who have been most closely involved in putting ELFs on Bar-tailed Godwits, the person who has maintained the sighting database and who extracted the information for this paper, and the two people in New Zealand who were responsible for most of the resightings there.

FLAGGING

Table 1 shows the number of orange ELFs put on Bar-tailed Godwits in Victoria since this process was commenced in February 2009. Catching in summer (February) and in winter (June) in Corner Inlet has been particularly successful. The catches have contained a high proportion of first year birds because in the last two summers there have been many juveniles present following two successive good breeding seasons in Alaska. All the birds caught in winter were immatures, with approximately 75% being first year birds.

On all occasions the ELF was placed on the right tibia (the same place which the plain orange flag used to be located), with the metal band on the left tarsus. A total of 625 orange ELFs have now been deployed, with 283 in the first year (August 2009) and 342 in the second year (September 2010).

Table 1. Engraved orange leg flags put on Bar-tailed Godwits in Victoria, Australia.

2008/09 season	**Location**	**Number of birds banded with engraved leg flagged**
7/2/09	Clonmel Island, Corner Inlet	81
9/2/09	Barry Beach, Corner Inlet	29
23/6/09	Clonmel Island, Corner Inlet	173
TOTAL		**283**
2009/10 season		
23/11/09	Mud Islands	3
1/2/10	Rhyll	32
10/2/10	Dream Island, Corner Inlet	150
28/6/10	Clonmel Island, Corner Inlet	157
TOTAL		**342**
TOTAL – All seasons		**625**

Table 2. Sightings of orange ELF Bar-tailed Godwits (Data to 31/7/2010)

Sighting Location		Number of individual birds
North Island, New Zealand		32
South Island, New Zealand		11
Japan		6
South Korea		3
Queensland	} same}	2
New South Wales	} bird }	1
Total		**55**

FLAG SIGHTINGS

Amazingly there have been 53 different individuals resighted away from the flagging areas up until the end of July 2010 (Table 2). All but one of these was originally marked in the 08/09 season, giving a distant resighting rate of 18% already on those birds.

Sightings in New Zealand

Not surprisingly the majority of resightings (43) have come from New Zealand – 32 in North Island and 11 in South Island. This is because a high proportion of first year Bar-tailed Godwits in Victoria move across the Tasman Sea to New Zealand during their second year, thereafter becoming New Zealand "citizens" (Wilson et al 2007). Of the sightings in New Zealand 34 relate to birds originally marked as juveniles and seven to birds in their second year, with only two apparent adults (2+) changing location.

The timing of the resightings in New Zealand is particularly enlightening. Firstly there was a most unexpectedly quick trans-Tasman movement with one bird (ELF 95) marked at Barry Beach on 9th February 2009 being seen near Auckland only seven weeks later (29th March). This is the first time there has been any indication that such movements can take place at the same time as the adult Bar-tailed Godwits are moving in the opposite direction on their way back to their breeding grounds.

The next sighting in New Zealand was not until late September and then there were eight sightings in October and eight more in November. These results tend to confirm previous views that the main trans-Tasman movements of immature birds take place in the late September/November period. Twelve of the birds which were subsequently seen in New Zealand were still in Corner Inlet on 16 September (Rob Schuckard observations). Many of the birds which have crossed to New Zealand have subsequently been resighted there several times. Thirty-two had moved to North Island and 11 to South Island.

Sightings in Asia and elsewhere in Australia

There have so far been six Bar-tailed Godwits with orange ELFs sighted in Japan and three in South Korea. As would be expected, most of these were flagged as adult birds or had reached at least the age of three by the time they were resighted.

However a considerable surprise has been the sighting of two different Bar-tailed Godwits in Japan which were only two years old. Previous information from recoveries of Australian Bar-tailed Godwits has suggested that they do not migrate northwards for the first time until age three. Both birds were seen at the same place by the same observer on 25th May. This is a rather late date as many Bar-tailed Godwits would normally have already reached their breeding grounds in Alaska by the last week in May (McCaffery & Gill 2001).

The two resightings in Queensland and one in New South Wales all relate to the same individual which was probably on southward migration back to its non-breeding area in Victoria.

CONCLUSIONS

With the unexpectedly high "dividends" already received from the first year's investment in ELFs for Bar-tailed Godwits the future looks extremely promising. With even more birds flagged in 09/10 than in 08/09 there should be another huge flood of sightings from New Zealand starting in late September/October 2010. Increasingly, as birds mature, we can also expect more sightings of birds on migration through Asia. And best of all it would be nice to have one seen on its breeding grounds in Alaska!

The ELF program has already shown an unusual mid-season migration across the Tasman by one bird and will gradually produce more quantitative information on the timing of the main trans-Tasman movement of immature birds. Further evidence should also accrue concerning the age of first northward migration for Bar-tailed Godwits.

ACKNOWLEDGEMENTS

As always, scientific results on wild birds are highly dependent on critical input by a wide range of people. VWSG members are thanked and congratulated on their perseverance in catching the godwits, especially in Corner Inlet. It took four consecutive days, for example, in June 2010 to achieve the most successful catch on 28th June. The huge amount of time spent by New Zealand wader enthusiasts, particularly Tony Habraken and Rob Schuckard, scanning wader flocks for flagged birds is greatly appreciated. Without the dedication and perseverance, and systematic recording and reporting of resightings by such people, a task efficiently coordinated by Adrian Riegen, results such as those detailed in this note could not have been obtained. Heather Gibbs set up and managed the database for storing all the ELF reports.

Special thanks also go to ChungYu Chiang in Taiwan who arranged for the manufacture of all the engraved leg flag blanks and to Doris Graham and the teams from the VWSG who spent many hours carefully forming the flags.

The Australian Banding Office and the Victorian Department of Sustainability and Environment are thanked for providing the necessary permits.

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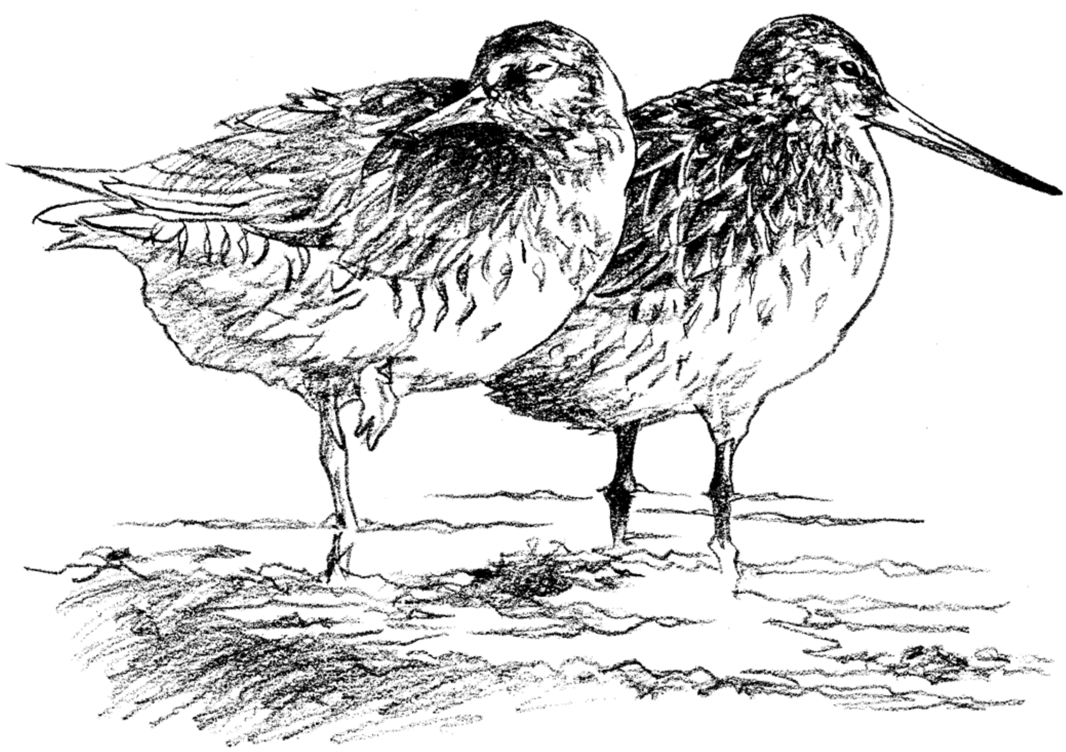

A NOTE ON THE PLOVERS WINTERING IN THE NORTHERN TIP OF RUPAT ISLAND, RIAU PROVINCE, SUMATRA, INDONESIA

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A survey of plovers was carried out on 18-19 February 2005 at the northern tip of Rupat Island, Riau Province, Sumatra, Indonesia. 256 plovers of four species were recorded: Lesser Sand Plover *Charadrius mongolus* (78%), Greater Sand Plover *Charadrius leschenaultii* (12%), Kentish Plover *Charadrius alexandrinus* (8%) and Malaysian Plover *Charadrius peronii* (2%). A leucistic Lesser Sand Plover was observed on 18 February 2005. This rare phenomenon is possibly the first record for leucistic Lesser Sand Plover in Indonesia.

INTRODUCTION

Rupat Island is an island in Riau Province (Sumatra) located in the mid-way between Sumatra and Peninsular Malaysia. The Island with total 70,300 ha geographically located in 01°70,2'-2° 5'N & 101° 30,5'-101° 72' E. Although not defined as an Important Bird Area in Sumatra based on Holmes & Rombang (2001), Rupat Island is the most important site for migratory raptors in Sumatra. Zalles & Bildstein (2000) estimated migrants move across Rupat Island from Bengkalis Island, 50 km to the North West and directly across from Tanjung Tuan (Cape Rachado) in Malaysia, where a total of 1,080 Oriental Honey Buzzard *Pernis ptilorhynchus* crossings were counted at Teluk Ruh Rupat Island on 19 February 2005 (Iqbal *et al.* 2009).

Located in the middle between Sumatra and Peninsular Malaysia, Rupat Island is a part of Riau Archipelago, Sumatra, Indonesia. Geologically, Riau Archipelago also borders with Lingga Archipelago and Singapore Island (Figure 1). There is very little information on shorebirds in Riau and Lingga Archipelago. Although the east coast of Sumatra and west coast of Peninsular Malaysia have been reported as important migrating sites for shorebirds in the East-Asian Australasian flyway (Li *et al.* 2006, Crossland *et al.* 2009, Iqbal *et al. in prep*), most of the shorebirds reported in Riau and Lingga Archipelago are recorded in small numbers (Marle & Voous 1988, Rajathurai 1996, Seng 1997, Crossland & Sinambela 2005). In this paper, we report the occurrence of four species of plovers found wintering in Rupat Island on 18-19 February 2005. It is hoped that this report will increase our knowledge about the wader community and its distribution along east coast of Sumatra, as one important Island as migratory shorebird in East Asian

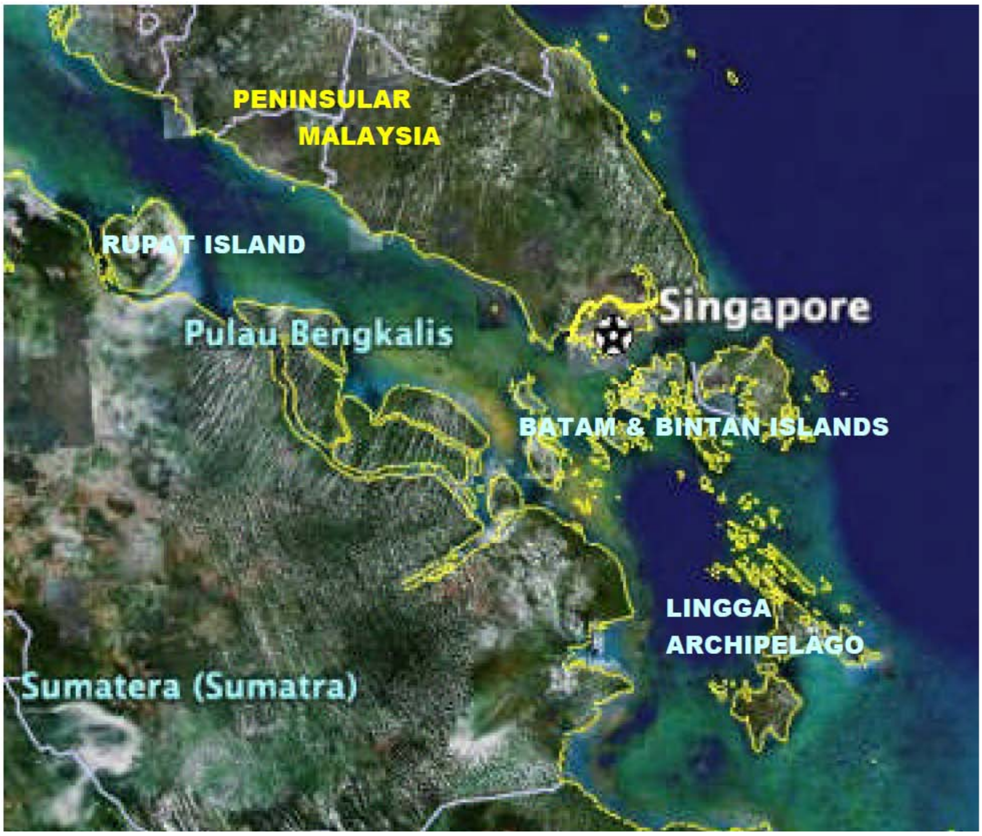

Figure 1. Map of Rupat Island and the Riau Archipelago, Indonesia.

Australasia flyway.

METHODS

A survey of shorebirds on the sandy beach at Teluk Ruh village northern tip of Rupat Island was carried out on 18-19 February 2005. Geographically Teluk Ruh located at 02°06' N & 101°41' E (Figure 2). Administratively, Teluk Ruh village located at Rupat Utara sub-district, Bengkalis district, Riau Province, Indonesia. All shorebirds were observed using a 10x magnification binoculars. Observations of shorebirds were made following the techniques outlined in Howes & Bakewell (1989).

RESULTS

Four species of plovers were recorded wintering in the northern tip of Rupat Island on 19 February 2005 (Table 1).

Species accounts

Lesser Sand Plover *Charadrius mongolus*

Approximately 200 birds were counted on 19 February 2005 during the survey (Figure 3). A leucistic Lesser Sand Plover was observed in Sandy Beach at northern tip of Rupat Island on 18 February 2005 (Figure 4). A leucistic bird is defined here as one whose whole plumage or part thereof is white due to loss of pigment in feathers, but with soft parts of normal colour, including the irides which are usually black (Harrison 1963, Buckley 1982). This condition may be complete or partial, symmetrical or asymmetrical and the criteria have been widened to include those birds with soft parts that are abnormally coloured (Buckley 1982). Aberrant plumage for shorebirds in Indonesia has been reported for Snipes, but it is not previously for Lesser Sand Plover (Bas van *Balen pers. comm*).

There were a maximum of 38 birds in Batam on 6 September 2002 (Crossland & Sinambela 2005). Lesser Sand Plover were reported wintering in Tanah Merah (Singapore) beach from August 2000 to March 2001 with the largest number, 104 birds, recorded on 6 October 2001 (Crossland 2002). It was also reported in large numbers from Singapore during the 1997-2001 AWC (Asian Waterfowl Census) count, with the maximum count of 1,000 birds being in 1997 and minimum 591 birds in 1998 (Li & Mundkur 2002, Gan & Ramakhrisnan 2005).

Greater Sand Plover *Charadrius leschenaultii*

A total of up to 30 birds were observed on a sandy beach at northern tip of Rupat Island on 19 February 2005. A few of the birds observed had partial breeding plumage (see Figure 5). Greater Sand Plover have been previously recorded on Riau and Lingga Archipelago's (Marle & Voous 1988). During the AWC count 1997-2001 in Singapore, 61 birds were reported on 1999 and 25 birds on 2001 (Li & Mundkur 2002).

Kentish Plover *Charadrius alexandrinus*

A total of up to 20 birds were counted during this survey on 19 February 2005. One bird observed bathing in the water at sandy beach on 18 February 2005 (see Figure 6). Rajathurai

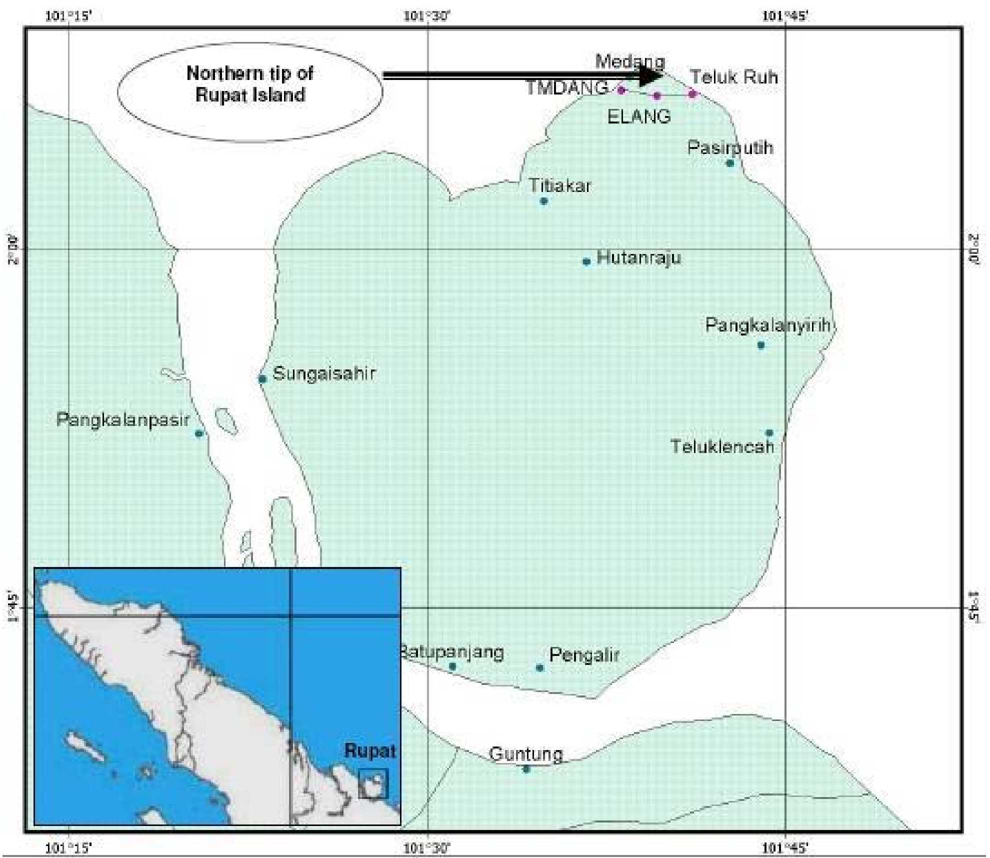

Figure 2. Map of survey area on the northern tip of Rupat Island, Sumatra.

Table 1. Maximum count of wintering plovers at northern tip Rupat Island, Sumatra, Indonesia.

No	Species	Number	Percentage
01	Lesser Sand Plover	200	78
02	Greater Sand Plover	30	12
03	Kentish Plover	20	8
04	Malaysian Plover	6	2
	TOTAL	**256**	**100%**

Figure 3. Flocks of plovers on Rupat Island which were dominated by Lesser Sand Plover (© Muhammad Iqbal).

(1996) reported 5 birds near Bintan on 21 November 1994 & several seen in Karimun Besar (Riau Archipelago) on 15 March 1993 (Ollinton & Poh 1996). Only one bird recorded in Tanah Merah beach (Singapore) on 6 October 2001 during shorebird survey between 12 May 2001 to 13 July 2002 (Crossland 2002). Recorded in small number during AWC count in Singapore from 1997-2001, where only 1 bird in 1997, 6 birds in 1999 and 2 birds in 2001 (Li & Mundkur 2002).

Malaysian Plover *Charadrius peronii*

At least six birds were sighted on 19 February 2005. Malaysian Plover has been widely recorded in small numbers in Riau Archipelago (Batam, Mapor and Galang) and Lingga Archipelago (Singkep) (Marle & Voous 1988). A further breeding record with two chicks was made at Pasir Panjang (Riau Archipelago) on 18 April 1993 (Seng 1997). Crossland (2002) recorded Malaysian Plover on its list during shorebird observation in Tanah Merah (Singapore) Beach between 12 May 2001 to 13 July 2002, with the largest number of 21 birds being recorded on 22 September 2001. Li & Mundkur (2004) reported eight birds during AWC count 1997-2001.

DISCUSSION

256 plovers were recorded in northern tip of Rupat Island on 19 Feburary 2005. Lesser Sand Plover was the most abundant species and made up 78% of the total count, followed by Greater Sand Plover 12%, Kentish Plover 8% and Malaysian Plover 2% (see Table 1).

Singapore Island is the next most adjacent Island within Riau and Lingga Archipelago and the largest number of records for Lesser Sand Plover with a maximum of 1,000 birds in 1997 (Li & Mundkur 2002). Two other plovers (Greater Sand Plover and Malaysian Plover) were also recorded at the northern tip of Rupat Island but in lower numbers than those recorded on Singapore Island. The maximum number of Greater Sand Plover on Singapore Island on the AWC count in 1999 was 61 birds (Li & Mundkur 2002), compared with 30 birds from Rupat Island on 19 February 2005. The largest number of Malaysian Plover recorded in Singapore Island was 21 birds on 22 September 2001 (Crossland 2002), compared with six birds in Rupat Island on 19 February 2005. The number of Kentish Plover recorded on the northern tip of Rupat Island was possibly the largest record among the Riau and Lingga Archipelagos and Singapore Island, with 20 birds counted in Rupat Island on 19 February 2005, compared with a

Figure 4. An leucistic Lesser Sand Plover on Rupat Island on 18 February 2005 (© Lim Kim Chye).

Figure 5. A Greater Sand Plover with partial breeding plumage on Rupat Island on 19 February 2005 (© Muhammad Iqbal).

maximum count of six birds in the AWC count 1999 in Singapore (Li & Mundkur 2002).

Observations of a leucistic Lesser Sand Plover on 18 February 2005 in the northern tip of Rupat Island is possibly the first record for this species in Indonesia. Aberrant plumage in shorebirds in Indonesia were previously confined to Snipes (Bas van *Balen pers. comm*). In the East-Asian Australasian Flyway records of aberrant plumage are known for Bush Thick-knee *Burhinus magnirostris*, Sooty Oystercatcher *Haematopus fuliginosus*, Red-capped Plover *Charadrius ruficapillus*, Masked Lapwing *Vanellus miles*, Latham's Snipe *Gallinago hardwickii*, Bar-tailed Godwit, *Limosa lapponica*, Black-tailed Godwit *Limosa limosa*, Great Knot *Calidris tenuirostris*, Red-necked Stint *Calidris*

Figure 6. A Kentish Plover bathing in sandy beach on 18 February 2005 (© Muhammad Iqbal).

ruficollis, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper *Calidris ferruginea* and Double-banded Plover *Charadrius bicinctus*. (Graham *et al.* 2005).

The difference in number of plovers between Riau Archipelago, Lingga Archipelagos and Singapore Island does not necessarily show that Singapore Island has better sites for migratory shorebird than among the Archipelago's during the over wintering season. The number of birdwatchers who are available to conduct regular surveys in this area is low and is likely to have affected the results. If intensive surveying and regular monitoring of shorebirds could be implemented on Rupat Island, Riau and Lingga Archipelagos, it will help to increase our knowledge and understanding of shorebird community in Sumatra, as one important migratory shorebird site in East-Asian Australasian flyway. This short survey of plovers on the northern tip of Rupat Island has demonstrated the possibility of these small Islands along the east coast of Sumatra as buffer zone for major migratory site in the mainland.

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WINTERING SHOREBIRDS MIGRATE DURING JANUARY 2009 ALONG THE EAST COAST OF NORTH SUMATRA PROVINCE, INDONESIA

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Keywords: Wintering, shorebirds, January, North Sumatra, Indonesia

A survey of the wader populations was carried out at three sites in east coast of North Sumatra Province (Indonesia) during January 2009. A total of 27,869 waders were counted of 20 species. The east coast of north Sumatra province was shown to be an important site for East Asian-Australasian migratory wader populations particularly for Green Sandpiper, Terek Sandpiper, Lesser Sand Plover, Eurasian Curlew, Eastern Curlew, Black-tailed Godwit, Bar-tailed Godwit, Common Redshank and Asian Dowitcher which occur in concentrations exceeding 1% of the estimated East Asian Australasian flyway population. We recommend that east coast of North Sumatra province be designated as a Wetland International importance under the Ramsar Convention.

INTRODUCTION

Indonesia can be expected to be important for shorebirds during the non-breeding and migration periods, with birds on passage to Australia likely to pass through it on both northward and southward migration. Most internationally important sites recorded are in Sumatra (Bamford *et al.* 2008). However it is only during 1980's-1990's that detailed information on the distribution of coastal waterbirds has become available. In those years, large numbers of waders were recorded on the mudflats of the Southern Sumatra (Silvius 1988; Danielsen & Skov 1989; Verheugt *et al.* 1990; Verheugt *et al.* 1993).

Crossland *et al*. 2009 reported sites of international importance for shorebirds in Asahan regency: in North Sumatra province. Other reports from the northern parts of Sumatra mostly recorded in small size numbers of shorebirds (Marle & Voous 1988; Ollington & Parish 1989; Holmes 1996; Crossland 2000; Crossland & Sinambela 2005; Crossland & Sinambela 2009; Crossland *et al.* 2006). Crossland *et al.* (2009) reported that the east coast of Sumatra province was an important area for refueling shorebirds on migratory as well as over wintering shorebirds for the East Asian Australian flyway. In this paper, we report our records for waders at three sites in the east coast of North Sumatra province on the non-breeding (over wintering) waders during 3-4 January 2009. This study confirms that the east coast of North Sumatra province is a significance habitat for shorebirds in the East Asian Australian flyway.

METHODS

Three selected sites were visited using small boats with outboard motors during 3-4 January 2009. Waders were counted during the low tide when they were present on the mudflat. Counting ended before high tide when the bird starting flying to roosts in the mangroves or inland plains. We found that the most effective method was to count from the boat as it was driven along the shores of the mudflat. Wide mudflats areas were counted by walking along the shore, using binoculars and telescopes to count the more distant areas.

Standard site description and waterbird count forms (Asian Waterbird Census form) designed and tested by Wetlands International were used for the surveys. Site description forms enabled data to be collected on types of wetlands, vegetation, uses of and threats to wetlands. Waterbird count forms provided a standard list of all waterbirds, against which numbers could be tallied (the standard list included other waterbirds; e.g. sandpipers, plovers, Redshank).

Study Area

Three selected sites were visited to conduct shorebird surveys along the east coast of North Sumatra province (Figure 1). East coast of Sumatra province was listed as one of Important Bird Areas by Holmes & Romabang (2001). The sites mentioned here are located following from northern to southern part of North Sumatra province; Tanjung Balai, Pantai Ancol and Bagan Percut.

Tanjung Balai (mouth of Asahan)

Tanjung Balai coast located in Bagan Asahan village, Tanjung Balai municipality, Asahan district north Sumatra province Indonesia. The area is very close to dense settlement because Tanjung Balai is capital city of district. However, good mangrove forest still occurs behind the mudflat. Tanjung Balai Asahan was visited in 3 January 2009.

Pantai Ancol

Pantai Ancol administratively is located in Rugemuk village Labu sub-district Deli, Serdang district, North Sumatra province. Pantai Ancol is a recreation area in Deli Serdang. It is easy to reach by car. Although a small mangrove forest still occurs, there has been considerable conversion of mangrove forest for fish ponds and recreation and their loss

Figure 1. Survey sites, North Sumatra province; Tanjung Balai, Pantai Ancol and Bagan Percut. Shorebirds surveyed on 3-4 January 2009.

is a major problem for shorebird conservation in the future. Pantai Ancol was visited in 3 January 2009.

Percut/Bagan Percut

Percut or Bagan Percut is located administratively located in Bagan Percut Sei Tuan sub-district, Deli Serdang district. Percut is one of many birding sites in North Sumatra province. The area is very close to Medan, capital city of North Sumatra province. The mangrove forest is still present, and some large threatened waterbird (eg. Milky stork *Mycteria cinerea* and Lesser adjutant *Leptoptilos javanicus*) are also found here. Percut was visited in 4 January 2009.

SPECIES ACCOUNT

An annotated list proved below provides details of waders recorded during survey on 3 January 2009. Distribution and number of species are also summarized in Table 1. The sequence and nomenclature of each species follow Sukmantoro *et al.* 2007 as reference for Indonesian birdlist.

Common Greenshank *Tringa nebularia*

A total of 50 bird in Pantai Ancol on 3 January 2009 and not recorded or overlooked in other sites. Marle & Voous (1988) recorded Common Greenshank from Percut on 14 February-2 March 1977 and 7 June 1979 without detail. Eight birds observed on 19 December 1995 at Sungai Asahan and total of 5 birds in Pantai Sejara and West Sejara on 28 March 2002 (Crossland *et al.* 2009).

Common sandpiper *Actitis hypoleucos*

Approximately up to 100 birds counted in Pantai Ancol on 3 January 2009. Widespread at each site in small numbers. Crossland *et al.* (2009) reported a maximum of 40 birds counted on Asahan River on 19 December 1995.

Green Sandpiper *Tringa ochropus*

Approximately 10 birds recorded in Bagan Percut on 4 January 2009. Marle & Voous (1988) reported only two sightings from Sumatra; one record from Northern Sumatra (Aceh) before records from Southern Sumatra on October-November 1988 (Verheugt *et al.* 1993; Holmes 1996).

Marsh Sandpiper *Tringa stagnatilis*

Marle & Voous (1988) did not record this species in North Sumatra province. A total of 236 birds recorded in Pantai Sejara on 28 March 2008 (Crossland *et al.* 2009). There were at least 2 birds in Percut on 4 January 2009.

Terek Sandpiper *Xenus cinereus*

Marle & Voous (1988) did not record this species in North Sumatra province. There were 12 birds on 19 December 2005 in Asahan River and a total 254 birds from Pantai Sejara and West Tanjung Tiram (Crossland *et al.* 2009). A

Table 1. Shorebird counts in North Sumatra Province during 3-4 January 2009.

Species	Tanjung Balai	Pantai Ancol	Bagan Percut	TOTAL	TOTAL EAA POPULATION	% FROM EAA
Common Greenshank		50		50	60,000	0.08
Common Sandpiper	10	100	25	135	25,000	0.54
Green Sandpiper		10		10	25,000	**1.2**
Marsh Sandpiper			2	2	100,000	0.002
Terek Sandpiper		2500	250	2750	50,000	**5.5**
Broad-billed Sandpiper			20	20	25,000	0.08
Pacific Golden Plover		250	150	400	100,000	0.4
Lesser Sand Plover	750	3000	300	4050	130,000	**3.11**
Kentish Plover		100		100	100,000	0.1
Ruddy Turnstone		23		23	35,000	0.065
Eurasian Curlew	1417	200	2000	3617	40,000	**9.04**
Eastern Curlew	600	300	800	1700	38,000	**4.47**
Whimbrel	200	50	500	750	100,000	0.75
Black-tailed Godwit		1500	1200	2700	160,000	**1.68**
Bar-tailed Godwit		800	600	1400	325,000	**1.68**
Common Redshank		4000	500	4500	75,000	**6**
Great Knot			100	100	380,000	0.02
Red Knot		5		5	220,000	0.08
Curlew Sandpiper		2	5	7	180,000	0.003
Asian Dowitcher		150	400	550	23,000	**32.39**
Unidentified	1500	2500	1000	5000		
TOTAL	**4,477**	**15,540**	**7,852**	**27,869**		

Note: EAA = East Asian Australian Flyway (based on Bamford *et al.* 2008).

total of 2750 birds were recorded from Pantai Ancol and Bagan Percut on 3-4 January 2009.

Broad-billed Sandpiper *Limicola falcinellus*

A total of 20 birds were observed in Bagan Percut on 4 January 2009. Marle & Voous (1988) reported only 2 specimens from Sumatra, collected on the coastal mudflats of North Sumatra from Belawan and Pantai Cermin.

Pacific Golden Plover *Pluvialis fulva*

A total of 400 birds were recorded at Pantai Ancol and Bagan Percut during this survey. Marle & Voous 1988) reported they were very common along the coast and in open country in lowlands and hills up to 1000 m at Balige, Lake Toba, North Sumatra province, usually in flocks of up to 50 or more. Crossland *et al.*)2009) did not record this species in their list but a total of 163 Grey Plover *Pluvialis squatarola* reported in Pantai Sejara and West Tanjung Tiram on 28 March 2002.

Lesser Sand Plover *Charadrius mongolus*

A total of up to 4050 birds were recorded during this survey. This is second largest number of waders observed during the survey after Common Redshank. Marle & Voous (1988) reported Lesser Sand Plover occurred from June-July 1979 in North Sumatra, in Deli Serdang. Crossland *et al.* (2009) recorded a total of 1520 birds at Pantai Sejara and west Tanjung Tiram on 28 March 2002.

Kentish Plover *Charadrius alexandrinus*

There were at least 100 birds of this species in Pantai Ancol on 3 January 2009. Marle & Voous (1988) recorded them at three sites in North Sumatra province without detail, Pantai Cermin, Deli Serdang and Perbaungan.

Ruddy Turnstone *Arenaria interpres*

Approximately 23 birds were recorded in Pantai Ancol on 3 January 2009. Marle & Voous (1988) did not record this species in North Sumatra province. A total of 224 birds were recorded from Pantai Sejara and West Tanjung Tiram on 28 March 2002 (Crossland *et al.* 2009).

Eastern Curlew *Numenius madagascariensis*

A total of up to 1700 Eastern Curlew were recoded from all sites during this survey. There have been no reports of this species from the Northern part of Sumatra (Marle & Voous 1988) since a record of 117 birds in mouth of Asahan River on 2 September 2006 (Crossland *et al.* 2009).

Eurasian Curlew *Numenius arquata*

A total of up to 3617 Eurasian Curlew was recorded from all sites during this survey. Marle & Voous (1988) reported the occurrence of this species from June-July 1979 in Deli Serdang, North Sumatra province. A total of 405 were recorded by Crossland *et al.* (2009) in Asahan River mouth on 25 September 2005.

Whimbrel *Numenius phaeopus*

A total of 750 Whimbrel from all sites were recorded during this survey. In Bagan Percut, the race *phaeopus* race was seen on 4 January 2009 in North Sumatra province (Figure 2). This is the second sighting for the *phaeopus* race, the first record being in June-July 2008 from South Sumatra (Iqbal & Ridwan 2009). Marle & Voous (1988) reported that Whimbrel occurred from June to July 1979 in Deli Serdang suggesting non-breeding summering. There was an inland record for Lake Toba on December 1988 (Holmes 1996). Crossland *et al.* (2009) reported 405 birds in Asahan River mouth on 25 September 2005.

Figure 2. A couple of Whimbrel showing phaeopus race in Bagan Percut.

Black-tailed Godwit *Limosa limosa*

A total of 2700 birds were recorded from Pantai Ancol and Bagan Percut during this survey. There are a few previous records from Percut, North Sumatra (Marle & Voous 1988). (Crossland *et al.* 2009) reported up to 4465 birds in Pantai Sejara and Tanjung Tiram on 28 March 2002. The largest count for Black-tailed Godwit in South-east coast Sumatra province was of up to 43,000 birds on July-August 1985 (Danielsen & Skov 1989).

Bar-tailed Godwit *Limosa lapponica*

Up to 1400 birds were recorded from Bagan Percut and Pantai Ancol on 3-4 January 2009. A few records have previously been noted from North Sumatra from Tanjung Tiram and Percut (Marle & Voous 1988). (Crossland *et al.* 2009) counted up to 125 birds on 25 September 2005 in Asahan River.

Common Redshank *Tringa totanus*

Common Redshank was the most abundant wader counted during this survey with total of 4,500 birds. Records from North Sumatra province on June-July 1979 in Deli Serdang suggest non-breeding summering occurs (Marle & Voous 1988). Crossland *et al.* (2009) reported of up to 1256 birds on 28 March 2002 in Pantai Sejara and Tanjung Tiram.

Curlew Sandpiper *Calidris ferruginea*

Marle & Voous (1988) recorded this species at three sites in North Sumatra province in Belawan, Deli and Percut, but without detail. Crossland et al. (2009) reported a total of 546 birds from Pantai Sejara & West Tanjung Tiram on 28 March 2002. Two birds were seen in Pantai Ancol on 3 January 2009 and 5 birds in Percut on 4 January 2009.

Great Knot *Calidris tenuirostris*

Approximately 100 birds were recorded from Bagan Percut on 4 January 2009. There are no previous reports from Sumatra (Marle & Voous 1988) after 380 birds on Pantai Sejara on 28 March 2002 (Crossland *et al.* 2009).

Red Knot *Calidris canutus*

Five birds were recorded during this survey, but it may be possible that some birds went unrecorded among unidentified shorebird flocks. Marle & Voous (1988) reported a few birds on 7 June 1979 in small flock at Percut, North Sumatra. Approximately 400 birds were observed in Bagan Percut on 14 April 2007 (Crossland & Sinambela 2009).

Asian Dowitcher *Limnodromus semipalmatus*

During this survey, at least 550 birds were observed at Pantai Ancol and Bagan Percut on 3-4 January 2009. There are no previous reports from Sumatra (Marle & Voous 1988) after 7957 birds on 28 March 2002 in Pantai Sejara and Tanjung Tiram (Crossland *et al.* 2009).

DISCUSSION

With total up to 27,869 waders recorded from three sites in North Sumatra province, it is clear that east coast of North Sumatra province is important habitat and feeding ground for migratory non-breeding shorebirds in East Asian Australasian flyway. This survey data shows that nine migratory wader species; Green Sandpiper, Terek Sandpiper, Lesser Sand Plover, Eurasian Curlew, Eastern Curlew, Black-tailed Godwit, Bar-tailed Godwit, Common Redshank and Asian Dowitcher occur in concentrations exceeding 1% of the estimated East Asian Australasian flyway population (Bamford *et al.* 2008).

The largest count of shorebirds at the three survey sites was at Pantai Ancol where 15.540 shorebirds were counted (Figure 3). The second largest site was at Bagan Percut where there was a maximum of 7,852 shorebirds (Figure 4). The lowest density site was Tanjung Balai which supported 4,477 shorebirds. Large areas of the intertidal mudflats and coastal wetlands along the coast of North Sumatra remain unsurveyed. Crossland *et al.* 2009 predicted that during peak migration periods the entire coastline would support upwards of 100,000 waders. Verheugt *et al.* (1990) estimated 500,000 waders are dependent on the coastal mudflat of South

Figure 3. A photo of at least 6000 shorebirds in Pantai Ancol (total number in flight and feeding).

Figure 4. Mix flock of shorebirds foraging together in Bagan Percut.

Sumatra. Although estimated to support fewer birds than the South Sumatra coast the east coast of North Sumatra province is a significant area for migratory non-breeding shorebirds in the East Asian Australasian.

Beside large number of migratory shorebirds, the east coast of North Sumatra province supports sizeable populations of other waterbird including the globally threatened Milky stork *Mycteria cinerea* and Lesser Adjutant *Leptoptilos javanicus*. Some areas in North Sumatra Province are protected as conservation area or important conservation area (Wibowo & Suyatno 1997; Wibowo & Suyatno 1998). However, based on the occurrence of at least 27,869 waders, it is recommended that the east coast of North Sumatra province be designated as Wetland International Importance under the Ramsar convention to protect shorebird conservation in the area.

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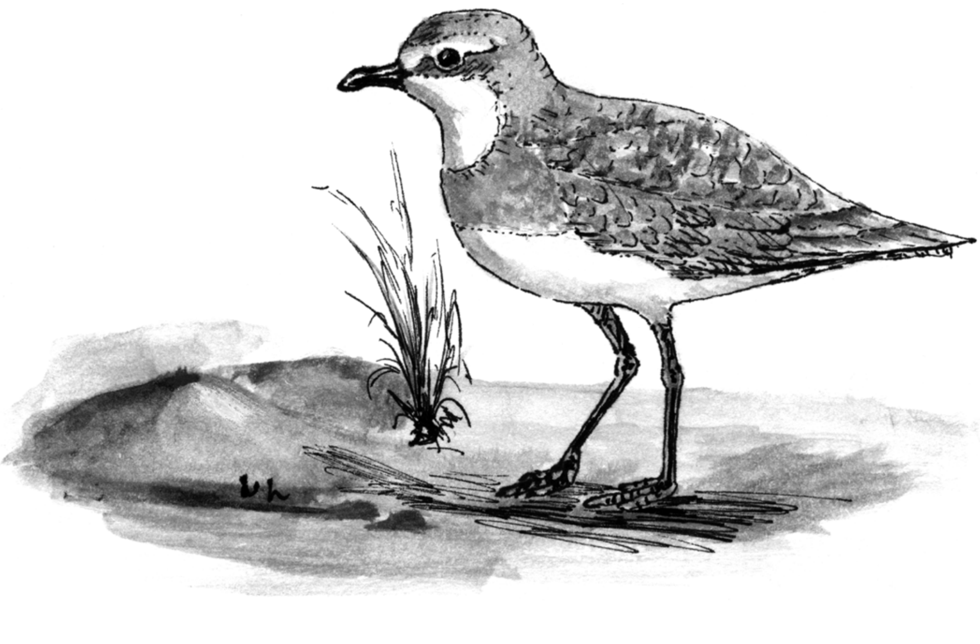

STUDIES OF THE AUSTRALIAN PIED OYSTERCATCHER IN SOUTH-EAST TASMANIA 1964-2009.

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The south-east Tasmanian population of the Australian Pied Oystercatcher *Haematopus longirostris* has been studied almost continuously since 1964, involving biannual counts, monitoring the movements of individually marked birds and investigation of its breeding biology. The results indicated that the population was largely sedentary.

Following an extended period of relatively stable numbers for the period 1964 – 1985, there was an almost three fold increase in oystercatcher numbers in the Ralphs Bay/Lauderdale area between 1987 and 2005. This increase appeared to be in conflict with widespread evidence of a decrease in breeding success.

A qualitative reconciliation of these apparently contradictory trends is proposed in which the increase in oystercatcher numbers is triggered by improvements in the environmental quality of the Derwent Estuary which have occurred progressively since the mid 1970s. It is suggested that these improvements and other factors contributed to the increased availability of food resulting in increased survival of the oystercatchers particularly immature birds. The impact of this improvement was most apparent at Lauderdale where the bay became a refuge for non-breeding oystercatchers.

Many factors have contributed to the long term decrease in breeding success of the oystercatchers including increased human recreational and commercial use of the beaches where they breed, as well as rising sea levels. As a consequence many of the traditional nest sites at or immediately above the high tide mark, which were used almost exclusively when this study commenced, became unsuitable. Individual oystercatchers adapted to this situation by using new types of nest site behind the beach front, for instance in newly created paddocks on acreage style properties where the grass was short. Other oystercatchers from the non-breeding population copied these breeding strategies and the number of breeding territories increased, including a spread into new areas of the coastline.

The net effect was an enlarged breeding population for which the average breeding success rate was lower than when the study commenced because the oystercatchers were using sub-optimal nest sites compared with the beach front sites which predominated around 1970. By 2005 this population increase had peaked and there was some evidence of the start of a decrease. It is suggested that it will be difficult for the south-east Tasmanian oystercatcher population to be sustained at current levels in the face of ongoing anthropogenic and climate related threats to the coastline. Sympathetic management is essential to the ongoing resilience of one of the most important local populations of this scarce species.

INTRODUCTION

The Australian Pied Oystercatcher *Haematopus longirostris* is relatively scarce compared with some other oystercatcher species (Taylor et. al. 2010). The global population is thought to be about 13,000 of which about 90% live in Australia, where dry conditions restrict its distribution to the coastline (Delaney & Scott 2006).

Australian Pied Oystercatchers have been studied in south-east Tasmania since 1964 when David Thomas carried out comprehensive monthly surveys of the Derwent Estuary and Pitt Water (Thomas 1968 and 1970). In 1972 the Bird Observers' Association of Tasmania (BOAT) now Birds Tasmania commenced annual summer surveys which were later extended to include winter counts as well (BOAT and Birds Tasmania Annual Bird Reports). These later surveys included Marion Bay and adjacent Blackman Bay. All of these studies were designed to provide a comprehensive assessment of the size of the migratory shorebird populations of south-east Tasmania and their trends over time. Australian Pied Oystercatchers occur at a number of additional locations in south-east Tasmania to those monitored regularly. However, as oystercatchers, especially non-breeding birds, often congregate at the same locations as the migratory shorebirds the annual counts provide a useful sample which indicates trends in the size of the oystercatcher population.

Australian Pied Oystercatchers breed throughout the south-east Tasmanian coastline (Figure 1) including the larger bays frequented by the migratory shorebirds, many smaller bays sometimes holding only one or two pairs and along a number of high energy beaches (e.g. Seven Mile Beach and Marion Bay). Systematic studies of the breeding biology of the Australian Pied Oystercatcher in the area commenced at Gorringes Beach, Mortimer Bay in 1977 (Newman 1992 and 2008), where nests were monitored each breeding season to collect information for the Birds Australia Nest Record Scheme (NRS). In addition oystercatchers of all age classes were banded and individually marked with colour bands. These studies were progressively expanded to cover much of the south-east Tasmanian coastline and the historical breeding sites used by oystercatchers at many of these locations are well documented (Anon. 1982 and Patterson 1982).

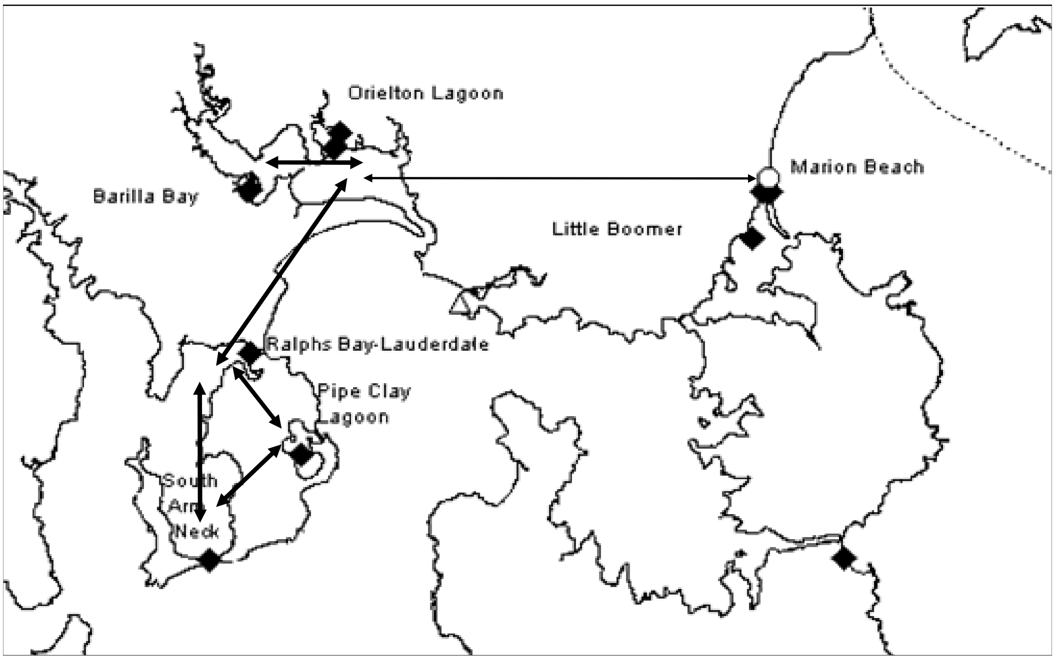

Figure 1. Study area in south-east Tasmania.

Flocks of non-breeding oystercatchers were monitored to determine the presence of colour banded birds which provided information on how immature birds moved around the south-east Tasmania coastline before eventually finding a breeding territory. In addition the survival of colour banded breeding adults was determined annually. The mortality rates of the various age classes of oystercatchers and information on density and annual breeding success in terms fledged young were used to construct a population model for south-east Tasmania which will be the subject of a subsequent paper.

These intensive studies continued until 1992/93 when one of the authors (MN) relocated to NSW. However, both authors have continued to monitor in a less intensive manner trends and changes both in the Australian Pied Oystercatcher population, their behaviour and habitat through to the time of writing. While AF continues to reside in the area and has a more comprehensive view of post 1993 changes MN has made frequent visits including a minimum of two each breeding season to Gorringes Beach to determine trends in breeding success and the survival (mortality is assumed when a bird disappears, given the sedentary nature of the population) of colour banded territorial adults (Newman 2008).

The ongoing monitoring of breeding success at Gorringes Beach indicated a decrease in success which was also discernable at a number of other locations in south-east Tasmania. Paradoxically the BA Tasmania surveys indicated a contemporaneous increase in oystercatcher numbers at Ralphs Bay, particularly at Lauderdale an area adjacent to Gorringes Beach (Fig. 1). These contradictory trends required an explanation and provided the inspiration for this paper.

The explanation provided in his paper is based on the adaptation of the behaviour of individual oystercatchers to exploit opportunities provided by natural and anthropogenic modifications to the south-east Tasmanian environment, which have ultimately resulted in change at the population level. As the observed trends and the proposed explanation were unexpected, quantitative information on environmental changes and habitat variation were not collected systematically as part of the study and some of the supporting evidence is anecdotal and thus only post-hoc analyses are possible. It is fortunate that one of the authors (AF) has a comprehensive photographic library showing changes in the area (e.g. wader roost sites) which can be used for reference.

METHODS

Population monitoring

Wader count protocols and timing were originally developed based on the results of Thomas' monthly count data (Thomas 1968 and 1970). A number of observers made synchronised high tide counts at all locations regularly carrying migratory shorebirds in south-east Tasmania. The summer count typically took place in February when the migratory wader population was at peak size before migration commenced. The corresponding mid year count of the winter population occurred before the migrant species started to arrive from their Palaearctic breeding grounds in late August. The timing of the Tasmanian counts was subsequently aligned with the national effort coordinated by the Australasian Wader Studies Group. Several years of monthly counting have been conducted at various times, particularly at Lauderdale, which is an important oystercatcher roost and foraging area.

Nest records

At Gorringes Beach the breeding sequence of every pair was comprehensively monitored annually each season between

1977 and 1992. This included visits commencing before eggs were laid, which usually occurred in early October, through to the fledging of runners. During the egg laying and incubation period typically two to three visits were made each week, more frequently at critical times to establish laying dates, hatching dates and incubation and fledging periods. Details of these visits and other breeding information like nest site descriptions were recorded on BA NRS cards. Similar, but less comprehensive monitoring was made at a number of other breeding locations. This included surveys at the end of the breeding season at some remoter beaches in the south-east Tasmanian area to determine the number of resident pairs and their breeding success in terms of fledged young (Newman and Park 1992).

Monitoring banded birds

Comprehensive banding studies were conducted using a range of techniques. Breeding adults were captured by cannon netting at high tide roosts. However, as breeding adults often remain on their territories and do not join roosting birds, breeding birds were also trapped on their nests. This did not cause any abandonment of eggs or apparent decrease in breeding success. By this combined approach all eight pairs of breeding adults at Gorringes Beach were eventually colour banded. The survival of these colour banded breeding adults was determined annually through to the 2008/2009 breeding season.

Runners were also banded annually from the 1977/78 season through to 1992/93. The survival and dispersal of individually marked runners and other first year birds captured during cannon netting was monitored by searching non-breeding flocks, both foraging and at roost for colour banded birds. In addition each breeding season extensive areas of the coastline were searched to find when and where the birds first entered the breeding population. These searches for colour marked birds included observations by a large number of observers and sensitized the community to take an interest in oystercatchers including in areas where they were less numerous.

Recoveries of banded birds were also important because they highlighted the frequency of road kills near certain high tide roosts and generated important anecdotal information on causes of mortality. These events became more prevalent after 2000 and are a portent of novel future threats to the species arising from rising sea levels and storm surges.

Results

The information reported in this section falls into two categories. Firstly there are the results of the population monitoring and banding studies involving data collected in a systematic manner based on protocols set up to address the key objectives of the study, namely to establish population trends and to quantify the basic breeding parameters of the Australian Pied Oystercatcher. However, as the study progressed it became increasingly apparent that the environment in south-east Tasmania was changing due to active management of environmental conditions such as pollutant levels, and this was impacting on the outcomes of the investigation. In the following sections we provide an indication of the environmental changes that have occurred and the way that individual oystercatchers have adapted to their changed circumstances. Of necessity this second type of information is qualitative and often of an anecdotal nature. Experience at Gorringes Beach is predominantly used and information from other breeding locations is only reported when it provides additional insights.

Total population trends

The long term trend in Australian Pied Oystercatcher numbers at Ralphs Bay/Lauderdale based on the biannual summer and winter counts conducted by Birds Tasmania (Figure 2) shows an increase from a plateau population size of around 300 before 1987 to about 800 birds in 2005. Ralphs Bay/Lauderdale numbers include birds present throughout the South Arm Peninsula including Pipeclay Lagoon, the South Arm Neck and Gorringes Beach, Mortimer Bay. The summer and winter count numbers are similar in magnitude and in overall trends. Post 2005 the numbers appear to have peaked and there is some evidence that the numbers may be either declining or stabilising around a new carrying capacity limit.

Other count information supports the observed increase in numbers shown in Figure 2. For instance MN has observed over 400 oystercatchers foraging at low tide in the bay at Lauderdale in the post 2000 period. In addition the numbers of non breeding birds foraging at Gorringes Beach during the breeding season has increased from less than 20 in the first 10 years of the study (1977-1987) to flocks exceeding 50 recently (2000-2008).

Increased distribution

During the 40 years of this study there have been substantial expansions in both the foraging and breeding range of the oystercatcher population in the Derwent Estuary.

Before 1980 records of oystercatchers in the Derwent River upstream of the Tasman Bridge were exceptional. During the 1980s, there were occasional reports of pairs breeding at upstream locations like Old Beach. Recently there have been more breeding records and flocks of up to 70 birds have been seen feeding and roosting at upstream bays.

During the 1970s AF found no oystercatcher breeding activity at a part of Five Mile Beach where a commercial *Pinus radiata* plantation had been established at edge of a steep sand cliff varying in height from 1 to 4m. Ten years later, this was one of the most productive breeding areas in south-east Tasmania supporting over 25 pairs of oystercatchers.

Territories

The prerequisites of a breeding territory are a nest site where eggs can be incubated and a supply of food for feeding the runners which is in close proximity.

At Gorringes Beach the area studied most comprehensively there were initially (1977) six breeding pairs of oystercatchers. Initially these pairs predominantly nested at the high tide mark along the 3km length of the beach. However, for a few years a pair nested in the paddocks up to 200m behind the fore-dune at the northern end of the beach, but this ceased following repeated failure

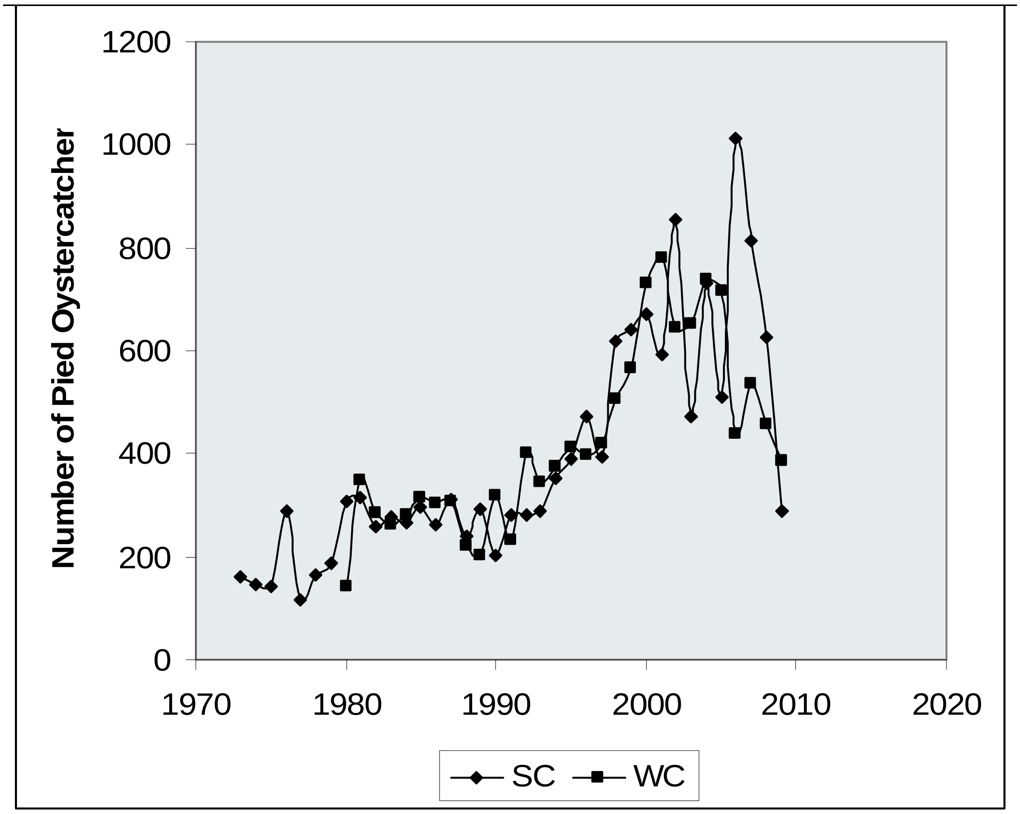

Figure 2. Variation in the number of Pied Oystercatchers at Ralphs Bay/Lauderdale based on Summer (SC) and Winter (WC) counts.

(Newman and Park 1986) and the establishment of residential buildings and a pony club in their territory.

Three pairs nested on banks of shell grit which formed where creeks flowed onto the beach. At the start of the study these creeks were shaped by scouring which occurred following periods of heavy rainfall. Two pairs nested approximately 30m apart at the extremities of a spit at the southern end of the beach. The spit and the banks at the creek entrances were primarily shell grit.

Early in the study a seventh pair established a territory on the southern side of a creek entrance in the centre of the beach. Initially the nest site was approximately 50m north of the creek entrance but in subsequent years both pairs nested on opposite sides of the creek entrance, which provided a natural border to their territories. While these birds roosted and nested in close proximity they always maintained the same north/south demarcation between their territories.

During the 1980s and 1990s the area behind the beach was progressively developed as an acreage style residential community. This resulted in improved access at both ends of the beach and greatly increased recreational use of the beach by people walking, exercising dogs, horse riding and by a few vehicles until barriers were erected to prevent their access.

In addition a combination of lower rainfall and less scouring out of the creeks, rising sea levels and increased prevalence of storm driven high tides re-contoured the beach eliminating shell grit banks at the creek entrances and the spit at the southern end of the lagoon. Contemporaneously with these changes there has been a progressive increase in the numbers of territories to eight or nine with the headlands at the ends of the beach where there is less disturbance being preferred (e.g. three territories on the southern headland).

During the 1980s Seven Mile Beach and the extensive dunes at the end of the beach opposite Lewisham were monitored for a number of seasons. Along Seven Mile Beach, a high energy ocean beach (Taylor and Taylor 2005), typically 7 or 8 pairs nested with greatest density towards the eastern point. An additional three pairs nested on the top of the high dunes. Post 2000 the size of these dunes has been greatly reduced by erosion and there has been increased recreational disturbance by people crossing to the spit area in boats from Lewisham. While a similar number of oystercatchers continue to breed on Seven Mile Beach the territories have been progressively pushed towards the point by increased recreational use of the other end of the beach including the training of race horses.

Pair and territory fidelity

Established pairs are extremely faithful to their partners and their territories with one pair at Gorringes Beach holding the same territory for 20 successive seasons. The only documented instance of an adult oystercatcher relocating to breed elsewhere involved a bird displaced from the paddocks at the northern end of Gorringes Beach subsequently breeding in a bay on the Tasman Peninsula.

One male oystercatcher banded as a breeding adult (4+ years) in 1977 maintained the same territory until the end of the 2006/07 season when it disappeared, presumably deceased at minimum age of 33 years. Throughout the latter years of his life this bird continued to defend his territory which was in the most disturbed section of the beach. He was frequently seen in the company of female birds but there was no evidence of successful breeding. Similarly a female banded in 1977 retained a territory at the base of the spit at the southern end of Gorringes Beach where numerous nest scrapes were made but no eggs were laid in her later years.

Nest sites

Initially all nest sites at Gorringes Beach involved nest scrapes in either shell grit or soft sand at or immediately above the high tide mark. A number of trial scrapes, up to a dozen in extreme cases, were made before one was selected and eggs were laid. Following the erosion of the shell grit banks at the creek entrances the oystercatchers increasingly selected nest sites in soft sand at the edge of the fore-dune and frequently lost clutches which were inundated by high tides. Where long term resident pairs had used several different nest sites over a number of years, sometimes separated by up to 200m, the oystercatchers made trial scrapes at these separate locations, presumably to monitor the relative disturbance and risk of inundation at the alternative sites before selecting one for use.

Following continued failure over several seasons, two pairs on the main beach commenced nesting beneath pine trees about 20m behind the fore-dune presumably to avoid the risk of inundation at beach front sites.

At the southern headland birds frequently nested in paddocks when suitable areas of short grass were available. The use of paddocks with short grass either mowed or grazed by horses as nest sites increased in other areas like Pipeclay Lagoon where widespread acreage style residential development occurred.

During the 1980s at South Arm Neck and at a number of other bays, extensive banks of washed up sea grass formed at the high tide mark and were used as nest sites because of their increased elevation. However, this opportunity was short lived as the sea grass became increasingly scarce during the 1990s.

Breeding success

At the start of this study in 1977 the upper limit for breeding success at Gorringes Beach was around 1.0 fledged young/pair/annum with the long term mean 0.54 for the eight years 1977 to 1985 (Newman 1985). By 1991, this rate had fallen to around 0.25 (Newman 1991) and during the subsequent period through to 2006/2007 this remained the upper limit for the area, although at least one young was fledged from six to eight pairs in most years. In 2008/2009 no young were fledged.

On the relatively undisturbed beaches of the Tasman Peninsula, the mean productivity was 0.69 fledged young/pair during the 1984/85 season (Newman 1985) which provides a benchmark for good breeding success.

Low breeding productivity was widespread during the 1991/92 season (Newman and Park 1992) with the mean productivity 0.27 fledged young/pair for 110 pairs on 15 beaches in the Derwent Estuary and Pitt Water areas. During 1991/992 there was total breeding failure at the Five Mile and Seven Mile Beaches. These areas were visited several times in the 2006/07 and 2007/08 seasons and the number of territorial pairs was almost unchanged at around 40. In 2007/2008 these areas were again unproductive. However in 2008/2009 five fledged young were present with adults in early February at end of Seven Mile Beach near the dunes.

Age of first breeding

While birds banded as runners as young as three years were observed to temporarily occupy territories (i.e. accompanying the geriatric male at Goringes Beach) they were at least four years before they entered a productive relationship and the average age at which they first bred was 6 years (Taylor et al. 2010). Birds as old as 10 years were present in the non-breeding flocks.

Dispersion of fledged young

Immature birds join the non-breeding oystercatcher flocks which congregate at the main high tide roosts. However all the birds monitored moved among the bays in the Derwent Estuary including moving through the beaches where breeding occurs like Gorringes, Five and Seven Mile beaches as well as some of the more remote areas of south-east Tasmania like Bruny Island and even as far south as Cockle Creek. There were very few sightings of these birds outside the south-east Tasmanian region. Most runners eventually entered the breeding population at locations which were less than 10km from their natal site, with the mean distance between the acquired territory and their natal site a mere 7km (Taylor *et.al*. 2010).

Roosts

Thomas (1968) divided the Derwent Estuary/Area into a number wader resorts which provided both feeding areas at low tide and a high tide roost at which mixed flocks of birds can congregate, ideally without disturbance. During the 40 year period of this study these roost have been substantially modified as described below for the South Arm area (Figure 1) where the summer and winter counts are conducted.

At Lauderdale there are two roost options; the Spit which protrudes into the bay and an area known as East Marsh. In the 1960s the Spit was the dominant roost supporting high numbers of migrant waders and gulls as well as oystercatchers. Over the past 40 years the spit has decreased in size and is increasingly inundated by storm driven high tides. Under these conditions East Marsh becomes the default roost option and some oystercatchers prefer this roost at all times. East Marsh is a samphire flat adjacent to a tidal lagoon separated from the main Lauderdale bay by a causeway through which there is limited tidal flow.

As indicated under the section on territories and nest site selection the spit at the southern end of Gorringes Beach has greatly decreased in size and does not provide a viable roost when tides are very high. Consequently, as shown by banding, oystercatchers which are the main species at this location move to alternative roosts like the South Arm Neck and adjacent paddocks under adverse conditions in winter.

When this study commenced there were two main roost options for shorebirds at South Arm Neck, a spit at an area known as West Bay (unofficial place name) and areas adjacent to the road running along the main length of the beach. Rising sea levels have diminished the viability of the West Bay roost. Along the main beach, flocks of oystercatchers are progressively pushed onto the road under extreme tidal conditions, particularly in winter and are frequently killed by vehicles. Black Jack Rocks on the southern side of the Neck is used occasionally but this roost is very exposed and is not suitable under extreme weather conditions.

Discussion

During these long term studies of the Australian Pied Oystercatcher two pronounced and apparently contradictory trends emerged. Firstly, the decrease in annual breeding success between 1977 and 1992 as indicated by surveys involving a large number of pairs across a number of breeding locations (Newman and Park 1992), which was attributed to increased human recreational use of the coastal areas where the species breeds. On this basis it was predicted (Newman 1991) that oystercatcher numbers would fall. Secondly, the population counts for the Ralphs Bay/Lauderdale area (Figure 2) indicated an almost three fold increase in both summer and winter numbers between 1987 and 2005. Clearly a unifying explanation of these apparently conflicting trends was required.

Basis of predicted population decrease

For discussion purposes the local Australian Pied Oystercatcher population which frequents the bays and beaches of the study will be termed the south-east Tasmanian population as shown in Figure 1. The limits of this area are arbitrarily defined as Triabunna in the north and Cockle Creek in the south. The area includes the coastline of off-shore islands like Bruny Island as well as the Derwent Estuary and the Pitt Water - Orielton Lagoon Ramsar site. The nomination of these boundaries is supported by the results of monitoring the movements of individually marked oystercatchers. Although this data requires more comprehensive analysis, preliminary assessments indicate that despite the occasional oystercatcher reaching the Bass Strait Islands and even Victoria relatively few sightings of marked birds or recoveries of dead birds come from outside the south-east Tasmanian area. Conversely, very few oystercatchers from Victoria, where there is an extensive colour marking program, reach south-east Tasmania. In contrast many individually marked birds were seen sufficiently regularly within the area (Newman 1982 and 1984) to allow the assumption that these birds were either resident or nomadic within the south-east Tasmanian region. Hence, on this basis it is proposed that the south-east Tasmanian population is closed with minimal immigration into or emigration from the area.

Monitoring immature birds through to breeding maturity showed that runners acquired a breeding territory close to their natal site (mean distance 6.7km and almost always less than 10km). This coupled with the fidelity of breeding adults to their pair bond and territory, supported the proposition that the south-east Tasmania Australian Pied Oystercatcher population was primarily sedentary and closed.

In addition it was found that the mean age at which oystercatchers bred for the first time was 6 years and there were some non-breeding birds as old as 10 years. As Australian Pied Oystercatchers and other species of oystercatchers can breed in their fourth year there were clearly numerous birds of breeding maturity in the non-breeding flocks queuing for a territory. This conclusion was supported by the rapidity with which a deceased breeding oystercatcher was replaced during the breeding season at Gorringes Beach (Newman 1992).

Basis of Population Increase

While the near threefold increase in Australian Pied Oystercatcher numbers at Ralphs Bay/Lauderdale (Figure 2) may reflect a pro rata increase in size of the south-east Tasmanian population other factors may complicate interpretation. For instance, as discussed earlier the Ralphs Bay/Lauderdale counts are a sample of the south-east Tasmanian oystercatcher population. It is possible that the increase at least partially reflects Ralphs Bay/Lauderdale becoming the preferred foraging and roosting area for oystercatchers in south-east Tasmania, thus magnifying the apparent increase at Lauderdale. Some support for this explanation is provided by differences which have emerged in the annual variation in numbers of oystercatchers at Lauderdale, where both Thomas (1968) and Newman (1982) found that numbers peaked in winter for monthly counts in 1964/65, 65/66 and 80/81, while the subsequent count data shown in Figure 2 shows a good correspondence between the summer and winter counts. This correspondence is consistent with the oystercatchers roosting at Ralphs Bay/Lauderdale being predominantly non-breeding birds. This conclusion is strongly supported by the presence of flocks of up to 400 oystercatchers foraging at Lauderdale, a number which greatly exceeds the breeding oystercatchers at that locality (less than 15 pairs).

During the breeding season studies at Gorringes Beach in the 1980s it was unusual to see foraging flocks of more than 20 non-breeding oystercatchers. However, this number has progressively increased and since 2000 it is normal to see 50 or more non-breeding oystercatcher at that location during the breeding season.

A further explanation for the increased numbers of oystercatchers is that birds were displaced from their feeding grounds on the east coast of Tasmania by commercial harvesting of pipi, a gastropod and coastal roosting sites by increasing sea levels. However this explanation is not favoured as more than a possible contributing factor given the magnitude and continuity of the increase shown in Figure 2.

Proposed explanation

A key finding of the banding studies was that the average age of first breeding of Australian Pied Oystercatchers in south-east Tasmania was of the order of two years greater than the age of breeding maturity. The classical explanation of this result is that the size of the oystercatcher population is constrained by the number of breeding territories available. As the Australian Pied Oystercatcher only breeds in coastal locations this seemed a reasonable assumption and it was concluded that there would be little annual variation in the number of territorial pairs. With hindsight the assumption that the south-east Tasmanian population was at a near equilibrium level with a constant number of territorial breeding birds and small variations in the total population size being determined solely by changes in annual breeding success and mortality rates was incorrect. For instance, during the first decade of the investigation (1977-1987), evidence such as the increase in the number of territories from six to eight or nine at Gorringes Beach was consistent with an expanding breeding population. Consequently the increased oystercatcher numbers shown in Figure 2 can be qualitatively explained by an expansion of the number of breeding pairs and the increased use of Ralphs Bay/Lauderdale as the preferred foraging and roosting habitat for non-breeding birds. In following sections factors underpinning this explanation are discussed.

Improvements in environmental factors

Around 1970 it was apparent that the sediments of the Derwent Estuary were heavily polluted with heavy metals (Anon. 1974) and that this contamination had spread to some adjacent bays like Pipeclay Lagoon. In addition to industrial waste discharges, there were numerous instances of untreated sewage entering the estuaries and bays of south-east Tasmania. At Lauderdale leachates from a municipal waste disposal site located immediately adjacent to the bay was a potential additional impost on the environmental quality of the inter-tidal mudflats. Despite these adverse factors as outlined above oystercatchers were breeding successfully in the Ralphs Bay/Lauderdale area, which also provided foraging and roosting opportunities for non-breeding birds.

During a 20 year period from 1970 to 1990, industry modernized their processes and progressively eliminated discharges especially of particulate solids and waste water (these improvements are ongoing). Continual monitoring of sediments demonstrated that these measures assisted by the buffering effect of silt deposition from upstream had resulted in a significant improvement in the environmental quality of the Derwent Estuary (Anon. 1985/86). However issues still remained with effluents and sewage discharges which were not addressed until the 1990s (Lockley *et. al.* 1993). In addition the Lauderdale municipal waste disposal site was closed about this time.

It is suggested that the cumulative effect of these measures progressively provided improved environmental quality and an increase in the food resources available to oystercatchers foraging in the Derwent Estuary. It is also possible that levels of nutrients increased in the bays, particularly at Lauderdale, as a consequence of residential development in the South Arm and other coastal areas from terrestrial runoff. The increase in numbers of oystercatchers at Ralphs Bay/Lauderdale between 1987 and 2005 (Figure 2) is consistent with the timing of the sequence of remedial measures and other changes described above. As indicated earlier the magnitude of the increase in oystercatcher numbers and the correspondence of the summer and winter totals suggests that the increased numbers are primarily associated with non-breeding birds. On this basis it is proposed that following improvements in environmental quality, Ralphs Bay and in particular Lauderdale became the preferred location, indeed a refuge for immature and non-breeding birds and may have contributed to an increase in their annual survival rate.

The spread of low density residential development with the establishment of acreage style properties through much of the coastal region of south-east Tasmania created numerous paddocks with short grass providing nest sites immediately behind the beach front. Historically these areas would have been unsuitable for nesting, being scrubby or covered in dense tussocks of native grasses.

Negative factors

Two factors have adversely impacted on the breeding success of Australia Pied Oystercatchers. First, the increased human recreational use of the coastal areas has caused extensive disturbance of the oystercatchers throughout the year, but particularly during both the incubation period and the extended subsequent period until the runners are fledged. Second, a combination of rising sea levels, an increased frequency of storm driven high tides, the loss of sea grass banks and the restructuring of the beaches have significantly reduced the number of viable nest sites at or immediately above the high tide mark. Initially these changes resulted in increased clutch loss by inundation. However, the oystercatchers reacted to their increasingly frequent failure during the incubation stage by using alternative nest sites behind the beach front such as paddocks with short grass and even among trees. The use of these sites increased the risk of predation, particularly for nests among trees. In some instances they also increased the risk and difficulty associated with feeding runners, as occurred at Lauderdale, where some nest sites were separated from the bay by a busy road.

The rising sea levels and increasing frequency of storm driven high tides has also impacted on the viability of the high tide roosts. This impact is most obvious at the South Arm Neck where under extreme conditions the oystercatchers roost on the side of the road, and eventually on the road itself, leading to mortality from vehicle strikes, including the loss of some breeding adults.

Productivity versus mortality

Between 1970 and 1985 there was little variation in the oystercatcher numbers at Ralphs Bay/Lauderdale, which suggests that the population was at an equilibrium level. This implies that the average production of fledged young equalled the average mortality of non-breeding and breeding oystercatchers. To maintain this equilibrium level any sustained decrease in breeding success must be offset by a decreased annual mortality rate (i.e. increased survival).

Starvation is a known cause of mortality and would be expected to be higher for inexperienced non-breeding birds. The environmental improvement of the Derwent Estuary, especially at Lauderdale, may have increased food availability resulting in decreased mortality of immature birds, but it is less likely that this would impact on experienced breeding birds. Unfortunately neither baseline data on food availability nor long term trends in the mortality rates of immature birds exist which can be used to test this hypothesis. It has also been suggested that low levels of pollutant below regulatory levels may impact on mortality (Goss-Custard 1996). Presumably this un-quantified effect would apply to all age classes. The trends in oystercatcher numbers may provide a broad indication of the health of an estuary. BirdLife International and others have long championed the notion of birds as bio-indicators. However, these gains would be partially offset by the losses, including experienced breeding birds, associated with oystercatchers being forced onto roads at high tide (e.g. the South Arm Neck roost) and nesting on the road side.

A chronological perspective

In this section the information provided previously is set out as a sequence of events which give a qualitative explanation of the increase in oystercatcher numbers in Ralphs Bay/Lauderdale (Figure 2). Before 1960, the coastal regions of south-east Tasmania were only lightly developed with a low human population density. There was little disturbance along the beaches and in the numerous bays which provide oystercatcher breeding habitat throughout the region. There would have been few opportunities for oystercatchers to have bred behind the edge of the beach because the adjacent areas would have been either scrub or dense tussocks of native grasses. This would have restricted the number of breeding territories leading to a build up of breeding age birds queuing for territory. However, by the 1960s, the Derwent Estuary was already heavily polluted by both industrial and various municipal discharges (e.g. sewage). This pollution probably impacted on oystercatcher mortality both directly by ingestion at sub-chronic levels and indirectly by restricting food availability.

The ongoing improvement in the environmental quality of the region, particularly the Derwent Estuary and the bay at Lauderdale between 1970 and 2000 as a consequence of the various pollution abatement measures discussed above increased food availability and lessened the exposure of oystercatchers to pollutants. Increased levels of nutrients may also have entered these estuarine areas following coastal residential developments further contributing to increased food availability. It is suggested that this decreased the annual mortality rates particularly of immature birds resulting in an increase in the number of birds capable of breeding, but having to queue for a breeding territory. Consequently, breeding pairs defending territories came under increasing pressure to defend their territories; not always successfully. For instance the number of breeding pairs at Gorringes Beach increased during the early 1980s and there were several instances of pairs nesting in very close proximity. It is possible that this competition for territories had an inverse impact on the breeding success of some pairs

The 1970s was the start of a massive increase in the development of acreage style residential properties, particularly in the South Arm area. As discussed previously this provided a range of new nest site opportunities in grazed paddocks behind the beach edge. Initially this was probably highly advantageous because it provided additional nest site options, particularly in areas like Pipeclay Lagoon where there were relatively few shell grit banks at the beach front providing elevated nest sites. Over the next 20 years as the demand for this life style increased exponentially and the beach front breeding areas became highly disturbed by human recreational use, a situation exacerbated by the burgeoning Pacific oyster aquaculture industry, which was established in many larger bays throughout south-east Tasmania.

The next phase of the oystercatcher population expansion involved the establishment of breeding territories in new areas such as the edge of the *P. radiata* plantation along Five Mile Beach during the 1980s and upstream in the Derwent Estuary. The former expansion probably involved suboptimal nest sites and the latter reflected the exploitation of foraging areas restored by the environmental improvements coupled with the creation nest sites in adjacent paddocks on acreage properties.

Contemporaneously with the expansion of breeding range there was increasing pressure on the traditional territories and their nest sites stemming from a combination of increased human recreational disturbance of the beaches, rising sea levels and a decrease in the extent of banks of washed up sea grass. As indicated earlier the oystercatchers responded to repeated failure by individually adapting their breeding strategies, including moving to nest sites behind the beach front. It is probable that the non breeding oystercatchers queuing for the historical nest sites observed these innovative changes in nest site selection by individual birds and imitated them in other areas where similar opportunities existed. Thus the adaptations of individual birds catalysed the expansion in local breeding range.

The combined impacts increased recreational disturbance and rising sea levels also impacted on the distribution of the increased number of immature and non breeding oystercatchers. Progressively the viability of roost options at a number of locations including the South Arm Neck, Pipeclay Lagoon and the Seven Mile Beach dunes deteriorated and the large bays of the South Arm, particularly Ralphs Bay/Lauderdale became the preferred option or indeed refuge for non breeding birds following the improvement in environmental quality. Lauderdale in particular was favoured because it provided both excellent foraging and roosting opportunities. At Lauderdale there are two roosts, namely the spit adjacent to the canal and on the samphire flat adjacent to a lagoon on the area known as East Marsh. The East Marsh roost is separated from the bay by a causeway which buffers it from the impact of extreme tidal conditions which can cause complete inundation of the Spit roost.

The net impact of all of these changes over a 30-year period involved an increase number of pairs breeding and an extended breeding range for Australian Pied Oystercatcher in south-east Tasmania. The expanded number of breeding pairs has at least in part offset the adverse impact of decreased breeding success associated with the current use of sub-optimal nest sites compared to those at the beach front which were preferred when this study commenced. It is also suggested that the annual mortality of oystercatchers, particularly immature birds may have decreased following the improvements in the environmental quality of the Derwent Estuary and surrounding areas. Decreased mortality rates also partly compensated for decreased breeding success.

Future trends

In the previous section a qualitative explanation was proposed to account for the increase in oystercatcher numbers which occurred at Ralphs Bay/Lauderdale between 1987 and 2005. However inspection of Figure 2 suggests that this upwards trend has ceased and may have moved into a period of stability or decrease. Factors which would result in a decrease in the south-east Tasmanian oystercatcher population and the extent to which they are a future threat are discussed below.

An ongoing decrease in the breeding success rate is clearly a threat to the long-term stability of the oystercatcher population at its present size. All the factors which impact adversely on breeding success are expected to increase, including human recreational and commercial use of the beaches and bays, and rising sea levels will act synergistically with extant threats. There is no obvious opportunity for the birds to find new breeding niches; indeed the ongoing development of coastal areas may result in further subdivision for residential developments, reducing the number and viability of the new generation of nest sites in paddocks which have been recently established on private property.

There may also be other more subtle balances in play. Australian Pied Oystercatchers are not the only species which can rapidly adapt to new opportunities. For instance in 1992 the oystercatchers failed to breed successfully at Five Mile Beach in the area of the *P. radiata* plantation despite this being the most prolific area for fledged young during the previous decade (Newman and Park 1992). Further monitoring suggests that breeding failure in this area is a long term issue and a suspected cause is predation by Forest Ravens *Corvus tasmanicus* which have become numerous in the area. The sand cliff along Five Mile Beach has become severely eroded and many pines have fallen onto the beach providing cover for the ravens and limiting the ability of the oystercatchers to observe and respond effectively to predator threats (i.e. the oystercatcher's flight mobility is limited).

Annual mortality rate could also be adversely affected in the future. One potential cause for increased mortality is the lack of viable high tide roosts with birds being killed when they are forced onto adjacent roads. Any reduction in the area of estuarine habitat available for foraging will increase the risk of starvation, particularly of immature birds. The Lauderdale Quays marina development proposed by the Walker Corporation would destroy much of arguably the most important feeding and roosting habitat for Australian Pied Oystercatchers in south-east Tasmania. This proposal is currently under review, but the fact that the Tasmanian Government was prepared to revoke the formally-declared conservation status of the Lauderdale foreshore to allow this project to proceed underscores the tenuous nature of the protection afforded to this species and its habitats. In the longer term if predicted rises in sea level occur as a consequence of climate change the area of estuarine habitat used by both non-breeding and breeding birds will be decreased in size potentially decreasing food availability and causing starvation.

CONCLUSIONS

Apparently contradictory trends involving the increasing size of the south-east Tasmanian Australian Pied Oystercatcher and decreasing breeding success rate have been explained qualitatively in terms of a complex set of interacting factors. Increased disturbance of the beaches and bays where the birds breed has been exacerbated by rising sea levels. These factors adversely affect the breeding success rate. The oystercatchers have responded to this situation by using different types of nest sites which are located behind the beach front, albeit less productive habitat.

It is suggested that improvements in the environmental quality of the Derwent Estuary and surrounding areas following the reduction of industrial and municipal waste discharges have impacted favourably on food resources available to the oystercatchers. Increased nutrient discharges associated with runoff from residential development in coastal areas may also have been beneficial. The net impact of these environmental changes may have resulted in decreased mortality rates of the oystercatchers, particularly immature birds. It is proposed that increased numbers of mature oystercatchers seeking a territory have been able to expand the breeding range of the Australian Pied Oystercatcher in south-east Tasmania. The net outcome is an increased number of pairs of oystercatchers which are breeding, but with a lower success rate in terms of the average number of fledged young/pair than when this study commenced. However, increasing pressures on the coastal areas of south-east Tasmania in terms of development, recreational and commercial use of the beaches and bays, exacerbated by the threat of rising sea levels, will require sympathetic coastal management for the present oystercatcher population size to be sustained. Quantitative assessment of these trends and the sensitivity to future threats will be the subject of a second paper.

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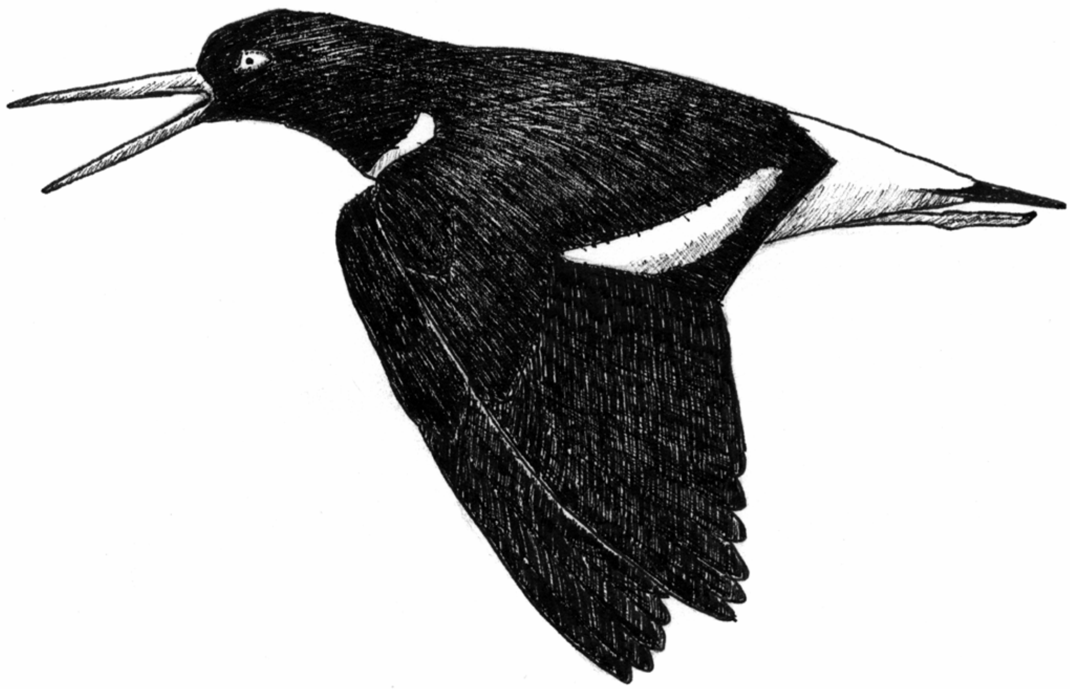

NORDMANN'S GREENSHANK *TRINGA GUTTIFER* USING KLEPTOPARASITISM AS A FEEDING TECHNIQUE.

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Nordmann's Greenshank *Tringa guttifer* is an endangered species and is listed by Bird Life International (Red data website) as having a population between 500 and 1000 individuals. With the ever increasing development on its breeding, staging and wintering grounds and the added pressure of hunting, this species is declining fast.

On 08/05/2010 whilst conducting research for the Global Flyway Network on Red Knots *Calidris canutus* in the North West of the Bohai Bay near Nanpu, China, 39° 03' 48" 118° 13' 03" Adrian Boyle and Matt Slaymaker observed a Nordmann's Greenshank *Tringa guttifer* using kleptoparasitism as a feeding method. This interesting observation was captured in a series of photographs by AB, some two of which are shown below (Figures 1 & 2).

At 10AM a single Nordmann's Greenshank was observed to be roosting in a small salt pond with Marsh Sandpiper *T. stagnatilis* and Dunlin *Calidris alpina* approx 100m from the mudflats. The birds were disturbed by an unidentified bird of prey and the greenshank flew back to the mudflat and landed close to the seawall. We walked to the sea wall to observe the greenshank more closely but just as we were arriving the greenshank was seen to take flight. At first it was thought that we had disturbed the individual but we were still not very close. It was quickly noticed that the greenshank was chasing, in flight, a male Bar-tailed Godwit *Limosa lapponica* that was carrying a large worm. This was thought to be interesting in its self but it was not until the birds landed and were viewed over a longer period that its significance became apparent.

After landing back on the mudflats the greenshank waited in-between two closely feeding Bar-tailed Godwits and appeared to be carefully watching them. It would alternate between the two godwits sometimes standing less than half a metre away from either bird apparently waiting for them to lift a prey item from the mud. If this were the case then the greenshank would attempt to steal the food item by lunging toward the bird and taking it directly from the godwits' bill. This was observed six times over the observation period of 10 minutes. On at least one occasion the greenshank was seen to be successful at stealing a food item from a female godwit, which appears, in the photos, to be a worm species. The godwit retaliated by chasing the greenshank, on foot, to try remove it from the area. Following this the greenshank ran directly to another feeding godwit, approximately 20 meters away from the original two and once again remained in close attendance observing the feeding bird. The greenshank was very persistent and tried this method for several minutes before leaving the godwits to feed on its own nearby.

Kleptoparasitism is a feeding method for a wide variety of birds particularly Terns, Egrets and Herons but is rarely recorded being used by shorebirds. So recording it in an endangered species that already has very little known about it feeding habits was interesting. Publishing this short note is to add to the very little data already known about this species with the hope that someday enough information will be gathered to safe guard this species from extinction.

There is a published record of Nordmann's Greenshank being involved in Kleptoparasitism (Howes J. and Lambert F. 1987) Here it is mentioned that Nordmann's were on the receiving end of such a practice by Grey Plovers and Common Redshanks. It is also mentioned that Nordmann's versus Nordmann's was recorded in Kleptoparasitism .

Figure 1. Bar-tailed Godwit *Limosa lapponica* being closely observed by a Nordmann's Greenshank *Tringa guttifer* (Adrian Boyle).

Figure 2. Bar-tailed Godwit *Limosa lapponica* being closely observed by a Nordmann's Greenshank *Tringa guttifer* (photo Adrian Boyle)

Other sightings of Nordmann's Greenshank in the same area during April and May 2010

Given the global rarity status of this species it was thought beneficial to publish our other sightings of NG at this under watched, yet highly important site.

The first record of Nordmann's Greenshank in 2010 was a single bird at Zuidong mudflats on the 9th April. Approximately 4km east of the sighting described above.

Two birds were seen feeding together on the 6th May less than 1km from the sighting described above. It is tentatively assumed, based on plumage, that one of these individuals was the same as the one displaying the kleptoparasitic behaviour described above.

On the day of the kleptoparasitism sighting observation another individual was recorded at Zuidong and was thought to be the same as the second individual of the two recorded on the 6th of May.

There were 3 further sighting of Nordmann's Greenshank during May, all at Nanpu, two individuals on the 11th and single birds on both the 12th the 15th. During May, all sightings involved birds with incomplete breeding plumage.

Based on photos taken of these birds it is thought that the May sightings comprised of just 3 individuals but it is not known if the sighting from early April was one of these birds.

ACKNOWLEDGMENTS

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HABITAT UTILISATION AND ASSEMBLAGE PATTERNS OF MIGRATORY SHOREBIRDS AT STOP-OVER SITES IN SOUTHERN INDIA

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Twenty one species of shorebirds, totaling 2236 individuals were recorded in the Pahzahiar tidal flat during the entire study periods from September 2000 to March 2001 and from September 2001 to March 2002. Maximum turnover of the shorebirds density, diversity and species richness were observed during the migratory seasons (October to December). Most of the species had a strong seasonal component to their presence, with greatest abundances coinciding with habitat availability. There were significant variations with regards to the shore bird characteristics such as bird density, diversity and richness. We identified three groups of shorebirds among the twenty one species i.e. tactile continuous, visual continuous and pause travellers. Out of 21 species, 18 species of shorebirds showed 76.75% similarities and the Dunlin, Little Stint and Kentish Plover showed below 75%. However, the overall results of the present study revealed that decrease in the number of species by annually when compared to the earlier reports due to degradation of natural wetlands.

Key words: Tidal flats, Charadriiformes, migratory shorebirds, seasonality, habitat interaction.

INTRODUCTION

Shorebirds or waders (Charadrii) are long distance migrants which migrate thousands of kilometers between breeding and wintering sites and are heavily dependent on passage sites along the flyways, where they can rest and refuel (Alexander *et al.* 1996; Iverson *et al.* 1996). Natural wetlands including tidal flats tend to be highly productive and are a vital habitat for shore birds (Velasquez 1992; Masero *et al.* 1999). In recent years, many coastal wetlands particularly tidal flats have been destroyed or transformed, resulting in major impacts on shorebird populations (Goss-Custard *et al.* 1977a, b; Goss-Custard & Moser 1988). Recher (1966) mentioned that the amounts of inter-tidal habitats with food availability are the most important sources influencing shorebird abundance. Although shorebirds are very sensitive to habitat changes (Alexander *et al.* 1996).

However, information on the numbers and distribution of shorebirds in the East Asia – Australasian Flyway is plentiful (Sampath & Krishinamurthy 1990), but, only a few studies, such as those by Ali & Hussain (1981, 1982) and Ali & Sugathan (1985), have investigated the movements of shorebirds on the Indian sub-continent. The east coast of India, especially the Tamilnadu region, is of major significance for shorebirds because many extensive wetlands are found there, including the Pichavaram mangroves and the swamps at Point Calimere, a Ramsar site (Thiyagesan & Nagarajan 1995, Pandiyan *et al.* 2006).

These wetlands are especially important as a wintering area. Also, an appreciable number of species migrate annually from breeding sites in arctic Siberia via India to wintering grounds in Tamilnadu have been shown to support a variety of shorebird species. Several studies have been undertaken in the better known coastal areas that enjoy conservation protection (Sampath & Krishinamurthy 1989, 1990, Nagarajan & Thiyagesan 1996, 1998, Pandiyan 1999, 2000, 2002, Pandiyan *et al.* 2006). Earlier intensive survey was made and identified and located six unprotected tidal flats of the coastal regions of great avian significance during their migratory periods of Nagaipattinam District of Tamilnadu State and Kariakkal District of Puduchery State, Southern India from 1999-2002 (Pandiyan unpublished data). Such areas are critical for the continuance of migration and, ultimately, for the survival of many shorebirds (Pandiyan & Asokan 2008a).

Knowledge of the species composition and diversity of migrant shorebirds is essential in the development of management and conservation strategies as global concern (Davis & Smith 1998). Moreover bird population parameters such as species density, richness and diversity are good indicators of habitat quality (Sampath & Krishinamurthy 1989, 1990, Nagarajan & Thiyagesan 1996). We therefore analysed the waterbird density, diversity and species richness in the pazhaiyar tidal flat. The present study would reveal how the migratory shorebirds use the Pazhaiyar tidal flat as a feeding as well as stop over site and we have tested the factors such as season and tides towards the shorebird characteristics such as density, diversity and species richness, finally we analysed spatial patterns of shorebird community. Further we recommended some conservation towards management of tidal habitats and shorebirds.

STUDY AREA

Pazhaiyar tidal flat located on the east coast of India between two important waterbird wintering areas: the Pichavaram mangroves and Point Calimere Waterbird and Wildlife Sanctuary (Figure 1). Because the tidal flat is small in size (1–2.5 ha) and are extensively used by waterbirds during the wintering period, they have not yet been given nature conservation protection status. However, the hunting of birds is not permitted in any wetland. Commonly available shorebird prey in these flats includes polychaetes (*Neries* spp.), gammarid amphipods, isopods (*Apseudes*), bivalves, gastropods, prawn larvae, crabs and fish fry. Chironomid larvae occur seasonally during November –March (Pandiyan

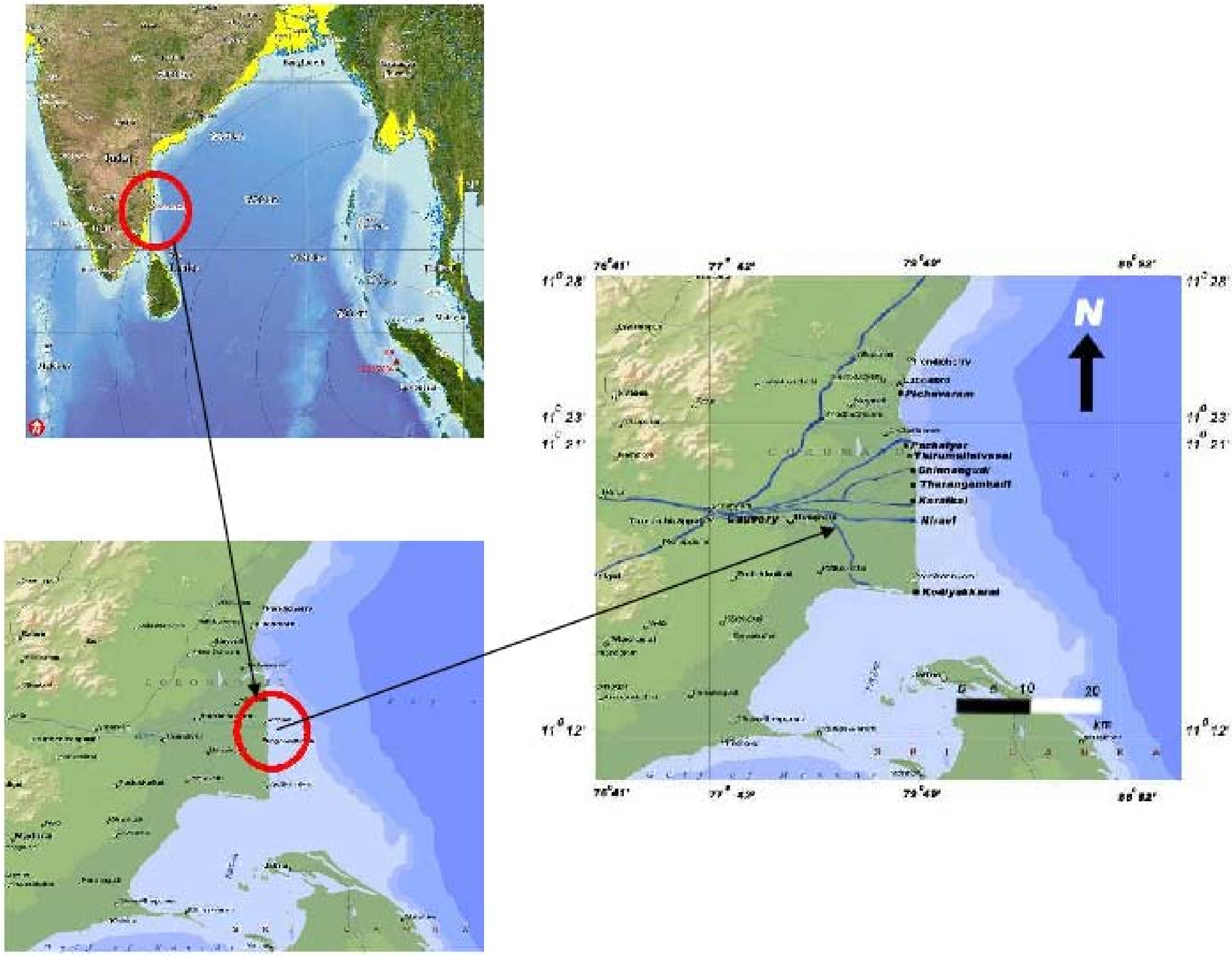

Figure 1. Map of the study area showing the six tidal flats studied at the east coast of southern India.

2002). These form the staple diet of the shorebirds. This region is subjected to the northeast monsoon, with most of the rainfall occurring during October–December. However, in the past decade, rainfall has declined markedly and, in recent years, most falls over a period of 2–3 weeks. Therefore, the periodic freshwater run-off has declined over the years and the intertidal flats have become more saline.

MATERIALS AND METHODS

Bird population estimation

The Pazhaiyar tidal flat is homogenous habitat, however, we have chosen three stations in the study area of one hectare at random. This study was carried out from September 2000 March 2001 and September 2001 to March 2002. Monthly total counts of the shorebirds were carried out fortnightly at low and high tides using the 'direct count'. The method of counting birds individually (Nagarajan & Thiyagesan 1996). The bird surveys were conducted only on fine days (days without heavy wind and rains). Each count lasted 3–4 h. A 7x50 binocular were used to identify and count shorebirds. At each site, a vantage point was selected from which all counts were made. Birds flying forward were excluded, and only those feeding in and flying within the sampling areas were recorded.

We have classified three seasons based on arrival and dispersal of the shorebirds in the Pazhaiyar tidal flat for the entire study periods i.e. Pre-migratory (Pre-monsoon) = (July-September); Migratory (Monsoon) (October – December) and Post-migratory (Post Monsoon) = (January – March).

Data analysis

Shorebird densities were calculated as number per hectare (Nagarajan & Thiyagesan 1996) and Species richness was the number of shorebird species recorded in study area (Verner 1985), and species diversity was calculated using the Shannon– Wiener Index (H': Shannon & Wiener 1949). The ANOVA and for the significance of shorebird population characteristics such as density, diversity and species richness in relation to seasons, habitats and tides were investigated and finally a dendrogram (Euclidean distance measurement) was developed to understand the shorebird groups and their relationships by using SPSS and Minitab statistical package.

RESULTS

Shore bird community seasonal variations

Twenty one species of shorebirds, amounting to 2236 individuals, were recorded in the Pahzahiar tidal flat during the survey periods. Density values indicated that the Ringed Plover *Charadrius hiaticula*, Swallow Plover *Glareola lactea*, Common Snipe *Gallinago gallinago,* Yellow-wattled Lapwing *Vanellus malabaricus* and Dunlin *Calidris alpina* were the dominant species during the first year (September 2000-March 2001) of pre-migratory season, but in the second year (September 2001-March 2001) the Little ringed Plover *Charadrius dubius*, Common Snipe *Gallinago gallinago*, Pectoral Sandpiper *Calidris melanotos*, Little Curlew *Numenius minutus* and Red-wattled Lapwing *Vanellus indicus* used the habitat predominantly than that of the other species. Red Knot *Calidris canutus* and Redshank *Tringa tetanus* were not present during the pre-migratory season of first year. (Table1). During the Migratory season of the first year Little Stint *Calidris minuta*, Kentish Plover *Charadrius alexandrinus* and followed by Dunlin showed the maximum turnover in the tidal flat when compared to the other shorebirds. However, in the second year (September 2001-March 2002) these three species decreased in their density and correspondingly all other birds also showed least numbers when compared with the first year i.e. September 2000- March 2001 of the Migratory season. Only four species were occurred in the tidal flat during the post-migratory season viz., Kentish Plover, Ringed Plover, Common snipe and Red-wattled Lapwing, but in the second year only two species were present i.e. Kentish Plover and Red-wattled Lapwing. (Table 1, Figure 2).

We tested the 21 species of shorebirds variations by using ANOVA with reference to seasonality, four species did not show significant variations among the 21 species viz., Common Snipe, Little Curlew, Yellow-wattled lapwing and Whimbrel ($P>0.05$). However, the overall bird density, species diversity and species richness were showed significant variations with regards to the seasons i.e. ($F=7.947$, $P<0.001$; $F= 9.435$; $P<0.001$ and $F=8.259$, $P<0.001$) respectively (Figure 3).

Shorebird community tidal variations

The overall bird density, diversity and richness differed significantly with regards to the tides ($F=15.477$, $P<0.001$; $F=16.703$ $P>0.001$; $F=11.666$, $P<0.001$) respectively (Table 2). But, the following species did not show variations viz., Pectoral Sandpiper, Sharp-tailed Sandpiper, Common Snipe, Little Curlew, Red-wattled Lapwing and Whimbrel ($P>0.05$) pertaining to tides (Table 2).

The Kentish Plover and Red-wattled Lapwing were present in all the seasons of the first and second year. But correspondingly the bird density, diversity and species richness were decreased in the second year when compared with the first year of the entire study period (Figure 4).

Patterns and assemblages of shorebirds

The associations of shorebirds were showed three groups of assemblages (Figure 5). Group I, comprising the Greater Sand Plover, Red Knot, Ruddy Turnstone and Great Knot; with the Pectoral Sandpiper, Whimbrel, Sharp-tailed Sandpiper, Common snipe, Yellow-wattled Lapwing and Little Curlew were the Group II and the Long Billed Plover, Redshank, Grey Plover, Common Sandpiper, Ringed Plover, Little Ringed Plover, Dunlin, Little Stint and Kentish Plover were Group III.

However, 18 species of the shorebirds showed 76.75% Euclidean distance similarities and the Dunlin, Little Stint and Kentish Plover exhibited below 75%. The patterns of distribution of these groups were significantly different (all pair wise comparison $P<0.01$) (Figure 5).

DISCUSSION

Shore bird community seasonal variations

Totally 21 species of shorebirds were recorded during the study periods (Table 1 Figure 2) in the Pazhaiyar tidal flat one of the stop-over sites of the Coramandal coast of Tamilnadu, southern India. There was a close relationship between bird abundance and species richness (Figure 3). The maximum turnover of bird density, diversity and species richness was observed during the migratory season (Figure 4). This result indicates that seasonally the tidal flat were playing as a vital role and attracting the shorebird communities and seemed to support them during their migratory season as a feeding ground. Birds may forage for prey that is locally available at any stopover site (Botto *et al.* 1998) and to maximize fat deposition at stopover sites rapidly, migratory shorebirds feed on whatever is available to them (Recher 1966).

Multi-species aggregation of shorebirds with high population densities feeding in coastal beaches, mudflats, and marshes are commonly found during the migratory season (Pandiyan *et al* 2006). Differences in habitat used by different species at stopover sites has been widely observed (Brush 1995; Long and Ralph 2001; Cole *et al.* 2002). But, shorebird species differentially exploits a given type of habitat (Hayes and Fox 1991), although they often use all the tidal habitats as a feeding ground (Burger *et al.* 1997b).

Evans (1988) argued that seasonal variation in food availability has influenced the timing of energetically demanding segments of a species' annual cycle. This argument relies on food as an ultimate factor explaining the evolution of molt and migration patterns as well as food availability operates as a proximate ecological factor influencing space use and daily activity patterns (Evans 1979, Puttick 1984). The present results of the dynamic nature of the shorebird community showed seasonality regulating the species richness and species abundances. Species composition exhibited a maximum turnover between November and December (Figure 2) and the abundance of most species changed abruptly in the subsequent year (Table 1).

Most of the species had a strong seasonal component to their presence, with greatest abundances coinciding with habitat availability. The seasonal variation in the Pazhaiyar tidal flat shows probably reflected seasonal migration because numbers were highest during October to December months of each year (Figure 2). Seasonal distributions of wading birds were also consistent with habitat predictions of

Table: 1. Seasonal variations of twenty one shorebirds observed in the Pazhaiyar tidal flat during the entire study period i.e. first Year (September 2000- March 2001) and Second Year (September 2001- March 2002).

Shore Birds	Seasons[a] Pre-migratory I YEAR	Pre-migratory II YEAR	Migratory I YEAR	Migratory II YEAR	Post-migratory I YEAR	Post-migratory II YEAR	Overall Bird density	ANOVA SEASON F	ANOVA SEASON P	ANOVA TIDES F	ANOVA TIDES P
Greater Sand Plover *Charadrius leschenaultia*	0.50± 0.261	0.25± 0.250	4.58± 1.443	0.50± 0.261	0	0	1.33± 0.418	4.118	0.022	11.744	0.001
Kentish Plover *Charadrius alexandrinus*	1.00± 0.674	0.88± 0.515	13.83± 6.846	10.67± 3.510	1.50± 0.957	0.50± 0.500	6.17± 1.904	5.064	0.010	12.250	0.001
Little Ringed Plover *Charadrius dubius*	1.00± 0.674	2.00± 1.086	9.58± 2.896	2.75± 1.067	0	0	3.38± 0.874	5.231	0.009	14.758	0.000
Long-billed Plover *Charadrius placidus*	0.58± 0.435	0.88± 0.441	6.75± 2.004	1.50± 0.669	0	0	2.17± 0.603	5.348	0.008	8.998	0.004
Ringed Plover *Charadrius hiaticula*	1.92± 1.490	1.13± 0.639	5.33± 1.698	3.33± 2.126	0.50± 0.500	0	2.65± 0.742	2.520	0.021	10.637	0.002
Swallow Plover *Glareola lacteal*	1.67± 1.170	0.75± 0.366	3.92± 2.141	1.67± 0.882	0	0	1.79± 0.609	1.436	0.025	7.695	0.008
Common Sandpiper *Actitis hypoleucos*	1.67± 1.176	2.25± 1.098	4.50± 2.043	1.33± 0.450	0.75± 0.479	0	2.13± 0.594	1.112	0.337	6.223	0.016
Pectoral Sandpiper *Calidris melanotos*	0.17± 0.167	2.71± 1.085	1.50± 0.774	1.00± 0.326	0	0	1.00± 0.270	5.322	0.021	2.103	0.421
Sharp-tailed Sandpiper *Calidris acuminate*	0.17± 0.167	0.25± 0.250	0.50± 0.261	1.17± 0.575	0	0	0.46± 0.161	5.503	0.036	2.448	0.124
Marsh Sandpiper *Tringa stagnatilis*	0.17± 0.167	0.25± 0.250	1.83± 0.716	1.92± 0.679	0	0	0.94± 0.257	7.035	0.002	12.704	0.001
Redshank *Tringa tetanus*	0	0.50± 0.327	5.92± 2.407	2.42± 0.543	0	0	2.00± 0.642	5.802	0.005	6.349	0.015
Common Snipe *Gallinago gallinago*	0.17± 0.167	0.13± 0.125	0.83± 0.366	1.17± 0.672	0	0	0.52± 0.187	3.096	0.054	0.169	0.682
Dunlin *Calidris alpine*	1.33± 1.025	0.75± 0.526	11.92± 4.328	3.50± 1.132	0	0	3.98± 1.205	4.761	0.013	10.060	0.003
Little Curlew *Numenius minutus*	0.75± 0.750	1.75± 1.161	1.00± 0.674	1.67± 1.068	0	0	1.06± 0.378	0.729	0.488	1.160	0.287
Little Stint *Calidris minuta*	0.92± 0.753	1.25± 0.526	21.08± 6.930	4.17± 0.796	0	0	6.23± 1.948	5.443	0.007	6.950	0.011
Red Knot *Calidris canutus*	0	1.00± 0.535	4.00± 1.249	1.33± 0.450	0	0	1.38± 0.374	6.137	0.004	5.958	0.022
Great Knot *Calidris tenuirostris*	0.33± 0.225	1.00± 0.500	3.67± 1.453	0.67± 0.284	0	0	1.23± 0.392	6.750	0.003	6.975	0.013
Ruddy Turnstone *Arenaria interpres*	0.33± 0.225	1.25± 0.648	2.67± 1.310	0.42± 0.336	0	0	0.98± 0.349	6.346	0.002	6.975	0.013
Red-wattled lapwing *Vanellus indicus*	0.67± 0.310	4.25± 0.701	2.17± 0.661	4.67± 0.595	1.00± 0.577	1.75± 1.182	2.60± 0.336	3.046	0.057	0.337	0.564
Yellow-wattled lapwing *Vanellus malabaricus*	1.33± 0.899	0	0.83± 0.613	0	0	0	0.50± 0.255	0.575	0.566	4.416	0.041
Whimbrel *Numenius phaeopus*	0.33± 0.225	0.63± 0.324	0.83± 0.588	0.58± 0.435	0	0	0.50± 0.181	0.903	0.412	0.100	0.753

[a]Pre-migratory = (Pre-monsoon i.e. July-September); Migratory (Monsoon i.e. October –December) and Post-migratory (Post-monsoon i.e. January – March)

this study area. In connection with year-round habitat availability, only two species were present in all the seasons (Table 1).

This study demonstrates that the shore bird community presence seasonal fluctuations in abundance, species diversity and species richness with a high concentration in migratory season (winter). This indicated that the concentration may be directly related to the arrival of migrant species at the beginning of winter from their breeding areas. The resource competition may be higher in winter than in summer (Pandiyan 2002, 2006), The annual mean abundance of all shore bird communities decreased and the declining of shore bird in the tidal flat with reference to seasonal impact has been reported in many studies (Micklin 1988; Lemly *et al.* 2000; Bunn and Arthington 2002; Kingsford and Thomas 2004; Pandiyan 2008 a, b). Thus, the patterns of change in abundance found in our study are clear with regard to shorebirds and shorebirds aggregations will be considered as good habitat indicators because they respond rapidly to environmental alterations

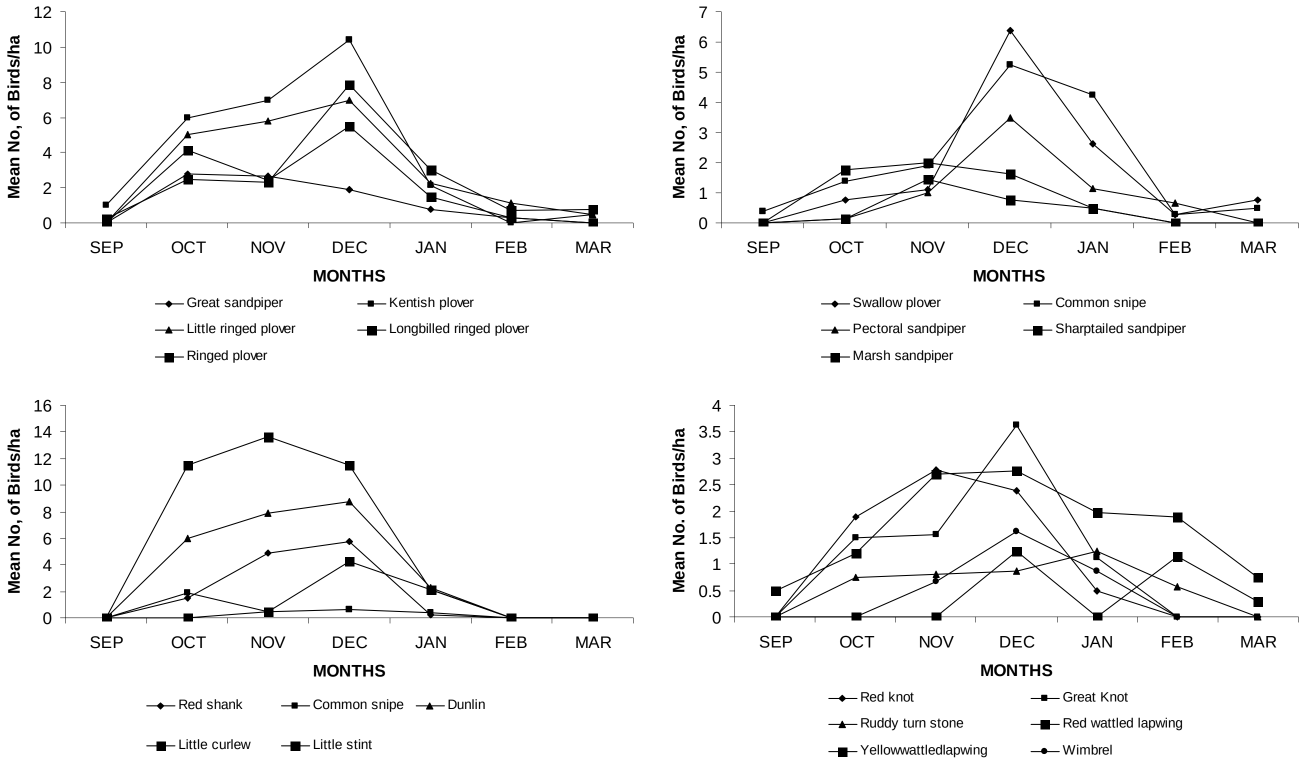

Figure 2. Density (mean values) per hectare of shorebirds was recorded in the Pazhaiyar tidal flat during the study period September 2000- March 2001 and September 2001- March 2002 (Two years of data were pooled for each month).

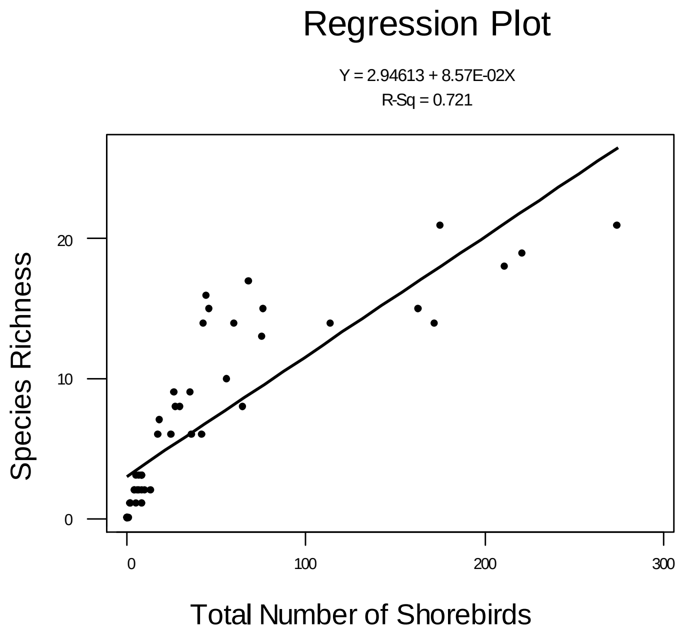

Figure 3. Interpretation of the bird abundance and species richness, at Pazhaiyr tidal flat during the study periods.

and consequently help in the early diagnostic of wetland changes globally.

Tidal variations

The overall bird density, diversity and richness were showed significant variations with regard to the tides (Figure 3). Foraging of shorebirds may be related to their habitat use and environmental factors, and many researchers have shown that physical factors, such as water level (Recher 1966; Boettcher *et al.* 1995; Colwell and Dodd 1995; Isola *et al.* 2000; Cole *et al.* 2002), tidal cycle (Recher 1966; Burger *et al.* 1997a; Blanco 1998) and substrate particle size (Danufsky & Colwell 2003), may affect the habitat use of shorebirds at stopover sites and wintering grounds because all the factors mentioned may affect prey availability.

Table: 2. Tidal variations of shorebirds with reference to different seasons of shorebird characteristics such as density (mean), Species richness and Species diversity (H') were observed in the Pazhaiyar tidal flat during the entire study period i.e. First Year (September 2000- March 2001) and Second Year (September 2001- March 2002).

Seasons [a]	Bird Characteristics	I Year		II Year	
		Low Tide	Hightide	Low tide	High tide
Pre-migratory	Density	27.17	2.83	26.00	22.00
Migratory		202.67	12.00	68.83	24.00
Post-migratory		6.50	1.00	1.00	3.50
Pre-migratory	Richness	5.67	1.17	7.67	6.80
Migratory		18.00	2.83	11.17	7.50
Post-migratory		3.00	0.50	0.50	1.00
Pre-migratory	Diversity	0.0036	0.0005	0.0037	0.0032
Migratory		0.0206	0.0018	0.0086	0.0035
Post-migratory		0.0012	0.0002	0.0002	0.0007

[a]Pre-migratory = (Pre-monsoon i.e. July-September); Migratory (Monsoon i.e. October –December) and Post-migratory (Post-monsoon i.e. January – March

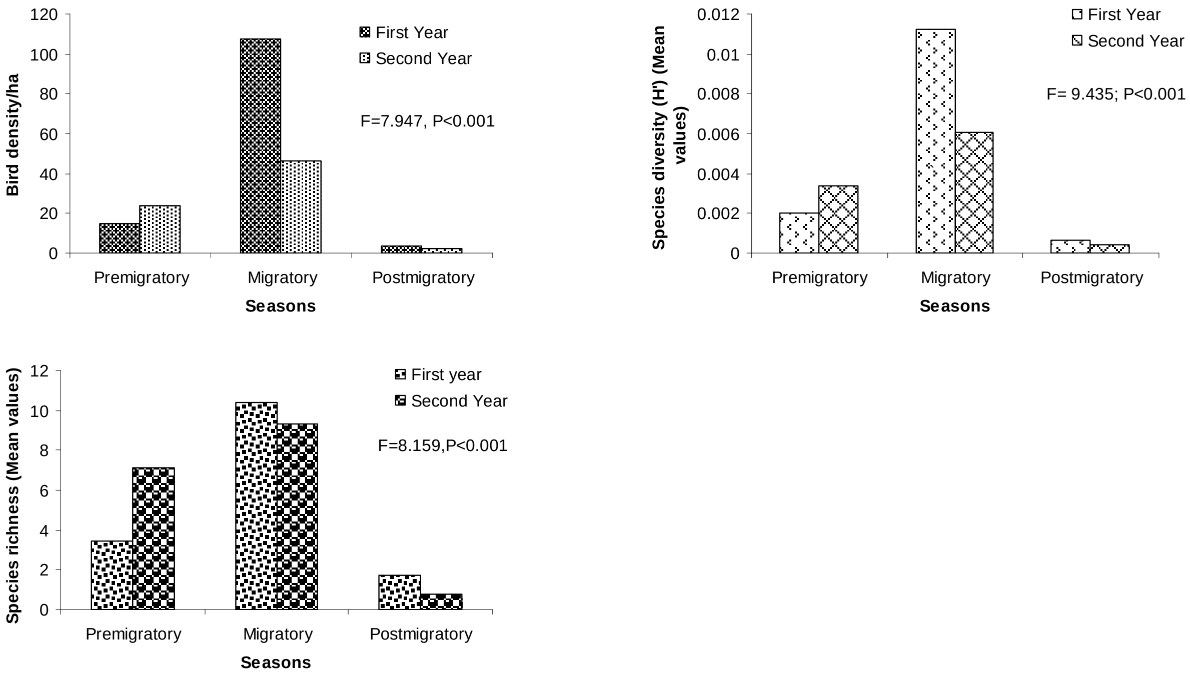

Figure 4. Seasonal variations of shorebird density/ha, species diversity (H') and species richness were recorded in the Pazhaiyar tidal flat in the entire study period i.e. First Year (September 2000- March 2001) and Second Year (September 2001- March 2002).
Pre-migratory = (Pre-monsoon i.e. July-September); Migratory (Monsoon i.e. October –December) and Post-migratory (Post-monsoon i.e. January – March).

Tidal variation constitutes the most important and predictable environmental factor influencing non-breeding shorebirds in coastal environments (Pandiyan & Asokan 2008b). The tides will influence the feeding behavior of many coastal shore birds species (e.g., Sanderling; Connors *et al.* 1981) by altering the amount of available foraging habitat and Burger, 1984, stated that the shore birds have been characterized as being strongly influenced by tides. He added that the shorebirds typically move between habitats in response to changes in the amount of available habitat and also tidal variations (Burger 1984).

In analyses of tidal data, exposed habitat explained that the maximum turnover variation in species richness, which was highest during periods of greatest exposed intertidal habitat during low tide (Table 1).However, exposed habitat contributed lot to understanding variation in total shore bird abundance. In contrast, the tidal range in Pazhaiyar tidal flat is so small that water levels may fluctuate and some extent deep foraging during entire tidal cycles (Pandiyan 2002, Pandiyan *et al.* 2006). The component of water-level variability induced by wind also exerts a greater impact on habitat availability in the east coast of Tamilnadu tidal flats (Pandiyan & Asokan 2008a&b). Here again, because of the

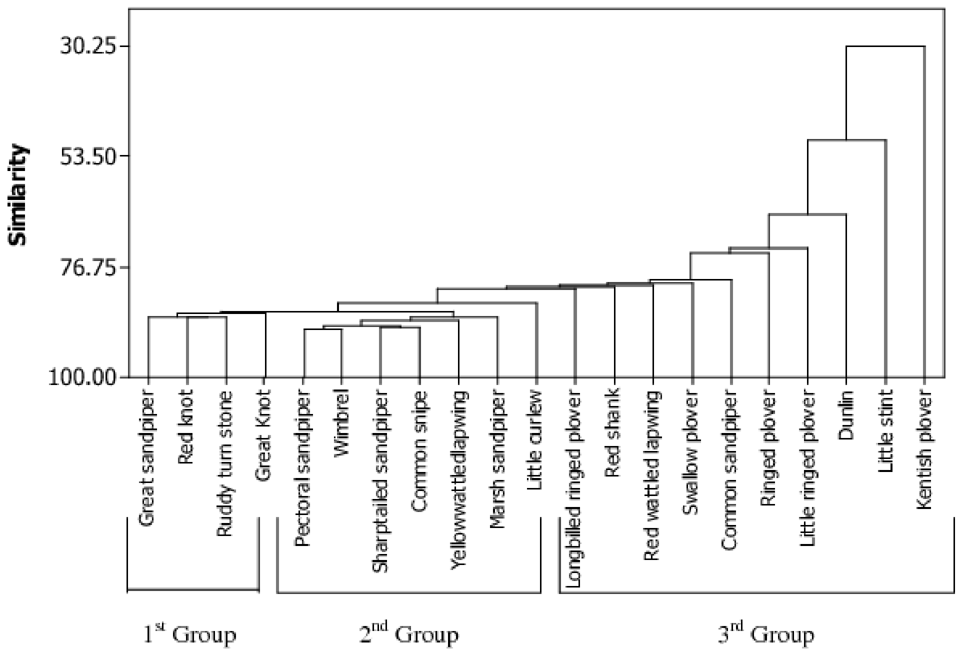

Figure 5. Dendrogram (Euclidean distance measurement) showing the shorebirds assemblages recorded in the Pazhaiyar tidal flat during the study period (entire two years of shorebirds data was used) (Groups are starting from left to right and there were classified into three groups, for group details see the result section.

small daily tides, a relatively minor rise in daily mean water level can result in water that is too deep for wading birds to forage even at low tide. But, basically when access to foraging sites is prevented by high water levels, the shore birds either must shift to alternative foraging habitats in the area or they can disperse.

In addition to tides and seasons, other factors are known to influence the ecology of non-breeding shorebirds i.e. the weather acts as a proximate factor influencing habitat and food availability of some species (Evans 1976), temperatures and wind velocity reduce prey availability, which influences the distribution and abundance of shorebirds (Evans 1976, Burger 1984). But we did not analyze the impact of weather directly on shorebirds by measuring wind velocity, precipitation, etc.

Shorebird assemblages

We identified three groups of shorebirds among the twenty species (Figure 5). The first group Greater Sand Plover, Red Knot, Ruddy Turnstone and Great Knot are classified into Tactile continuous, the Pectoral Sandpiper, Whimbrel, Sharp-tailed Sandpiper, Common snipe, Yellow-wattled Lapwing and Little Curlew were classified into visual continuous and the Long-billed Plover, Redshank, Grey Plover, Common Snipe, Ringed Plover, Little Tinged Plover, Dunlin, Little stint and Kentish plover were classified into the pause travelers. With reference to the Euclidean Distance matrix, 18 species of the shorebirds showed 76.75% similarities and the Dunlin, Little stint and Kentish plover below the level. Among the three groups the tactile continuous and pause travelers differed significantly pertaining to the seasons and tidal variations ($P<0.05$).

Although different groups of shorebirds were showed distinct spatial distributions. But, the relationship between foraging methods and habitat use of shorebirds has not been clarified. Botto *et al.* (2000) attribute the different habitat uses of shorebirds to different feeding success. An example is the visual searchers that use crab beds more often since they can capture more prey inside burrowing crab beds. Moreover, Pienkowski & Evans (1984) have found that tactile foraging of sandpipers might impair the visual foraging of plovers, resulting in the exclusion of plovers from the best feeding areas.

Apart from that the second group i.e. visual continuous were not showed significant differences with regards to the seasons and tides when compared to the other two groups, because, the plovers were differentiated into sandpiper with reference to their foraging strategies (Nikel 2005) that also implies their habitat use and partitioning in the available habitat. The grouping of shorebirds me be nature of the nature of habitat, availability of prey, coarse structure of the sand particle, inter and intra-species competitions climatic conditions etc. So, we suggest that the shorebirds were grouped into three categories as we mentioned above, may be based on their behavioural response to changes on prey availability. This is also supported by Thompson & Nikel (2005), i.e. Plovers are hunters and Sandpipers are probers. Although, the shorebirds used Pazhaiyar tidal flat as a feeding ground and they have grouped into different categories may be due to their foraging style and food partitioning for avoiding competitions. Shorebirds are using tidal flats seasonally to regulate their migratory cycle and in the mean time they are assembling into several groups to avoid inter and intra specific competitions and they have to meet out the availability of prey and habitats. Shorebirds were using the wetland types as a stop over sites for refuel the energy while they were migrating.

Conclusion conservation implications

Our study revealed the first evidence of the shorebirds using the tidal flat as a feeding ground while they are migrating from their native places and our study provides the first prediction of the patterns and assemblages of several species of shorebirds at a high spatial distribution of the Pazhaiyar estuary. Density, diversity and species richness of migratory shore birds can indicate the quality of habitat and they are closely associating coastal ecology. So the quality of tidal and coastal habitat will strongly regulate the bird migration. However, the availability of tidal habitat (exposed muddy flat), onset of monsoon in a right time and tidal rhythm are more precious to sustain the shorebird ecology.

Apart from that the practice of wetland management for providing waterbird habitat, it is necessary to develop effective tools of predicting the effects of wetland management on the dynamics of waterbirds and their habitats. This requires simplified decision supporting systems on the basis of complex multidisciplinary knowledge. The socioeconomic scenarios can also be involved in the systems to provide an integrated prediction of wetland management (Zhijun *et al* 2010).

Although, the overall results of the present study revealed that decrease in the number of species of shorebirds when compared to the previous observations (Pandiyan, 2008 a, b).We have to protect the tidal flats and accommodate sea level modifications .i.e. restoration of natural hydrology could facilitate sediment accretion and building of deltaic coastal wetlands. If the climatic changes continued the disappearance of wetlands particularly tidal flats will be lost very soon. This is very important and critical issue very particularly wetland ecology for the sake global network of migratory routes, otherwise internationally birds migratory routes will be fragmented.

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WOOD SANDPIPER *TRINGA GLAREOLA* ON KAMCHATKA, RUSSIA

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Data on the migration, distribution and breeding biology of Wood Sandpiper were collected in different parts of Kamchatka from 1966–2008. Information on duration of spring migration and counts at some sites in Kamchatka are provided. During northward migration, Wood Sandpipers are rare on the south-west coast of Kamchatka and numerous in the central part. Most of the birds arrive on Kamchatka after high-altitude flight over the Sea of Okhotsk and land in the central part of peninsula after crossing the Sredinniy Range. The Wood Sandpiper is one of the most common breeding waders of Kamchatka. Breeding densities in different habitats and data on breeding phenology are provided.

MATERIALS AND METHODS

Data used in this paper were collected from 1966–2008 as part of various studies on Kamchatka birds. In addition, we have used published data from other sources (Kistchinski 1980, Lobkov 1986, Dyakonov 2000, Malinovskiy 2002). Most of the data were collected during our waterfowl and shorebird migration studies, the majority involving counting of birds in flight. For estimation of breeding density we used transect counts with transect widths of 100 m for flood-plain forest and 300 m in open habitats (different types of tundra).

More details of our investigation methods are available in previous papers (Gerasimov 1991, 1999, 2001; Gerasimov & Kalyagina 1995; Gerasimov *et al.* 1998).

Figure 1 shows the location of all places mentioned in the text.

RESULTS AND DISCUSSION

Northward migration

West Kamchatka

In 1993 only one Wood Sandpiper was recorded at the Bolshaya River mouth (52°32' N; 156°17' E) during May 2–27 (Gerasimov 1998). In 1994 we also observed Wood Sandpipers only once (two birds) at the Opala River mouth (52°00' N; 156°30' E) (Gerasimov & Kalyagina 1995). In 2001 we saw a total of six Wood Sandpipers on Levashova Cape (52°47' N; 156°10' E).

We recorded more Wood Sandpipers on the southwest coast in 2007, when we conducted observations of northward migration of waterfowl and shorebirds on Levashova Cape (52°47' N; 156°10' E) from April 22 till May 24. Migration of this species takes place from May 16–18; in total we counted 70 Wood Sandpipers, with most of them flying past in small flocks on May 17. However, in the following years we did not see any Wood Sandpiper in the same area during the April 20–May 24 period.

Comparing these data with concurrent observations of tens of thousands of other waders species we can conclude that visible northward migration of the Wood Sandpiper is almost completely absent on the southwest coast of Kamchatka Peninsula (at least at low heights).

We encountered more Wood Sandpipers in the central part of the west coast of Kamchatka at the Moroshechnaya River mouth. (56°50' N; 156°10' E). Data about commencement and active northward migration at this site are listed in Table 1.

The earliest appearance at the Moroshechnaya River mouth took place in 1976 and the latest in 1990. We think this timing difference probably demonstrates that migration of this species is not dependent on spring weather conditions. However, it may be a random circumstance as northward migration of Wood Sandpipers in this area is rather small. Wood Sandpipers fly over the Moroshechnaya Mouth as single birds and small flocks. Only once (May 28 1976) we recorded a flock of 44 individuals. The maximum number of Wood Sandpipers that we counted during one season was only 136 individuals.

Central Kamchatka

Observations were conducted at two points in the Kamchatka River Valley: near Krapivnaya Village (central part of the valley; 55°52' N; 159°37' E) and at Kharchinskoe Lake (northern part; 56°33' N; 160°50' E).

In 2003 at Krapivnaya Village, Wood Sandpipers appeared on May 12 and significant migration was observed from May 17 for the next 4 days (Figure 2). The direction of movements was south-north as well as north-south. Some birds migrated probably as pairs, as birds were often seen flying in twos and the male was flight displaying. In total, we counted 275 Wood Sandpipers at this site in 2003. In 2004 at the same site, we observed one Wood Sandpiper on May 8, the earliest spring record of this species on Kamchatka.

Kharchinskoe Lake was most interesting place for Wood Sandpipers on Kamchatka during northward migration. In 1999 the first Wood Sandpiper was recorded on May 11; the first short display flight was recorded on the same day also. The next sighting was on May 13, with two more birds on May 17; next day the number of Wood Sandpipers increased to 14 individuals. Active migration started on May 19 and continued until the end of our observation period. The maximum birds of 1314 individuals was counted on May 24 (Fig. 3).

In this region, Wood Sandpipers migrated mainly as small flocks up to 20 individuals, but we also recorded bigger flocks of 32, 50 and 60 individuals. It was easy to see the birds during active migration as flocks arrived at Kharchinskoe Lake from the northwest over the Sredinny

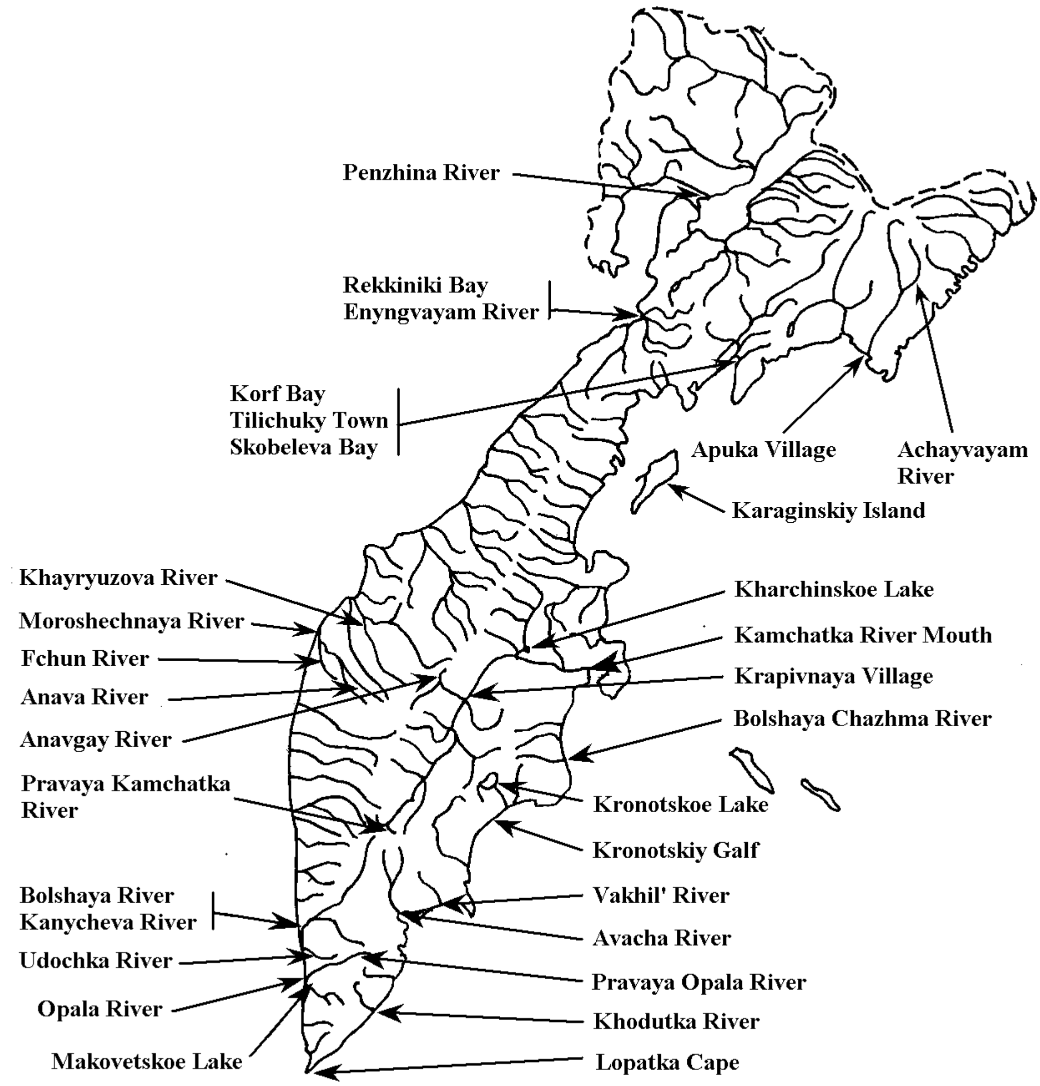

Figure 1. Locations of places mentioned in text.

Table 1. Northward migration of Wood Sandpipers at the Moroshechnaya River mouth.

Year	Migration start	Period of active migration
1976	10.05	23–28.05
1977	12.05	26–28.05
1980	13.05	22–25.05
1990	24.05	28–29.05

Range. In total, we counted 3600 Wood Sandpipers and believe that in 1999 at least 4000–5000 birds of this species used the shores of Kharchinskoe Lake as a staging site (Gerasimov, 2001).

East Kamchatka

During northward migration, Wood Sandpipers are more common on the southeast coast of Kamchatka compared to the southwest coast. The most southern point of our observations in that area was the Khodutka River mouth (52°47' N; 158°02' E). In 1995, we recorded the first flock of 8 individuals on May 12; however, we did not see significant migration until the end of our observations on May 20.

In the Avacha River delta (53°03' N; 158°30' E), Wood Sandpipers appear in the second decade of May. Earliest records were on May 14 in 3 different years: 1965, 1966 and 1977. Visible migration is much more intensive at the Avacha River than in more southerly areas of Kamchatka. For example, on May 14, 1965 we saw flocks of some tens of Wood Sandpipers in the delta. At least 60 feeding birds were counted on a few hectares of flooded land on May 24 1995. On the same day over a period of two hours we saw three flocks of 6, 7 and 17 birds flying past.

At the Vakhil River mouth (Southeast Kamchatka; 53°15' N; 159°34' E), we recorded the arrival of Wood Sandpipers on May 19, 1991 and May 16, 1992. The total number counted was some tens up to the end of our observations on

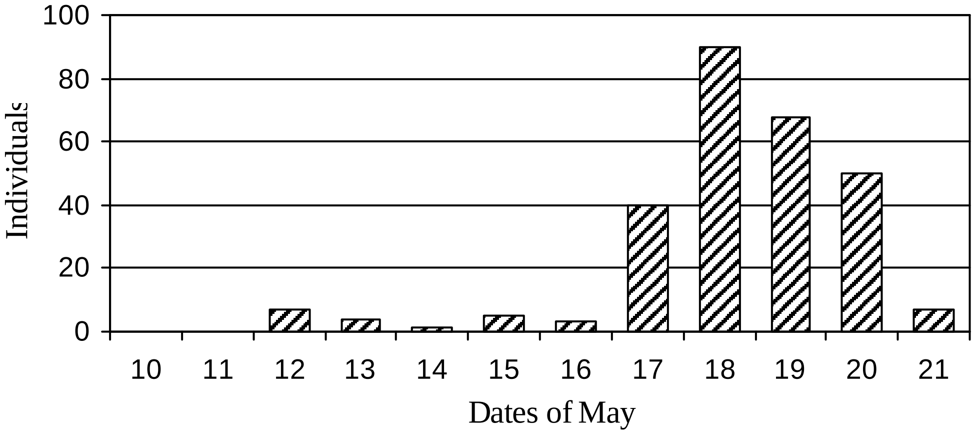

Figure 2. Daily migration of Wood Sandpipers in central part of Kamchatka River Valley in May 2003.

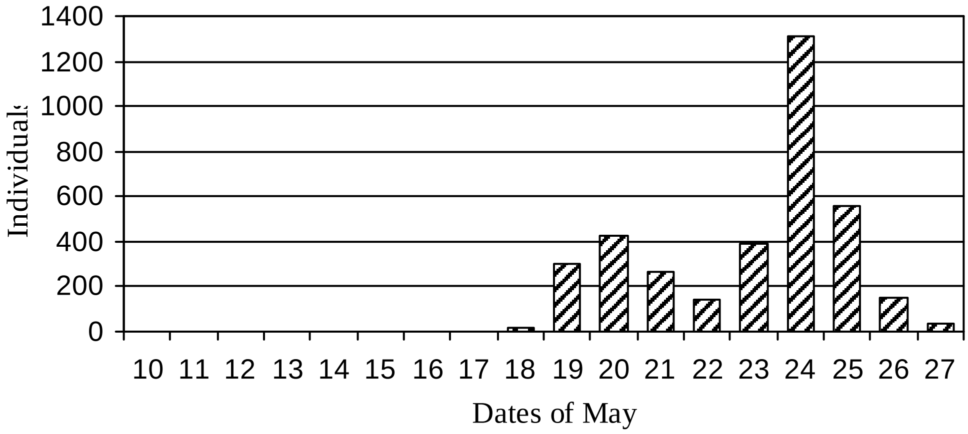

Figure 3. Daily migration of Wood Sandpipers at Kharchinskoe Lake in May 1999.

May 22, including flocks of 16 and 40 birds (Gerasimov et al., 1998).

On the Kronotsky Bay coast the first Wood Sandpipers were recorded on May 10–19, averaging May 14 over 10 years. Migration occurred in two waves: May 13–15 and May 23–26. Flocks of up to 30 individuals were observed (Lobkov, 1986).

North Kamchatka

In Tilichiki Town (60°26' N; 166°05' E) in 1998, we observed active migration of Wood Sandpipers on May 21–22. During this period some tens of birds were recorded flying northward in pairs and single birds from the Korf Bay direction. During the following days (May 23–31) we observed Wood Sandpipers daily in Skobeleva Bay (60°26' N; 166°22' E). These birds also migrated northward from the coast; some males were song flying. Maximum birds counted were 36 on May 26 (Gerasimov, 1999).

Near Apuka Village (60°26' N; 169°40' E) in 1960, the first Wood Sandpipers appeared on May 21; migration finished on May 30 (Kistchinski, 1980).

In Rikkiniki Bay (Kuyvivayam River mouth; 60°56' N; 163°50' E) in 1998, we recorded Wood Sandpipers arriving on May 20. On Enyngvayam River (60°50' N; 163°48' E) in 1982, active migration took place during May 20–23. On all four days Wood Sandpipers were seen flying southward instead of northward.

At the Penzhina River mouth (62°28' N; 156°15' S.) migration started on May 18 in both 1981 and 1982. However, the 1981 spring was normal but, on the contrary, the 1982 spring was extremely late.

Data collected during northward migration on Kamchatka demonstrated that Wood Sandpipers do not use the same migration routes that have been noted earlier for waterfowl and shorebirds (Gerasimov, 1995; Gerasimov & Gerasimov, 1995; 1997; Lobkov, 2003b). Few Wood Sandpipers are present on the southwest coast of Kamchatka and rather few on the west coast. Numbers are much higher on the southeast coast and in central areas. In this connection, we think that most Wood Sandpipers arrived on Kamchatka after a long distance high-altitude flight over Sea of Okhotsk and descended after passing the west Kamchatka coast. The frequent observation of birds migrating in the "wrong" direction (southward instead northward) could be a consequence of some birds arriving too far north of their breeding areas; further research is needed to support this suggestion.

Breeding

The Wood Sandpiper breeding range on Kamchatka includes all areas except high mountains. Main habitats types are swampy landscapes: sedge, sedge-peat and sedge-peat-low bush bogs and meadows in river valleys. Also the Wood Sandpiper breeds in wet tundra, but the density is usually lower there except for some areas located close to rivers.

Wood Sandpipers breeds in mountain regions up to 1000 m above sea level (headwaters of Karakovaya and Anavgay Rivers).

The results of transect counts from different areas and habitats are listed in the Table 2. We also include data for sites where Wood Sandpipers were not recorded but the habitats looked suitable for breeding.

Unfortunately we were unable to count in some habitats where the breeding density of Wood Sandpipers was highest, e.g. in tussock wetlands in the flood-plain of the middle and lower stream of the Kamchatka River.

Display flights were recorded just after arrival of the first birds, e.g. on May 12, 1995 in the tundra between the Pravaya and Malaya Khodutka Rivers we first saw migrating flocks of Wood Sandpipers and on the same day heard the first singing. During active migration we heard passing males singing. Data on Wood Sandpiper breeding phenology are recorded in Table 3.

In southern Kamchatka river valleys display flight activity gradually decreases in the middle of June. Some

Table 2. Wood Sandpiper counts on Kamchatka in the breeding season.

Studied area (type of habitat)	Year	Length of count, km	Density, pairs/km^2
Makovetskoe L. (wet tundra with lakes)	1989	14,0	0,2
	2000	15,9	0
	2002	6,4	0
Fchun R. (wet tundra with lakes and streams)	1999	15,6	0
Khayryuzova R. (flood-plain forest)	1999	1,8	1,9
Anava R. (wet tundra)	1999	26,6	0,5
Anava R. (flood-plain forest)	1999	13,4	1,5
Pravaya Opala R. (flood-plain grassland with bushes 450 m asl)	2000	2,7	8,7
Pravaya Kamchatka R. (tundra with streams and bushes 500 m asl)	2001	5,8	1,7
Khodutka R. (wet tundra with lakes)	2002	14,8	1,5
Kanycheva R. (wet tundra with lakes and streams)	2002	24,7	0
Korf Gulf (different types of tundra)	2002	25,8	0
Penzhina River Mouth (different types of tundra)	2002	17,2	1,7
Anavgay River (larch forest with lakes and streams 700 m asl)	2003	5,6	0,9
	2008	10,4	0,5
Anavgay River (wet mountain tundra with streams and lakes 800–1000 m asl)	2008	29,2	0,8
Opala R. (wet tundra with streams)	2003	13,4	0,1
Kamchatka River Mouth (wet tundra without bushes)	2008	6,9	8,7
Kamchatka River Mouth (wet tundra with lakes, streams and many bushes)	2008	17,1	8,4
Kamchatka River Mouth (dry tundra without bushes).	2008	13,6	0,4
Kamchatka River Mouth (dry tundra with many bushes)	2008	20,2	2,0
Kamchatka River Mouth (flood-plain forest with bushes)	2008	7,9	4,3
Total		**309,0**	**2,0**

Table 3. Breeding phenology of Wood Sandpipers on Kamchatka.

Type of observation	Place	Date(s)	Reference
Mating	Avacha Delta	May 23	Our data
Nest building	Avacha Delta	June 12	Our data
Eggs	Avacha & Opala Rivers	June 1–18	Our data
	Kamchatsk River Mouth	June 16	Our data
	Avacha Delta	June 20	Malinovskiy, 2002
	Kamchatka River	June 5–20	Dyakonov, 2000
	Kamchatka Region (all)	June 12–24	Lobkov, 1986
Chicks near nest	Avacha Delta	June 16	Our data
	Kamchatsk River Mouth	June 22	Our data
	South Kamchatka	June 22–26	Lobkov, 1986
Birds near brood	Anava River	June 18 – July 24	Our data
	Udochka River	June 25	Our data
	Pravaya Opala River	July 7	Our data
	Karaginskiy Island	July 15–20	Our data
	Achayvayam River	July 6–26	Kistchinskiy, 1980
	Avacha Delta	July 10–30	Malinovskiy, 2002
Fledglings	Kronotskoe Lake	July 10	Lobkov, 1986
	Avacha Delta	July 19	Malinovskiy, 2002
Juveniles	Kamchatka Region	From July 21	Lobkov, 1986

birds continue song flights until the end of first decade of July, obviously connected with replacement clutches. The number of such birds is dependent on weather conditions and is usually much higher in years with high flood levels which in Kamchatka occur in June. In June 1994, floods covered the main part of Wood Sandpiper breeding habitats in the Avacha River Delta. After floods subsided at the end of June we saw many birds displaying until the end of the first decade of July. Obviously the observation of late Wood Sandpiper breeding (mating was observed on June 28, nest with eggs was found on July 4) mentioned by Loblov (1986) was related to loss of the first nest. Malinovskiy (2002) mentioned records where Wood Sandpipers placed grass under the eggs, trying to increase the nest height above the rising water level.

Four nests found in Avacha Delta were located on sedge-peat bogs with some bushes of Sweet Gale *Myrica tomentosa.* They were simple hollows in moss lined with dry grass and leaves of Sweet Gale or pieces of dry Sedge *Carex* sp.

We found two nests at the Kamchatka River mouth. One was made on sedge bog with rather high bushes of Willow *Salex* sp. and Srubby Alder *Alnus fruticosa.* The construction of this nest was the same as mentioned above. The other nest was found in an atypical place – a sand spit which separated a big salt water lagoon from the Pacific Ocean. The nest was built on dry, low tundra bushes, including Crowberry *Empetrum nigrum*, Bog Blueberry *Vaccinium uliginosum* and Lingonberry *V. vitis-idaea*. The nest was a little above ground level and was unusually large with well developed walls made from dry cereal plants.

Nest measurements were: (Lobkov, 1986 and our data, n=10): outside diameter: 82–110 mm, average 93 mm; inside diameter: 65–105 mm, average 91 mm; depth of hollow: 39–70 mm, average 46 mm.

Egg measurements (n = 24) were: 36.5–40.8×26.1–27.9 mm, average 39.0±1.0×27.0±0.5 mm. Four eggs from one nest recorded in Lobkov (1986) were smaller: 34.7–37.7×21.7–25.6, average 36.4×24.4 mm.

Southward migration

The most significant information on southward migration was collected during counting at the Penzhina River mouth in 2002 and 2003. Observations were organized so that in the second year they commenced (August 11) on the date after they finished in the first year. This allowed us to carry out observations over a period of two months.

Wood Sandpiper migration took place during a rather short period from July 20 till August 23 (Fig. 4); also single birds were recorded at night on September 1. Wood Sandpipers migrated mainly in small flocks of up to 10 individuals. Birds stopped to feed and rest mainly on small brackish water lakes located along the coast on the border of marshes and wet tundra. In total we counted 1131 Wood Sandpipers (Gerasimov, 2004).

Kistchinski (1980) recorded the last Wood Sandpipers in the upper stream of the Achayvayam River (61°25' N; 171°20' E) on August 16 and near Apuka Village on August 28.

On the Fchun River (tributary of Moroshechnaya River; 56°22' N; 156°00' E) in 1995, we recorded the start of southward migration on July 19. At the Moroshechnaya River mouth in 2004, active migration took place from August 7–11, peaking on August 10. Birds were mainly flying past, only a small number stopped on the spit and mudflats. The maximum size of flying flocks was 32 (August 10 2004).

In the lower Bolshaya River in 1978, we recorded the start of southward migration on July 19 (Gerasimov, 1998).

Near Petropavlovsk-Kamchatsky City and Elizovo Town, southward migration takes place from the 3rd decade of July to the 2nd-3rd decades of September. Wood Sandpipers fly past mainly in darkness and in a westerly direction. From this we assume that Wood Sandpipers do not fly farther south along the east coast in that region, but cross the Kamchatka Peninsula from east to west. The latest record was on September 27 1994, when we heard Wood Sandpipers calling four times flying over the Avacha River.

On the most southern point of Kamchatka (Lopatka Cape [50°52' N; 156°40' E]) southward migration is almost absent; Lobkov (2003a) recorded only two single birds during regular observations from August 24 till October 11, 1987.

The study of southward migration of Wood Sandpipers on Kamchatka shows that birds leave the peninsula in the

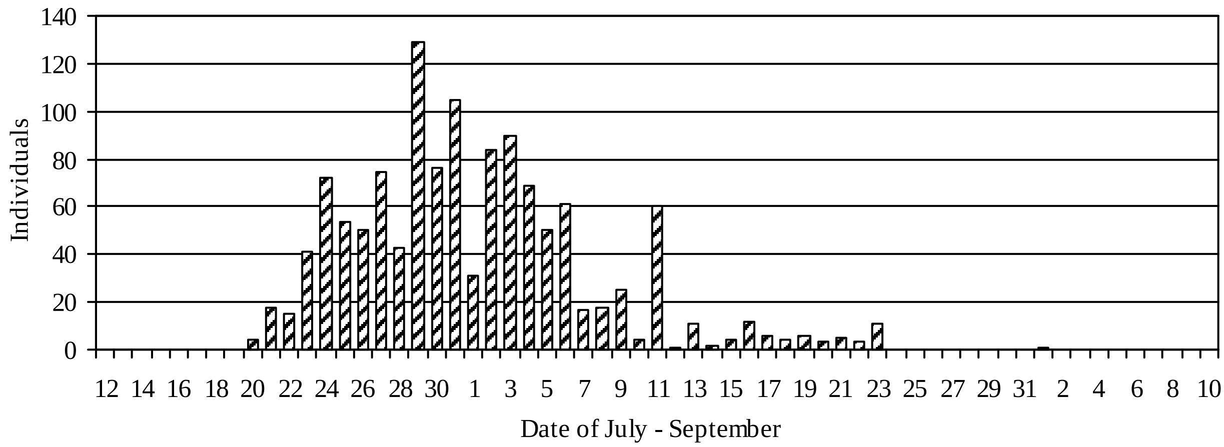

Figure 4. Daily counts in 2002 and 2003 of Wood Sandpipers at the Penzhina River estuary.

same directions as many other bird species; they migrate southwest over the peninsula leaving from various sites on the west coast.

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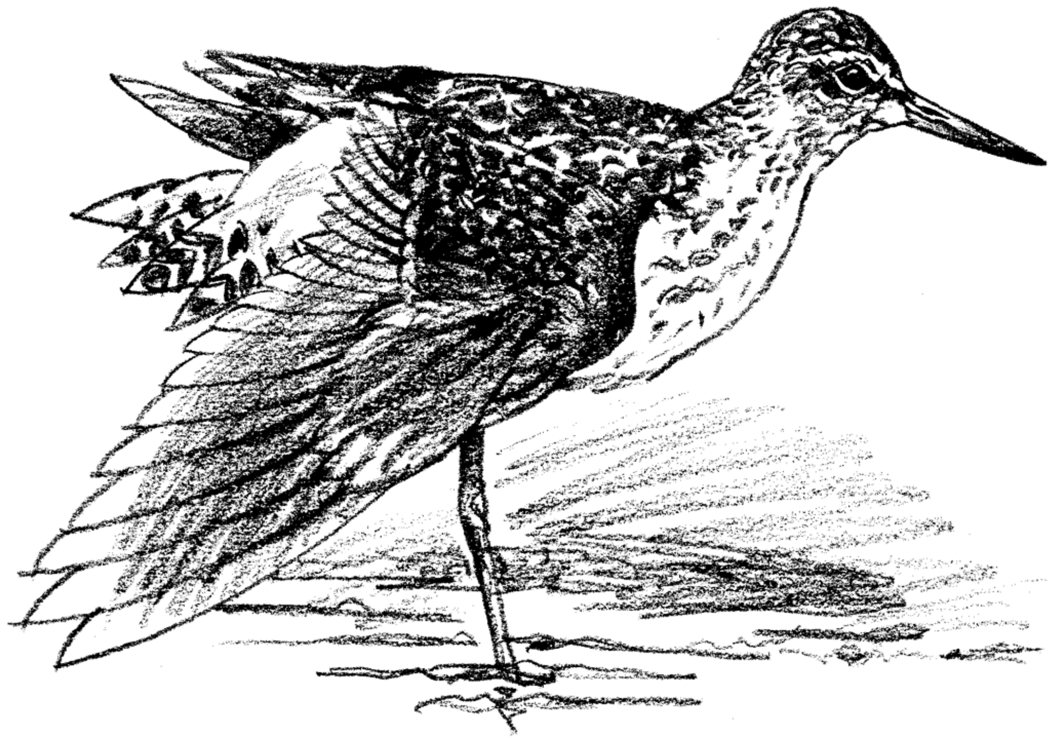

THE STATUS OF MIGRATORY SHOREBIRDS DIVERSITY IN RAMSAR SITE DURING SOUTHWARD AND NORTHWARD MIGRATION IN KUALA GULA BIRDS SANCTUARY

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Kuala Gula 04º 55. 60'N E 100º 28.0'E is a well established bird sanctuary in Malaysia and the Asian region. It is one of the primary corridors or stopover sites of migratory shorebirds during annual migrations and considered one of the major routes of the East Asian – Australasian flyway. Two sampling stations each measuring 100 x 100 meters squared were established within the Kuala Gula Bird Sanctuary. The first station (station 1) was located at the mouth of Ban-Zhu-Kao River estuary (104^O 55.185'N, 100^O 27.840'E) adjacent to a fishing village. The other station (station 2) was located at the inner mouth of Teluk Rubiah River estuary (104^O 55.00'N, 100^O 27.761'E) surrounded with mangrove forest. The study was undertaken to compare the migratory shore bird species diversity, species richness, evenness, density and the species relative abundance during southward and northward migration in Kuala Gula Bird Sanctuary over a one-year period. Sixty-one migratory shorebirds species representing 12 families were identified. No significant ($P>0.05$) difference in the migratory shorebirds relative abundance and density was observed during northward and southward migration. However, species diversity index (H' = 3.6) of northward migration was significantly higher ($P<0.05$) compared to southward migration (H'= 3.4). Similarly the species richness of northward migration is higher ($P<0.05$) compared to southward migration. However, the species evenness does not show significant ($P>0.05$) difference in both stations.

INTRODUCTION

Kuala Gula Bird Sanctuary, Perak, Malaysia (04º 55. 60'N E 100º 28.0'E) is one of the most important and established bird sanctuaries in Malaysia and in the Asian region. Kuala Gula is one of the primary corridors and stopover sites of migratory shorebirds during annual migrations. The bird sanctuary is considered one of the major routes of the East-Asian – Australasian flyway along which migratory shorebirds fly between northern breeding grounds and wintering areas in the south (Riak *et al.*, 2003b; Parish and Wells, 1984; Edward *et al.,* 1986; Hawkins and Howes, 1986). Mangrove areas extend from Kuala Gula in the North to Bagan Panchor in the south, measuring a distance of about 52 km from one end to the other; and about 13 km wide in the middle portion that provides food and shelter for shorebirds. The area has low wave energy coastlines with an extensive area of intertidal flat characterize the site. Although the mangroves of Kuala Gula Bird Sanctuary has been conserved for the past 22 years until the present time for the protection of the shoreline and the local high biodiversity of wildlife (Jasmi 1986; Jasmi *et al.* 1997), this sanctuary has been approved as Ramsar site only recently in the year 2002. The high biodiversity of wildlife is highly dependent on the maintenance of the pristine conditions of the area and therefore good management is necessary. The objective of the present study was to determine the diversity of migratory shorebirds during southward and northward migration.

STUDY AREA AND METHODS

The study was carried out in Kuala Gula Bird Sanctuary located in northwestern part of Peninsular Malaysia N 04º 55. 60' E 100º 28.0'E (Figure 1). Two sampling stations each measuring 100 x 100 meters squared were established within the Kuala Gula Bird Sanctuary. The first station (station 1) located at the mouth of Ban-Zhu-Ka River estuary (104^O 55.185'N, 100^O 27.840'E) adjacent to a fishing village. The other station (station 2) located at the inner mouth of Teluk Rubiah River estuary (104^O 55.00'N, 100^O 27.761'E) surrounded with mangrove forest.

Bird sampling

Surveys of shorebirds were conducted within the plot established along the intertidal mudflat of Kuala Gula from October 2006 until September 2007 following the method described by Bibby *et al.* (1992). The plots were set during low tide at totals measurements. The boundaries of each plot (measuring 100 x 100 meters) was delineated with fishing stakes, with a number of red ribbons attached to it. The plots were set randomly at locations where high number of shorebirds were observed during the reconnaissance surveys. Each plot has an interval distance of 1,500 meters. To identify various species of migratory shorebirds, binoculars (Nikon Egret 8 X 40 spotting scope) and camera were used. The observation and identification of bird species were undertaken from low tide until the high water neap tide. The counting of birds in each plot was performed using a tally counter. The guidebook by Robson to the Birds of South-East Asia (2002) was used to identify all the migratory

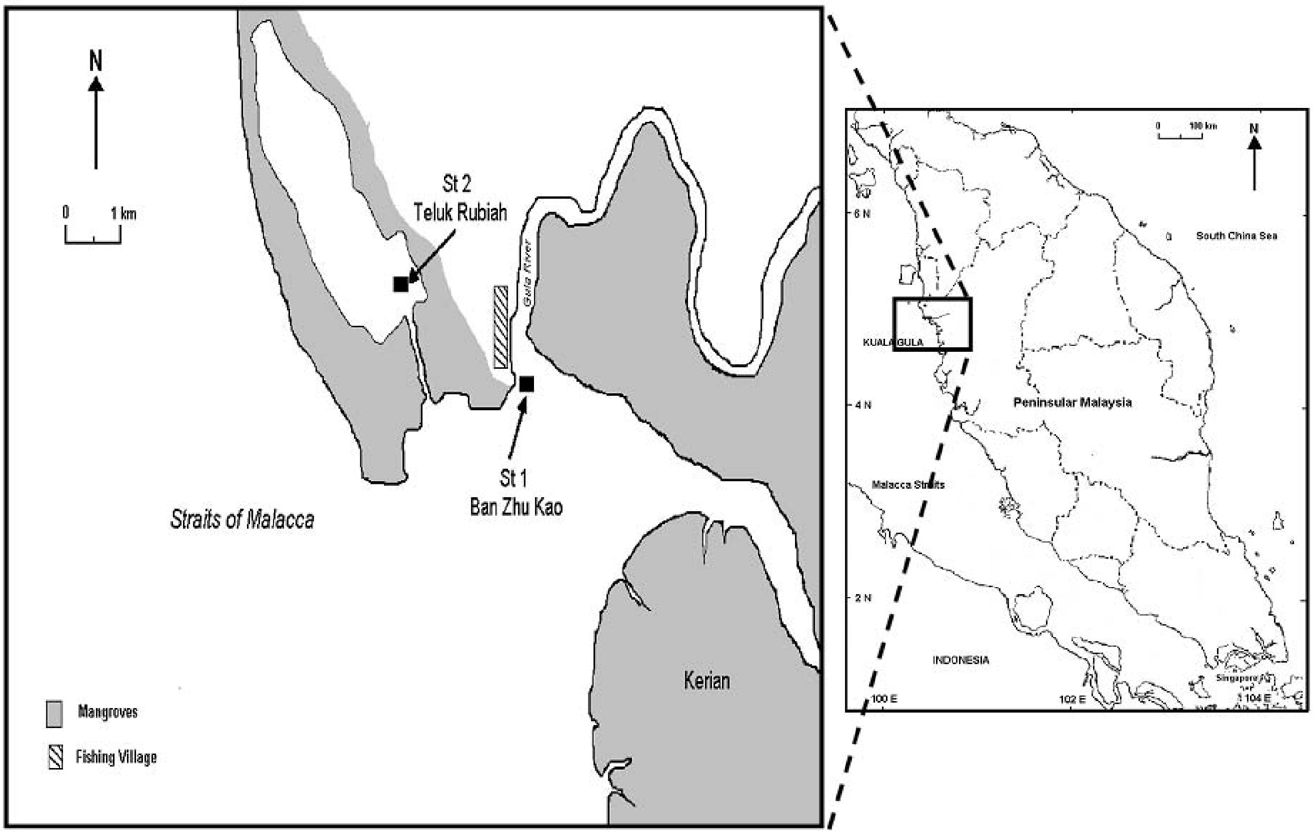

Figure 1: Map showing the location of the study site in Kuala Gula Bird Sanctuary, Perak.

shorebirds species observed. According to McKinnon and Phillips (1993), repetitions have to be done in order to obtain accurate data. Therefore, two series of observations were carried out for each plot in each station.

Statistical analysis

The statistical analysis was done using Statistical Package Data for the Social Science (SPSS) for windows version 15.0 (2007). The analysis of variance (ANOVA) was used to evaluate differences in mean abundance, diversity, and number of shorebirds species between stations. The richness indices, diversity indices and evenness indices were calculated using (PRIMER) Plymouth Routines in Multivariate Ecological Research version 6.1. Prior to the statistical analysis, all data were tested for the basic assumptions of normality and homogeneity of variance inherent in linear model statistics by normal probability plots generated by the univariate procedure in the SPSS package. All statistical significances were considered when $P<0.05$. All values that are not normally distributed were transformed accordingly to satisfy the condition of homogeneity of variance (Gomez,Gomez & Zar 1984).

RESULTS

The total mean density of migratory shorebirds was found highest ($P<0.05$) in October (2,885 Ind ha^{-1}) during southward migration and March (1,870 Ind/ha) during northward migration in station 2 and station 1, respectively. Whereas the lowest ($P<0.05$) observed bird density in station 2 was recorded in May (267 Ind ha^{-1}) and June (106 Ind ha^{-1}) in station 1 (Figure 2). In the year 2001, the percentage of shorebirds recorded in the Kuala Gula Bird sanctuary during southward and northward migration accounted for 11%, and in 2002, the number increased to 14%. However, in 2003 and 2004, the number declined to 4% and 8%, respectively but increased to 18% in 2005.

Shorebirds relative abundance

A total of 4,396 of shorebirds and water birds in southward migration and 7,913 during northward migration were recorded in both stations. The relative abundance of birds during migration were mostly dominated by Common Greenshank (*Tringa nebularia*), Brown Headed Gull (*Larus ridibundus*), Greater Crested Tern (*Thalasseus bergii*) and Eurasian Curlew (*Numenius arquata*) which accounted for 66.0%, 43.4%, 23.6% and 19.3% of the total bird populations, respectively in station 1 (Table 1). The same pattern was observed in station 2 were the relative abundance was dominated by Common Greenshank, Common Snipe (*Gallinago gallinago*), Eurasian Curlew, Bar-tailed Godwit (*Limosa lapponica*) and Little Egret (*Egreta gazetta*) which accounted for 62%, 37.8%, 25.0%, 15.6%, and 12.3% of total bird populations, respectively (Table 2). The abundance of Common Greenshank attained their peak abundance in the month of December during the northward migration (Table 1).

Sixty-one species of shorebirds were recorded and identified at station1 and station 2 during the southward and northward migration in Kuala Gula Bird Sanctuary from 12 families. The diversity index of northward migration is

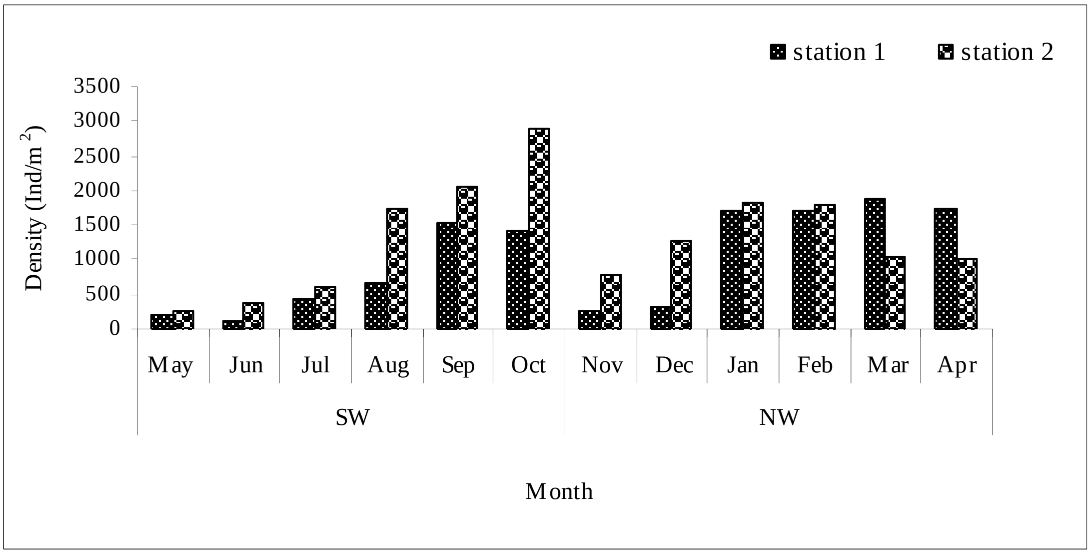

Figure 2: Average bird density in the two stations (stations 1 and 2) in Kuala Gula Bird Sanctuary during the southward and northward migration.

Table 1: Relative abundance (%) of bird species in southward and northward migration in station 1

Months		Common Name	Scientific Name	Total %
May	SW	Common greenshank	*Tringa nebularia*	47.2
June	SW	Brown headed gull	*Larus ridibundus*	43.3
July	SW	Greater crested tern	*Thalasseus bergii*	23.6
August	SW	Common redshank	*Tringa nebularia*	26.3
September	SW	Lesser sand plover	*Mesophoyx intermedia*	16.7
October	SW	Eurasian curlew	*Numenius arquata*	19.3
November	NW	Common redshank	*Tringa nebularia*	37.0
December	NW	Common redshank	*Tringa nebularia*	66.0
January	NW	Common redshank	*Tringa nebularia*	19.0
February	NW	Curlew sand piper	*Calidris ferruginea*	13.7
Mach	NW	Terek sandpiper	*Xenus cinereus*	13.7
April	NW	Whimbrel	*Numenius phaeopus*	13.8

significantly higher ($P<0.05$) compared to southward migration. All recorded and identified shorebirds were passage migrants. The migratory shorebirds identified during the one-year data collection by families were Accipitridae, Ardeidae, Charadriidae, Ciconiidae, Scolopacidae, Sternidae, Rallidae, Bucerotidae, Heliomithidae, Laridae and Recurvirostridae. In station 1, the diversity index ($H' = 3.6$) was significantly higher ($P<0.05$) during northward migration compared to the southward migration. Similarly, in station 2 the diversity index was significantly ($P<0.05$) higher ($H' = 3.4$) during northward compared to southward migration (Figure 3A). The highest ($P<0.05$) peak of species richness ($d' = 8.7$) obtained in station 1 was observed in the month of January during the northward migration period. Similarly, in station 2, the peak ($d' = 6.4$) was observed in November which also falls during northward migration (Figure 3B). The species evenness and the distribution of shorebirds species during southward and northward migration has no specific pattern and no significant difference ($P>0.05$) during the whole period of study (Figure 3C).

DISCUSSION

According to David *et al.* (2006), Scott and Rose (1989), Perennou *et al.* (1990), Perennou & Mundkur (1991), Perennou & Mundkur (1992), Siti Hawa & Ismail (1994), Kuala Gula and the adjacent coastal areas supporting large number of shorebirds including lesser adjutant which comprised 56.4% and 43.6% of total shorebirds community recorded from the year of 1989 to 1992. The reason for the decline of shorebirds and water birds in 2003 and 2004 was probably because there has been no real assessment or surveys of shorebirds done particularly during southward migration (David *et al.* 2006). The result of the present study revealed that the population of migratory shorebirds in the study site has now increased to 45% during southward and northward migration from 2006 until 2007 (Figure 4). The reason for the increased may perhaps be attributed to ample food supply in the intertidal mudflats. Previous studies have revealed that macrobenthic invertebrates such as polychaetes, crustaceans, and molluscs constitute a major part of the diet of migratory shorebirds during the wintering period (Shinichiro *et al.* 2007). The previous study of Riak *et al.* (2002) revealed peak abundance of the same species, the Common Greenshanks, although it was reported to dominate during the month of October which was during the

Table 2: Relative abundance (%) of birds species in southward and northward migration in station 2

Months		Common Name	Scientific Name	Total %
May	SW	Common snipes	*Gallinago gallinago*	37.8
June	SW	Common redshank	*Tringa nebularia*	62.0
July	SW	Common redshank	*Tringa nebularia*	41.5
August	SW	Eurasian curlew	*Numenius arquata*	10.5
September	SW	Bar-tailed godwit	*Limosa lapponica*	10.8
October	SW	Lesser sand plover	*Mesophoyx intermedia*	11.3
November	NW	Little Egret	*Egretta garzetta*	12.3
December	NW	Eurasian curlew	*Numeneus arquata*	25.0
January	NW	Bar-tailed godwit	*Limosa lapponica*	18.7
February	NW	Bar-tailed godwit	*Limosa lapponica*	15,6
Mach	NW	Common snipes	*Gallinago gallinago*	12.6
April	NW	Common redshank	*Tringa nebularia*	20.9

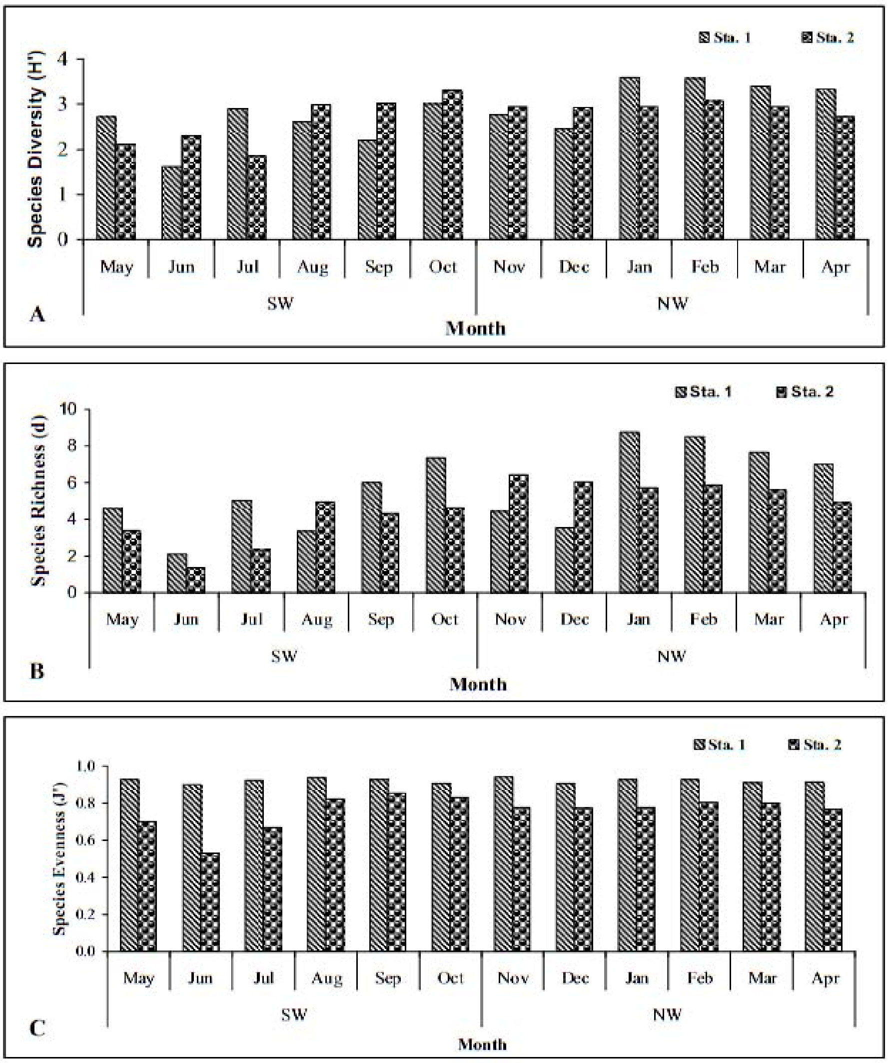

Figure 3: (A) Species diversity index (B) Species richness (C) Evenness of migratory shorebirds during southward and northward migration between station 1 and station 2.

southward migration. The pattern during migration of shorebirds might be dependent on fat deposition and only birds with fat reserve activity show a distinct singled-peaked activity pattern (Berthold 1989).

The high abundance of shorebirds, species diversity, species richness and species evenness recorded in the intertidal mudflat habitat of Kuala Gula could be due to suitability and availability of diverse foraging niches available such as soft bivalves and polychaetes. Similarly, Kalejta (1994) reported high abundance and diversity of shorebirds in foraging habitat with soft bivalves and polychaetes (as preferred diet) on extensive exposed intertidal mudflat. He further observed that within the intertidal habitats shorebirds have been switching habitat use based on the quality and quantity of habitat available in order to take advantage from newly exposed prey resources and

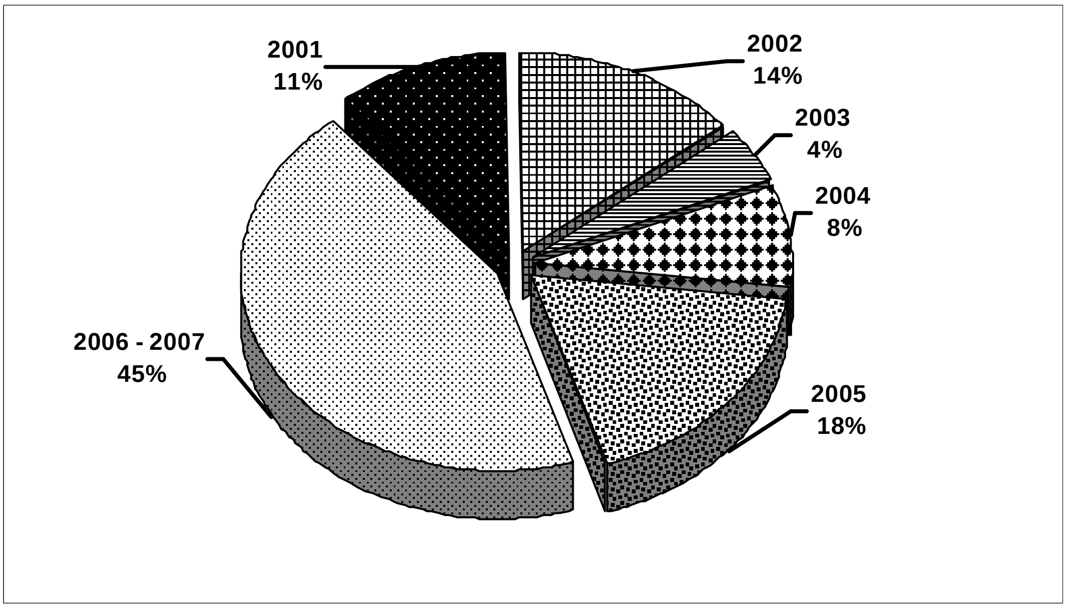

Figure 4. Comparison of shorebird abundance (%) from 2001-2007 in Kuala Gula Bird Sanctuary

maximize their foraging efficiency. Likewise, Piersma et al. (1993) reported that many species of waders (shorebirds) depend on coastal intertidal areas for their survival as they feed on macrobenthic invertebrates, which are available in the area.

The high abundance of migratory shorebirds in northward migration could also probably be due to the longer duration of stay and over wintering of some shorebirds species from the southward migration. Riak *et al.* (2003b) reported that the northward duration of stay for Marsh Sandpiper at mudflat of Kapar lasted for few weeks. Presumably, some of the southward moving waders lingered in any area proportionately to their immediate nutritional needs and to the quality and amount of food available (personal communication). The highest significant ($P<0.05$) of species diversity in migratory shorebirds during northward migration might be attributed to the longer duration of stay and over wintering of some shorebirds species and the availability of food in the mudflat. The species richness might be attributed by the higher presence of macrobenthic invertebrates observed in mudflat during the northward migration. The non-significant ($P>0.05$) difference of shorebirds in species evenness during southward and northward migration in both stations probably because shorebirds are used to spend more time in their foraging activities. Another possible explanation is that this site may comprise variety of habitat that supports the community population of shorebirds like substrate type, safe for roosting and the extent of disturbance.

The present study revealed that the high diversity of shorebirds found during northward migration might be related to high diversity and abundance of their preferred macrobenthic prey encountered in the mudflat habitat. Based on the results, the shorebirds utilized the Ramsar site in Kuala Gula during the 12 months period from May to April 2007 was equivalent to 45% indicating that total number of shorebirds using a given area during migration lies in the range of 1989 and 1992 peak percentage (56.4% and 43.6%). Therefore, the turnover rate percentage of shorebirds during the whole period of study indicating that the status of shorebirds annually migrates to the site were already increased compared to the previous records from 2001 to 2005. Further research remains necessary to continue to monitor the existing and future population of shorebirds especially during annual migration. Such monitoring will contribute to the long-term conservation of migratory shorebirds in Kuala Gula Bird Sanctuary particularly the whole Peninsular Malaysia.

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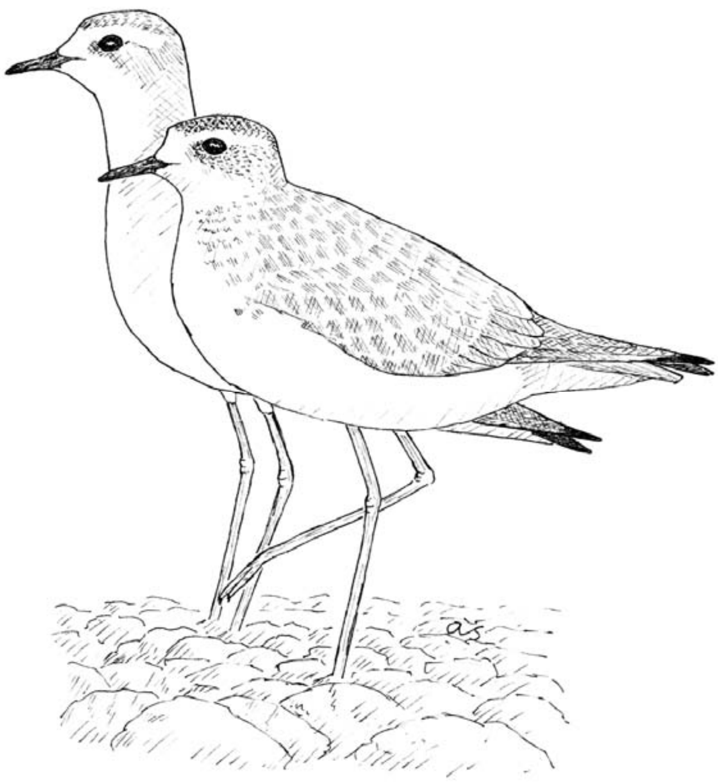

PANTAI TRISIK, YOGYAKARTA: ANOTHER INTERNATIONALLY IMPORTANT SITE FOR SANDERLING *CALIDRIS ALBA* IN INDONESIA

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INTRODUCTION

Pantai Trisik (7^{0}58’11.54” - 7^{0}58’58.87”S, 110^{0}11’82” - 110^{0}12’20.10”E) is a sandy coastal beach about 2.4km long on the south coast of Java approximately 20km east of Pantai Glagah that recently become known as an internationally important site for Sanderling *Calidris alba* with records of 432+ birds (Crossland *et al.* 2010). (Figure 1). The beach is administratively located in Banaran village, Galur sub-district, Kulon Progo district, Yogyakarta province. Although not mentioned by Howes *et al.* (2003) as an important site for migratory waterbirds in Java, the sites of Muara Gembong (with more than 29,000 birds) and Indramayu-Cirebon in West Java (with more than 10,000 birds) were known to be important. Pantai Trisik is known locally as the most important site in the Yogyakarta region for shorebirds.

Recent population estimates for the East Asian-Australasian Flyway (Bamford *et al*. 2008) suggest there are some 22,000 Sanderling. Here we report our shorebird observations in the area that also records a huge number of Sanderling. This paper contains our data on the number of Sanderling at Pantai Trisik and gives additional information on the significant number of Sanderling at Pantai Glagah and ascertains that both sites are internationally important for Sanderling.

Records of Sanderling in Java

Sanderling are an uncommon winter visitor to the Greater Sundas but more frequent on the south coast of Java (MacKinnon & Phillipps, 1993). It was recorded during Asian Waterbird Census in 1994-1996 (Lopez & Mundkur, 1997) and 1997-2001 (Li & Mundkur, 2004) (see Table 1). The maximum count in Indonesia during the census was 266 birds but with no information on the time and location

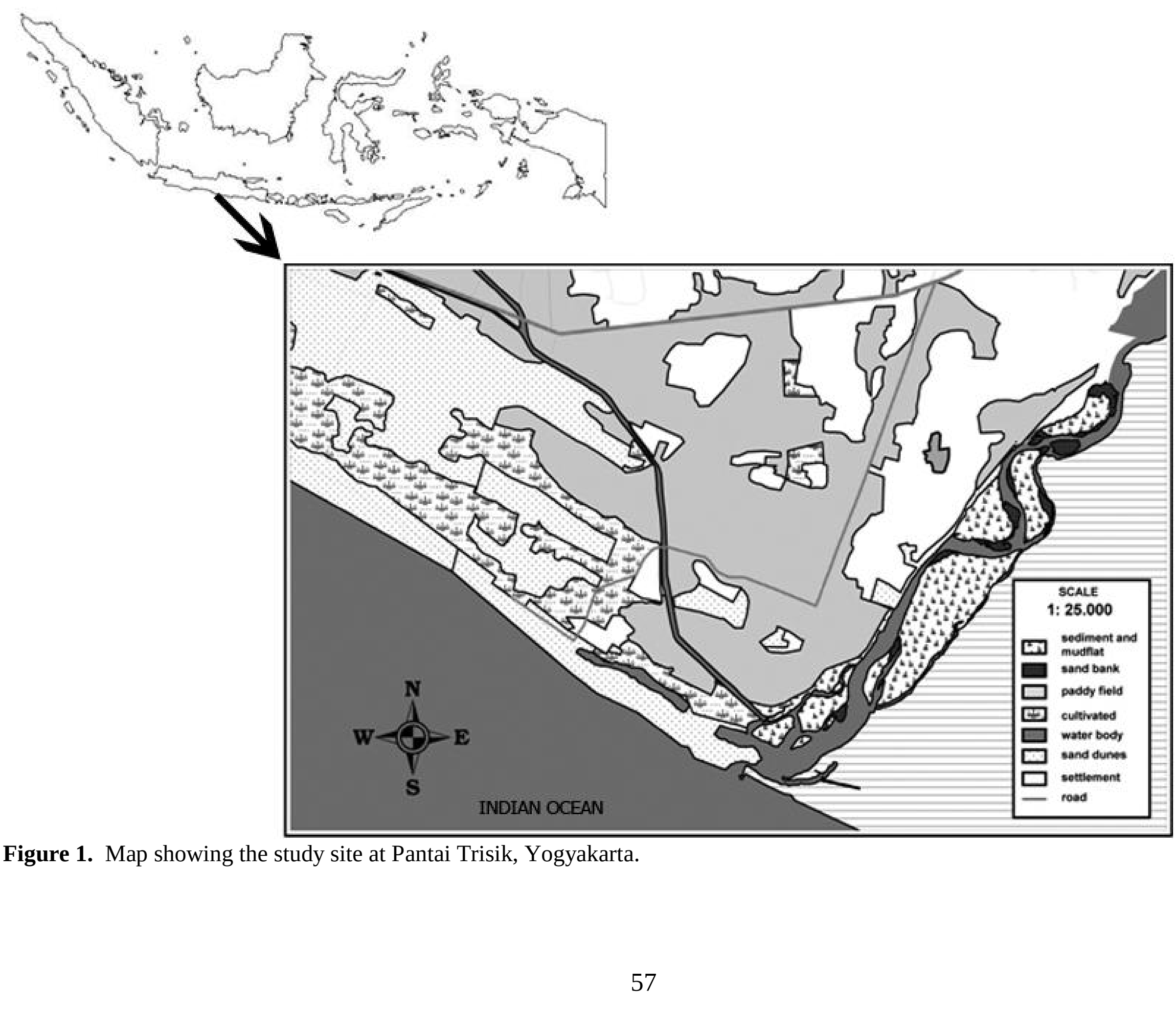

Figure 1. Map showing the study site at Pantai Trisik, Yogyakarta.

Table 1. Number of Sanderling counted in 1994-2001 AWC

YEAR	1994	1995	1996	1999	2000	2001
NUMBER	35	-	6	12	-	-

(Bamford *et al.* 2008). This AWC result does not represent the Sanderling status in Indonesia, because sites covered by AWC are still very limited compared to large areas of wetland sites in Indonesia.

Before Crossland *et al.* (2010), Sanderling had been recorded at several locations on the south coast of Java. Junge (1948) notes the collection of four specimens out of a flock of about a hundred birds on the south coast of Java by Kooiman on 18 September 1938 but does not mention the specific area. From Alas Purwo National Park, East Java, Indrawan *et al.* (1997) counts of 10 birds at Segara Anak in November 1989 and 50 birds at Tanjung Sembulungan on 28-30 September 1995, while Grantham (2000) counted 220 birds on 7 October 1997. One orange leg-flagged Sanderling was seen at Cungur from 31 August to 4 September 1997 and was the first reported flagged bird in Indonesia. Noni and Londo (2006) list the bird during an expedition searching for the Javan Lapwing *Vanellus macropterus* in Selokawar-awar and Meleman village on 27 December 2005 and 6-10 January 2006 on the coast of Lumajang, East Java. Other records of Sanderling in Java come from Ujung Kulon National Park, Pulau Dua and Meru Betiri National Park (MacKinnon 1991) and Segara Anak, Cilacap, Central Java (Tomascik *et al.* 1997).

METHODS

Our surveys from 2007 - 2010 were conducted in two phases. The first being a monthly survey from April 2007 to December 2008 as part of Monitoring Burung Pantai Indonesia (MoBuPI) or Indonesian Shorebird Monitoring and the second phase was a survey by AMT, HS and HZU at one to eleven day intervals from October 2009 to January 2010.

The dispersal and number of shorebirds were determined on walkovers and motorcycle rides covering rice paddies, the Kali Progo deltas and estuaries, lagoons and the sand beaches at four major sites preferred by the shorebirds at Pantai Trisik. All shorebirds were identified and counted either directly or from photographs taken at the time and counted later. In this paper, we only report our Sanderling records; other results will be published elsewhere.

STUDY AREA

Pantai Trisik as a birdwatching site was first observed in the 1990's by Kutilang Indonesia Birdwatching Club (now Yayasan Kutilang Indonesia (YKI)) with the first intensive observations lead by Lim Wen Sin during 2002-2005. For the next three years, during 2006-2009, Pantai Trisik became one of the study areas for Avian Malaria H5N1 Surveillance in Java conducted by the Ministry of Forestry under the supervision of the Indonesian Ornithologist's Union (IdOU) (Stoops *et al.* 2009).

During our survey, we divided the study area in four main sites based on the wetland types and the most significant occurrence of the shorebirds in the area. All of the sites were easily reached on foot or by riding motorcycle as described below.

Rice Paddies

Rice paddies cover most of the area (c.60%) for 3.6 km along the north to south of Banaran village. During the dry season, the farmers plant the area with soybeans. The presence of shorebirds is mostly from the preparation for rice planting until the early growing phase.

Kali Progo deltas & estuary

Kali Progo is the biggest river in Yogyakarta province. The river estuary forms some deltas that are preferred by shorebirds and other waterbirds for roosting and foraging. The observations were made by crossing the river but when the river flooded during the wet season, access to the deltas was almost impossible; the observations were then conducted from opposite side of the river.

Lagoons

The lagoon (known by the local people as 'tegongan') is a small pool containing brackish water. There are two lagoons located about 100m from the shoreline. Big waves sometimes inundate the lagoons for approximately 1km along the shoreline. In 2009, the western lagoon was used by the local people to nourish 'Bandeng' (Indonesian for Milky Fish *Chanos chanos*) by building a c.1m high dyke.

The area between the lagoons and the shoreline is surrounded by sands dominated by *Spinifex littoreus* and *Pandanus tectorius* plants. The area is known for the importance as the nesting area of Javan Plover *Charadrius javanicus*.

Sand Beach

The sand beach of Pantai Trisik is approximately 2.4km long. The Kali Progo estuary confines the eastern side while to the west, the sand beach is continuous to the Kali Bogowonto estuary in Pantai Glagah.

RESULTS

Sanderlings were recorded in Pantai Trisik during southern and northern migration. In the first phase of the survey (2007-2008), the presence of the birds during the southern migration was observed from August to October 2007 and August to November 2008, and during the northern migration, the birds were observed in April and May 2007 and January to May 2008. The Sanderling is absent in June and July considering the breeding period of the migratory shorebirds (Table 2).

Sanderlings were initially recorded mostly at the lagoons with only a few occuring in the deltas and estuary but this changed dramatically during the second phase of the survey. Most birds were then found in the deltas, estuary, and the sandy beach, with only a few birds found on the lagoons

Table 2. Number of Sanderling counted during monthly surveys on MoBuPI April 2007 to December 2008

LOCATION	2007								2008										
	15 Apr	13 May	17 Jun	08 Jul	19 Aug	02 Sep	28 Oct	10 Nov	19 Jan	17 Feb	20 Apr	25 May	22 Jun	20 Jul	22 Aug	28 Sep	12 Oct	23 Nov	14 Dec
Deltas and Estuary	-	-	-	-	15	10	125	-	-	-	-	-	-	-	-	-	-	-	-
Lagoons	59	3	-	-	-	-	-	-	1050	50	129	1	-	-	6	-	9	1	-
Sand Beaches	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice Paddies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	59	3	0	0	15	10	125	0	1050	50	129	1	0	0	6	0	9	1	0

Table 3. Number of Sanderling counted during intensive survey, 19 October 2009 - 10 January 2010.

DATE	LOCATION				TOTAL
	Deltas and estuary	Lagoons	Sand Beach	Paddy rice fields	
19 Oct 09	95	-	-	-	95
20 Oct 09	135	-	-	-	135
23 Oct 09	184	-	-	-	184
24 Oct 09	27	-	-	-	27
29 Oct 09	-	-	31	-	31
31 Oct 09	37	-	-	-	37
4 Nov 09	304	-	-	-	304
5 Nov 09	203	-	-	-	203
7 Nov 09	300	-	63	-	363
10 Nov 09	687	-	-	-	687
11 Nov 09	781	-	-	-	781
14 Nov 09	400	-	-	-	400
15 Nov 09	300	-	-	-	300
16 Nov 09	320	-	-	-	320
21 Nov 09	-	-	440	-	440
22 Nov 09	-	-	37	-	37
24 Nov 09	-	-	158	-	158
28 Nov 09	460	-	-	-	460
2 Dec 09	605	-	-	-	605
13 Dec 09	69	8	4	-	81
22 Dec 09	161	3	-	-	164
29 Dec 09	348	2	-	-	350
31 Dec 09	709	-	-	-	709
02 Jan 10	1845	-	-	-	1845
03 Jan 10	230	-	-	-	230
09 Jan 10	171	-	4	-	175
10 Jan 10	153	-	43	-	196

(Table 3). In both phases of the survey, no birds were recorded in the rice paddies.

The highest number of Sanderling counted during the first phase was 1050 on 19 January 2008. The birds were observed roosting at the lagoons in mixed flock of Red-necked Stints *Calidris ruficollis* and Javan Plovers. On 2 May 2008, a bird was seen with orange and yellow flags (Figure 2) from South Australia about 4482km south east of Pantai Trisik. This is possibly only the second flagged sighting of Sanderling in Indonesia, Grantham (2000).

The second phase of the survey was conducted during the southward migration period. The lowest count was 27 birds on 24 October and the highest was 1845 birds on 2 January 2010.

DISCUSSION

With 5000 birds being the estimated total population of Sanderling in Indonesia (Bamford *et al.* 2008), the counts of 1050 birds on 19 January 2008 and 1845 on 2 January 2010 account for 21% and almost 37% of the total population (see Figure 3). These numbers also exceeds the 1% thresholds used to identify sites of international importance (Bamford *et al.* 2008) and place Pantai Trisik as an internationally important site for Sanderling in the East Asian-Australasian Flyway.

Lim Wen Sin first recorded the high number of Sanderling at Pantai Trisik on 10 February 2005 (Sin 2006) (Table 4), when about 900-1000 birds were noted in the rice paddies. However, this record is questionable as Sanderling are usually found on sandy beaches along sea coasts and rarely on mud (MacKinnon & Phillipps 1993). Compared to our survey, it seems that the note is only based on the first observed location during walkovers and motorcycle rides to cover the whole area. The lagoons, deltas and the sand beach are always visited after the rice paddies and we suppose that the record actually came from one of those area.

The most interesting record is the occurence of 75 birds on 8 June 2003 at the deltas and estuary (Sin 2004). This is the only over-'summer' record of Sanderling in the area as no records of migratory shorebird were made during our

Figure 2. Sanderling with an orange and yellow flag photographed at the lagoons of Pantai Trisik. Photographed on 4 May 2008 by Arif Nugroho.

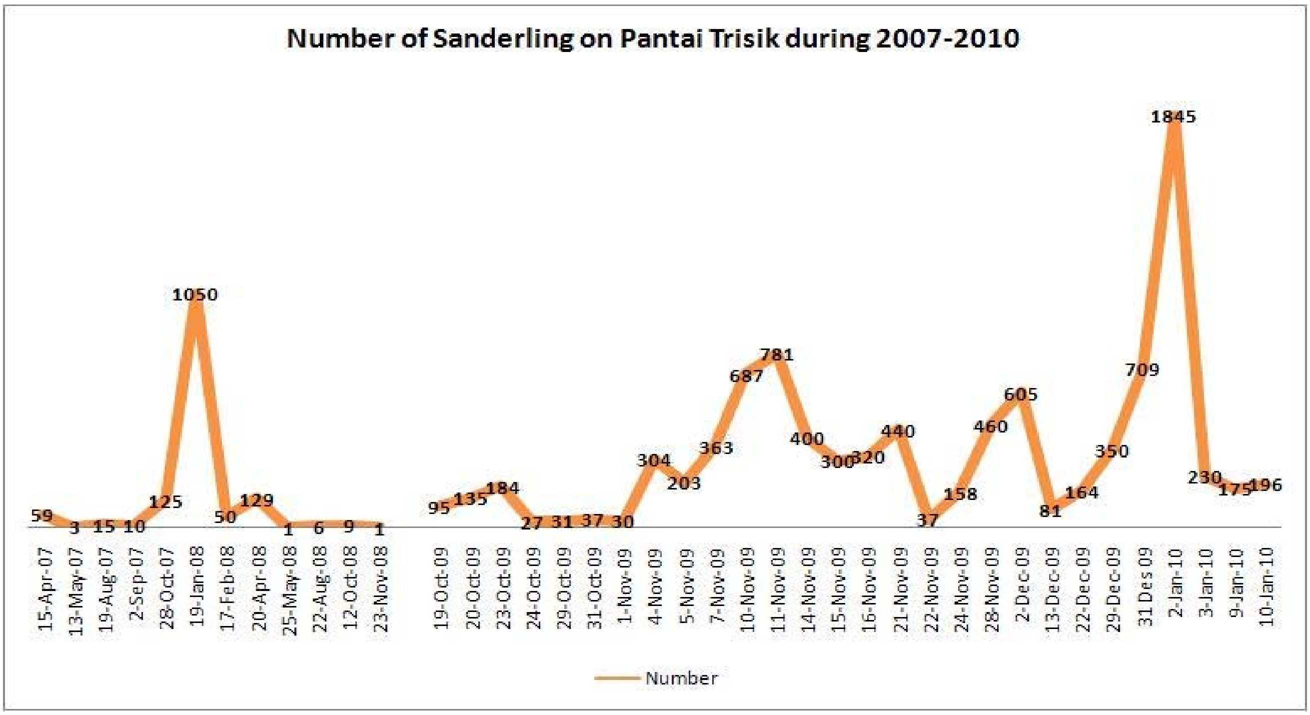

Figure 3. Graph shows total number of Sanderling counted at Pantai Trisik during April 2007 - January 2010.

observations in June and July. However, MacKinnon & Phillipps (1993) noted that a few Sanderlings were found over-‘summer’ in the Greater Sundas.

There was a significant shift on the Sanderling’s site preference. During the first phase of the survey, the biggest number of the Sanderling were counted at the lagoons while in the second phase, the deltas and estuary were their prefered location. We presume that this is as the impact of the development of the western lagoon by the local people for the Milky Fish nourishing. The construction of a 1m high dyke around the west lagoon between July and August 2009 has made the area unsuitable for foraging and roosting and birds now prefer to use the deltas and estuary.

Connection with Pantai Glagah

There has been a significant increase in birds counted between the first phase and second phase, probably due to the more frequent and intensive surveys in the area during the second phase but we also assume that there is a dynamic movement of the birds from Pantai Trisik and Pantai Glagah which may influence the number of the birds seen.

Our assumption is based on the fact that Pantai Glagah is located only about 20km to the west of Pantai Trisik with no significant barrier in between. Setiawan (2007), who conducted a migratory birds survey in the west side of the south coast of Yogyakarta province covering three beaches (Pantai Trisik, Pantai Glagah and Pantai Congot) during

Table 4. Sanderling record by Lim Wen Sin during 2002-2005 survey

DATE	NUMBER	LOCATION
02 Aug 2002	No information	Delta and shore line
02 Jan 03	No information	Lagoons
08 Jun 03	75	Delta and estuary
24 Sep 2003	No information	Delta and estuary
31 Aug 2004	13	Delta and estuary
26 Sep 2004	13	Delta and estuary
06 Nov 2004	2	Delta and estuary
11 Nov 2004	13	Delta and estuary
10 Feb 2005	900-1000	Rice Paddies

2005 and 2006, recorded a high number of Sanderling only at Pantai Glagah with about 1000 Sanderling during the 2005 southern migration (no date) and an estimated 2025 birds in 24 December 2006.

The connection between the birds of both sites is also confirmed by AMT & IT who observed several times the movements of birds at dusk from Pantai Trisik to the west. The birds were always observed flying in small flocks with a straight pattern and constant speed above the sea (Figure 5).

Potential Threats

Potential threats of concern that could affect the shorebirds in Pantai Trisik, include mining exploration of iron sand started in 2012. The massive scale of this mining exploration will extend for about 20 km along the south coast of Kulon Progo district covering some 3900ha between Pantai Trisik and Pantai Glagah. Although more research is needed the long time scale of the mining operation will almost certainly be detrimental to the south coast of Yogyakarta and will impact the shorebirds along the coast.

There is a need to continue the monitoring and conduct a more intensive survey at Pantai Trisik and Pantai Glagah to better understand the international importance of these sites for shorebirds.

ACKNOWLEDGEMENTS

The first phase of the survey were conducted as a part of the Indonesian shorebirds monitoring (Monitoring Burung Pantai Indonesia or MoBuPI) carried out by Anak Burung bird community. We thank Iwan Londo and Francisca Nonny who initiated and rolled out the programme and for the Sanderling records from Lumajang, East Java. Thanks also to all Bionicers and all members of Paguyuban Pengamat Burung Jogja (PPBJ) who have collected data from the field. Thanks to Muhammad Iqbal (Spirit of Sumatra Bird Club) for helping with the Sanderling data during AWC in Indonesia and develop the communication with Dr. Roz Jessop, Lim Wen Sin and B. Bambang Setiawan (Mas Wa) for their data during 2002-2006, Arif Nugroho for the photo of the flagged Sanderling, Agung "Asat" Satriya Wibowo for providing the map and also Ign. Kristianto Muladi (Pak Ige) from Yayasan Kutilang Indonesia who was facilitating us with the references and other sources. We are gratefully to Karyadi "Kang Bas" Baskoro from Universitas Diponegoro and Siti Cholifah K. for the constructive comments during the preparation and reviewing of the manuscript. Finnaly, thanks to Dr. Roz Jessop and the referees of *The Stilt* for the final edited version.

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Figure 4. A flock with over 500 Sanderling photographed at the Kali Progo estuary on 31 December 2009 (Photographed by AMT).

Figure 5. Small flock contain about +44 Sanderling crossing the sea from west side (presumed from Pantai Glagah) (Photographed by IT).

SIGHTINGS OF ENGRAVED LEG FLAG RUDDY TURNSTONES *ARENARIA INTERPRES* ON MIGRATION

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INTRODUCTION

When engraved leg flags were first put on waders in Australia it was primarily for the purpose of being able to resight individuals locally, to facilitate survival rate analyses. However there has been an unexpectedly large bonus in the form of sightings of these individually marked birds away from the flagging area on migration.

This note summarises the movements information which has been derived so far from the introduction of the use of engraved leg flags on Ruddy Turnstone *Arenaria interpres* in Victoria in late 2003, in South Australia in early 2004, and in King Island, Tasmania, since March 2007. The authors of this paper are those who have been most closely involved in putting on the engraved leg flags, the persons responsible for many of the sightings and the coordination of all reports from the main sighting country (Taiwan), and the person who has created and operated the sighting reports database in Australia and prepared the information for this note.

METHODS

Birds were all flagged with the normal colour code allocated to their particular area – orange (Victoria), orange over yellow (South Australia), and orange over blue (Tasmania). In all cases it was the orange flag which was engraved. This was always placed on the right tibia. This had the advantage of minimizing wear of the engraving but the disadvantage that resting turnstones often fluff up their feathers in cold weather and can sometimes therefore obscure the engraved flag when roosting.

Wear of metal bands and flags on Ruddy Turnstones is considerable. This meant that engraved flags periodically had to be replaced when birds were recaptured. Even metal bands were occasionally worn to become illegible if placed on the tarsus and therefore in later years these have been placed on the tibia (left) whenever possible.

RESULTS

Up to the end of June 2010 the number of Ruddy Turnstone given engraved flags has been 174 in Victoria, 974 in South Australia and 828 in King Island (Table 1).

So far there have been 143 resightings of ELF Ruddy Turnstone away from the marking areas, with 131 of these overseas (Table 1). 126 of these have been in Taiwan where systematic massive field observation work has been organized by ChungYu Chang (Taiwan Wader Study Group coordinator) in recent years. Other overseas sightings have been in Hong Kong, mainland China, Japan and Korea. Sightings have been both during northward and southward migration although, as with most other species of waders in Australia, sightings on northward migration predominate.

The 12 resightings elsewhere in Australia are of birds staging on southward migration on their way back to their respective non-breeding areas (Table 1). Excluded from the table are a small number of movements between the three flagging locations, mainly between King Island and South Australia.

The listed sightings include many multiple sightings of the same bird. So the total number of individuals involved is significantly less than the 143 total shown. Some of these resightings have given an excellent insight into the constancy of use of particular stopover locations (Table 2). It is particularly interesting that the two birds illustrated have so regularly used the same stopover location in Taiwan on both northward and southward migration. XO/EA has been seen in all except one migration season ever since it was originally banded and flagged on King Island in March, 2007. 4H/XM has been seen in Taiwan in each migration season since it was marked at King Island in March 2008.

Table 1. Sightings of Ruddy Turnstones with engraved leg-flags (Data to 31/7/10).

	Sighting location							
Flagging Location	**Taiwan**	**Hong Kong**	**China**	**Japan**	**Korea**	**Elsewhere**	**TOTAL seen**	***Total flagged***
Victoria (Flinders & Barwon Heads)	6						6	*174*
South Australia (south-east)	21	2	2	1		7 in NWA	33	*974*
King Island, Tasmania	89	2	5	4	1	3 in NT & 2 in WA	104	*828*
TOTAL	**126**	**4**	**7**	**5**	**1**	**12**	**143**	***1976***

Table 2. Resightings of two individual Ruddy Turnstones

Engraved flag XO, then EA (Metal band 052-51886)

Date	Location	Circumstances	Status
24/3/07	Currie, King Island	Original banding	Non-breeding area
4 & 8/5/07	Taiwan	Seen at migratory staging location	Northward migration
3/8/07	"	"	Southward migration
17/4/08	"	"	Northward migration
30/3/09	Currie, King Island	Recaptured, Flag changed	Non-breeding area
14/4 to 21/5/09 (8 sightings)	Taiwan	Seen at migratory staging location	Northward migration
22 & 24/8/09	"	"	Southward migration
19&28/4/10	"	"	Northward migration

Engraved flag 4H, then XM (Metal band 052-52039)

Date	Location	Circumstances	Status
9/3/08	Whistler Point, King Island	Original banding	Non-breeding area
17 to 23/4/08 (4 times)	Taiwan	Seen at migratory staging location	Northward migration
16/8 to 2/9/08 (3 times)	"	"	Southward migration
18/2/09	Porky's Beach, King Island	Seen back in non-breeding area	Non-breeding area
13/4 to 7/5/09 (10 times)	Taiwan	Seen at migratory staging location	Northward migration
19 to 24/8/09 (3 times)	"	"	Southward migration
21/3/10	South Whistler, King Island	Recaptured. Flag changed	Non-breeding area
19/4 to 3/5/10 (3 times)	Taiwan	Seen at migratory staging location	Northward migration

Both birds have also been recaptured once back in King Island (when their flags were changed) and 4H/XM was also seen there during the other non-breeding season.

DISCUSSION

The strong emphasis on Taiwan as a stopover location for Ruddy Tunstones on both northward and southward migration is not considered to have solely derived from the high sighting efforts there. It does appear to be a location particularly favoured by Ruddy Turnstones. This is illustrated by the fact that all four Ruddy Turnstones from Flinders carrying geolocators used Taiwan as their first stopover location in Asia on northward migration (see Turnstone Geolocator article elsewhere in this Bulletin and Minton et al. 2010).

The lack of sightings elsewhere in Australia during northward migration supports the view that when birds depart from their breeding areas in April they make very long non-stop migrations well into Asia. Taiwan is 7,600km. from Flinders and from South Australia and further still from King Island.

The insight which these engraved leg flags are giving into the migratory movements of individual birds is quite amazing. These results are of course only achievable because of the incredible dedication of flag sighters in Taiwan.

THE FUTURE

The use of ELFs on Ruddy Turnstone in Victoria, the south-east of South Australia and on King Island is planned to continue for several more years. This is not only to strengthen the data for calculation of survival rates but also because the ELFs are providing such valuable information on migratory movements.

This work has been greatly supplemented by the deployment of a further 75 geolocators on Ruddy Turnstones at these locations in March/April 2010. As results become available from the retrieval of these geolocators over the next couple of years we will hopefully develop a greater insight into the migratory strategy of Ruddy Turnstone than any other wader species which visits Australia.

ACKNOWLEDGEMENTS

As with all VWSG research our results are dependent on a large number of people in a wide range of ways. Firstly the banding and flagging teams spend a lot of time in the field catching birds and in trying to recapture them (especially those carrying geolocators.). A key input to this particular study has come from flag-sighters in Taiwan and elsewhere in the east Asian/Australasian Flyway. The Taiwan Wader Study Group is particularly thanked for its intensive flag-sighting efforts. Everyone who is responsible for maintaining the various records is thanked, especially Heather Gibbs for keeping a comprehensive record of all birds which have moved and for maintaining it in such a form that the information can be retrieved.

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REFERENCE

Minton C., Gosbell K., Johns P., Christie M., Fox J.W. and Afanasyev V., 2010. Initial results from light-level geolocator trials on Ruddy Turnstone reveal unexpected migration route, Stilt 57, 21-28.

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