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STUDY

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Bird Populations

Assessment of Bird Populations of the Environs of Fisherman Island - Feb. 1992

by P. V. Driscoll

Assessment of Bird Populations of the Environs of Fisherman Island

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1. Introduction

The study was designed to assess the birdlife in the vicinity of the Fisherman Island port facilities at the mouth of the Brisbane River. Major shipping, storage and rail freight facilities already occupy much of the site and over a wider area are a number of other major facilities, including oil refineries, sewage processing plants and Brisbane Airport. Nevertheless, there remain significant areas of relatively undeveloped natural habitat and other areas that are used by birds despite human interference. The area generally appears to be highly productive with patches that have a very high diversity and abundance of birdlife.

Careful management of natural resources, including bird populations, along the coastline of South East Queensland is necessary in view of the current population surge in the region. There are considerable habitat changes occurring throughout Moreton Bay and parts of Fisherman Island sustain high populations of certain bird species. The need for a study of birdlife around Fisherman Island was even more important in view of planned extensions and changes to the port facilities. Hopefully, information from this study will aid in ameliorating the impact on birdlife of future developments. Present and future impacts on local bird habitat include the complete removal of natural conditions and vegetation and more indirect effects such as nutrient enrichment, pollution, and digging for polychaete worms in seagrass beds by commercial and amateur operators.

2. Local habitats and birdlife

Even before the extensive changes and developments that have occurred on Fisherman Island, habitats in the area would have predominantly been those of the littoral zone, that is, intertidal areas including mangroves, herbland, closed grassland and mudflats, with or without seagrass. Woodland habitats of paperbark or eucalypts may have once occurred on higher ground with low open forest of *Casuarina glauca* situated behind mangroves, forblands and claypans. To what extent this range of typical habitats of the region existed around Fisherman Island would require a specific historical assessment.

Purely terrestrial bird species on Fisherman Island have limited diversity due to the scarcity of forest cover other than mangroves. The mangroves cater for a small group of mangrove specialists and several other species that are typical of a range of forest types. The areas covered with reeds and tall grasses as a result of disturbances and clearing on Fisherman Island harbour several grassland species.

By far the most diverse grouping of birds includes waders and waterbirds that utilise the site primarily because of the extent and nature of local intertidal feeding areas. In contrast, pelicans, gulls, terns and cormorants rest in mangroves or on sand and forage in local waters, or farther out in Moreton Bay on fish and other foods. Recent studies by Thompson (1990) and Driscoll (1991) indicate that there are discernible patterns to

resource use by waders in the Moreton Bay region but there are few details recorded about birds that frequent Fisherman Island and nearby feeding areas. Parts of Bishop Island (or Fisherman Island) are used as a main high tide roost site by waders while the extensive intertidal feeding grounds to the south-east of the Island, until now, had not been properly surveyed. Thousands of waders and other shorebirds are known to feed during summer at Luggage Point and many of these birds use roost sites on Fisherman Island.

The objectives of this study were to determine the distribution, relative density and movement patterns of birds around Fisherman Island and where appropriate, relate these findings to other areas of Moreton Bay. The focus of the study is on birds using the littoral zone which is still largely intact. Less detailed consideration is given to forest (mangrove) birds or birds that mainly occur in open grassland that has been artificially created on Fisherman Island.

Because of the dramatic seasonal changes that are a feature of much of the birdlife around Fisherman Island, three periods of fieldwork were undertaken with a winter sampling in July, spring sampling in October and summer sampling in January. The fieldwork was most thorough during spring at the time of highest numbers of birds during the southward migration of migratory waders. Furthermore, because the tide has an overriding influence on the activity of birds that feed on intertidal mudflats much of the assessment of local distribution is for times of both high tide and low tide with a consideration of the positioning of high tide roosts with respect to low tide feeding areas.

3. Migratory waders

The term "wader" (or "shorebird") applies to a collection of small (12 cm) to medium size (66 cm) wading birds, which have a wide variety of bill structures. They are usually gregarious and inhabit wetland areas, where they feed and breed. Some species are highly migratory, breeding in high northern latitudes and migrating to the tropics and south of the equator. Others are resident in temperate and tropical regions. In scientific terms, waders belong to the order Charadriiformes (which also includes the gulls, skuas, terns and auks). The order has 12 families and most of the 214 "waders" throughout the world belong in the families Charadriidae (Lapwings, Plovers etc) or Scolopacidae (Sandpipers, Snipes, etc) (Howes and Bakewell, 1989)

The terms "wader" or "shorebird" give an indication of the habitat preferences and behaviour of the majority of these birds during the non-breeding period. However, most species breed inland (away from the shore) and some in quite dry habitats (e.g. steppes or deserts).

Migration can be defined as the regular movement between two geographical locations -

usually a breeding area and a non-breeding area. Most of our migratory waders breed in the Siberian tundra, and the steppes and deserts of Mongolia and extreme Northern China. After breeding, they fly south along various routes within Asia, to spend the non-breeding period either in Asia, New Guinea, Australia or New Zealand. Some species fly as far as 13,000 km between the breeding grounds and wintering area or a return journey of 26,000 km.

Particular emphasis in the report is placed on migratory waders for three reasons. Firstly, as a group they are increasingly subject to environmental constraints throughout their migratory range from distant regions of the Northern Hemisphere to southern parts of Australia. Many species are restricted to coastal feeding zones where locally they may appear abundant but have restricted distributions.

Secondly, because these species rely upon feeding and breeding areas in a number of countries, their requirements have been the focus of inter-governmental discussion. A large proportion of the migratory waders that occur in Moreton Bay are subject to international migratory bird agreements, namely the Japanese-Australia Migratory Bird Agreement (JAMBA) and the Chinese-Australia Migratory Bird Agreement (CAMBA). Migratory bird habitat can also come under the RAMSAR convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat - adopted in Ramsar, Iran in 1971).

The JAMBA and CAMBA agreements are aimed at promoting conservation of migratory species between the two countries, endangered species within each country and critical habitats used by the birds mentioned in the agreements. They commit the signatories to study migratory birds and conservation needs in each country and in the flyway, and to provide support and equipment for training and education. Another agreement of this type between the ASEAN countries and Australia and Japan is currently being developed.

Thirdly, Moreton Bay is arguably the most important feeding area for migratory waders along the coastline of eastern Australia. During their non-breeding season (southern summer) thousands of migratory waders occupy various parts of Moreton Bay including the environs of Fisherman Island. Even during winter, Moreton Bay caters for large populations of migratory birds less than a year old which generally stay in Australia rather than migrate to breed. It is likely that many of these young birds have moved short distances up the east coast to spend their first winter at lower latitudes. However, very little is know about such local movements of first year birds. In fact, many of the finer details of movements and the final distribution pattern of migratory waders within Australian are still unclear and much general research is still needed. For example, it is now apparent that not only first year Eastern Curlews overwinter in Australia but that

second year birds may also (pers. comm. C. Minton).

Populations of migratory waders fluctuate seasonally in Moreton Bay being highest during the peak periods of southward migration (September-October) and northward migration (March-April). On the southward migration it is not only birds that are arriving in Moreton Bay for the summer that suddenly appear but many thousands stopover in Moreton Bay on their journey to other feeding grounds farther south in Australia and New Zealand. Similarly, the fluctuation in numbers in March and April relates to the passage of birds through Moreton Bay and the departure of individuals that have been resident through the austral summer. Even though summer populations are comparatively stable, movements of the different species are not synchronised and different species prefer different parts of Australia in which to spend their non-breeding season.

4. Methods

The study area includes the mangroves, claypans and all high ground on Fisherman Island and the surrounding intertidal mudflats and seagrass beds. Other sites in the vicinity that were visited include adjacent foreshores on the western side of the Brisbane River and the southern shoreline of the Boat Passage. Observations were also made around nearby islands (Mud, St Helena and Green), the Wynnum foreshore, and "Lytton roost" near the disused refuse tip on Whyte Island. These additional observations were necessary to ascertain how the birdlife of Fisherman Island may have differed from neighbouring areas and to detect daily movements of birds to and from Fisherman Island (Figure 1).

After preliminary observations, sampling effort was concentrated where birds were known to be plentiful. Nevertheless, a few areas were sampled less intensively than I would have liked because of lack of time. These included sites adjacent to Fisherman Island on Luggage Point and the eastern side of Whyte Island towards Wynnum. On Fisherman Island, the mangroves and confined feeding area on the south western corner warranted more attention than time permitted. However, these are small limitations to meeting the objectives of the study and at least for Luggage Point other sources of data are available.

Three systematic approaches to sampling were employed. Firstly, within closed mangrove forest a single transect (Figure 1) of bird counts was undertaken in each of the 3 sampling periods. Birds were counted along a 1 km m route through a process of stopping every 65 m (approx.) or 15 times to record birds seen and heard for 5 minutes within a 60 m radius.

Whereas the transect counts sampled the mangrove bird community, two approaches were taken to systematically record the waders and waterbirds of the area in the same way as in previous studies conducted in Moreton Bay by Thompson (1990) and in

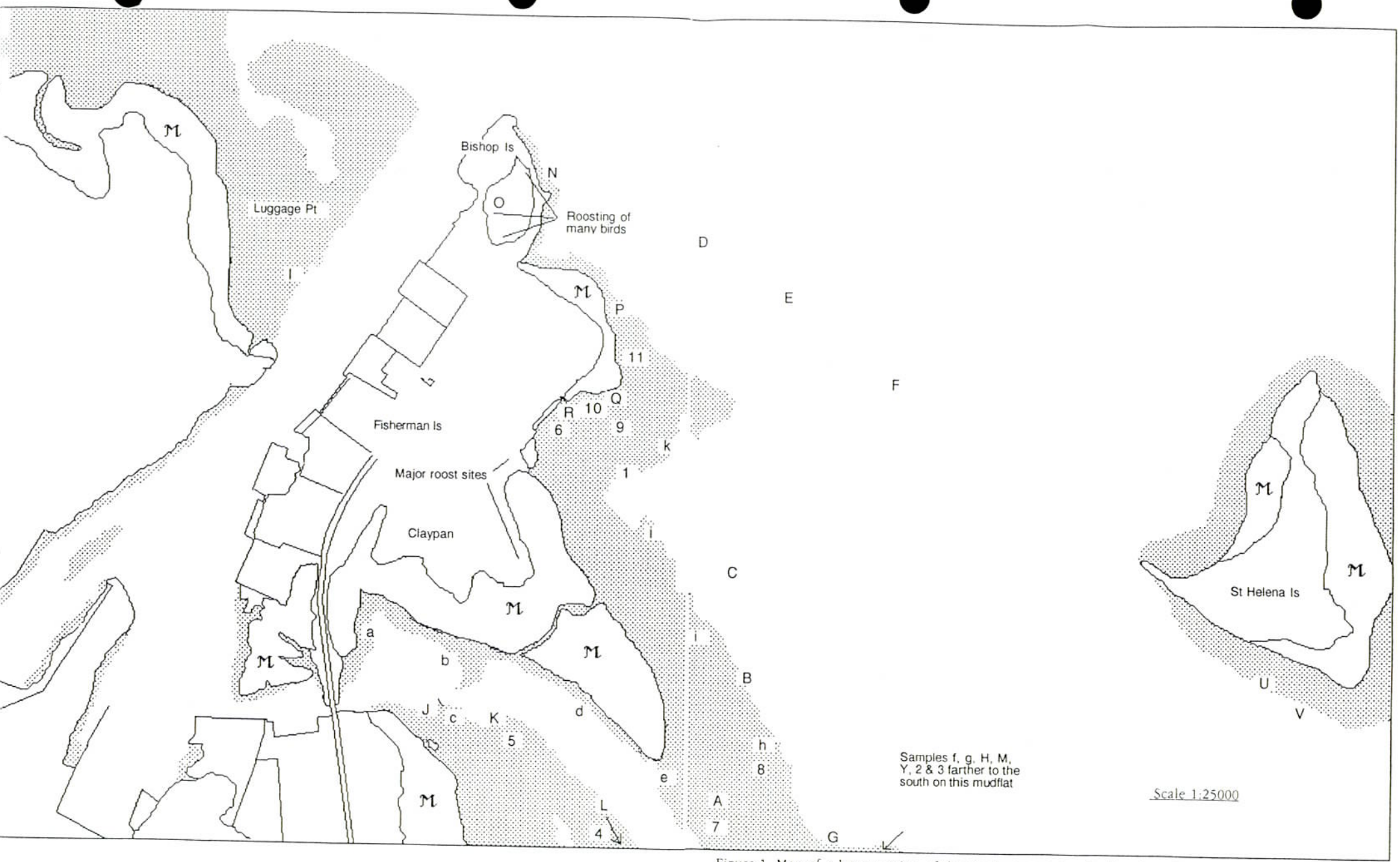

Figure 1. Map of a large section of the study area giving the location of scan counts of feeding birds taken in August (a-k), October (A to Y) and January (1-11). Refer to Appendix A for data from the counts. Not recorded are locations S (Whyte Is.), T (Wynnum), W (Green Is.) & X (Green Is.). Areas in grey are intertidal feeding areas and those mark "M" are mangroves. Refer to Appendix E for miscellaneous sightings of birds and details in Section 5.1.4 on roost counts.

Pumicestone Passage by Driscoll (1991). At low tide, exposed intertidal areas were sampled using a telescope (20x lens) and records of birds made within a radius of up to 150 m of a point through an arc of between 40° and 340°. Sites were mostly approached by canoe but also from the land so that bird counts were not necessarily taken from the edge of the water. In the three sampling periods, 11, 25 and 11 counts were made in August, October and January respectively.

Scan counts are primarily intended to give the percentage representation of the different species being counted and are not a measure of the absolute number of birds in an area. However, during the October survey, one series of low tide counts were conducted as a sequence which was intended as an absolute count of birds over a discrete area of mudflat off the eastern side of Fisherman Island. This estimate of absolute numbers is very approximate and, because there was no opportunity to repeat the exercise, no measure of the reliability of the estimate can be given. Problems in the field arise because birds tend to withdraw from the observer. Secondly, it is difficult to be precise about the boundaries of an area being observed for each scan and thirdly, birds often feed in clumps and concentrate in different areas as the tide changes. Observations were made within 90 minutes of only one low tide in order to minimise this last effect.

The final systematic approach to fieldwork involved estimating the total number of birds at high tide roosts, in particular the roost on the northern tip of Fisherman Island, although two other sites were also sampled in this way. Counts were conducted at the main Fisherman Island roost once in August, twice in October, and twice in January. Getting a reliable count of all species at a high tide roost is very difficult because with few exceptions, individuals of a species will not be obvious because of size or a tendency for some birds to roost in or under mangroves, or as scattered flocks. There are two clear exceptions to this tendency of dispersed roosting and these exceptions can act as "key" species. Bar-tailed Godwits and, to a lesser extent, Eastern Curlews, readily congregate in coherent flocks at a limited number of select high tide roosts and offer a good opportunity for gaining an accurate assessment of numbers. Numbers of other wader species can be inferred using the ratio of low tide scan counts of other species to that of the key species given that there is a fairly accurate estimate of the numbers of the key species from the roost counts.

All other fieldwork involved unsystematic observations to record the number and location of birds seen, whether they were feeding, flying or roosting. A large body of incidental sightings was accrued at all stages of the tide and these are mapped in Appendix E and/or referred to directly in the text. Also, I have past knowledge of the roost at Fisherman Island, having on several occasions caught birds there for banding when working with J. Thompson (Univ. of Qld) using bands issued under the Australian Bird and Bat Banding Schemes. Data from these banding exercises are presented in this

report.

Data from the scan counts are subjected to classification analyis (Section 5.3.1 and 5.3.2) using counts of waders only, providing a species was observed during at least two scan counts. Details of the analysis technique can be found in Clifford & Stephenson (1975), Gauch (1982) and Williams (1976). Counts are transformed to the percentage contribution for each species and the resulting two-way table of species versus sites where counts were made, is subjected to a form of classification which is hierarchical and agglomerative using the BIOΣTAT suite of programs (Pimentel and Smith 1986) for microcomputers. Prior to the classification, the two-way table is used to calculate a dissimilarity matrix between sites based on Gower's General Similarity Coefficient. The classification is then run using flexible sorting with a beta value of -0.25. The classification sets out the scan counts in a dendrogram showing the various grouping of sites where the counts were made and sequence in which sites were linked to one another on the basis of their similarities in terms of the feeding bird community.

5. Results

The eighty four bird species recorded during the fieldwork are listed in Table 1 with an indication of their habitat and food preferences and their regional abundance. About 10% are uncommon around Moreton Bay (coded 1 in the Table) with the Red-rumped Parrot being the least regularly seen of this uncommon group of species. About 30% of species could be considered moderately common and the remaining 60% common to very common (coded "3") around Moreton Bay for at least part of the year.

In terms of the food categories known to be eaten by the bird species listed in Table 1, the categories of small vertebrates, seeds, and other plant products (either nectar, fruit or soft shoots etc) are each consumed by about 20% of the avifauna. Fish is consumed by a higher percentage (25%), and terrestrial invertebrates by about 45% of the avifauna. Aquatic invertebrates are consumed by the highest number of species (about 55%). These food categories are not mutually exclusive and do not necessarily apply to the actual foods consumed around Fisherman Island, however, they give some indication.

Further details of habitat utilisation by birds throughout the study area will be given in later sections. However, as a generalisation, Table 1 assigns species to one or more of 5 broad habitat categories. Sixty one percent of species are "coastal" and will utilise the intertidal mudflats and/or open water, and 32% utilise mangroves and 10% may be found in open areas of grass and reeds. The two other habitat categories of freshwater swamps and forest are less easily defined on Fisherman Island. The former category would include some of the drainage canals across the island and much of the grassland area in time of wet weather when there is local inundation. Fifty two percent of species fall into this category which includes many of the waders which will opportunistically use

Table 1. Bird species recorded during fieldwork around Fisherman Island. The naming and ordering of species is in accordance with the Atlas of Australian Birds (Blakers et al. 1984). The information below refers to the various column headings, as indicated.

A: Species listed under the China-Australia Migratory Bird Agreement (CAMBA) or the Japan-Australia Migratory Bird Agreement (JAMBA) are indicated with C or J respectively.

B: Species marked on a 3 point scale (1-3) were recorded during the compilation of data for the Atlas between 1977 and 1982 from the one-degree grid square that includes the study area, centred on 27°30'E, 153°30'S. The scale value is indicative of the reporting rate for species and gives a rough measure of the ubiquity or commoness of each species in the area. The scale is based on the number of times a species was recorded in relation to the number of bird lists submitted to the Atlas for the relevant area. For a scale of 1 this proportion is less than 12%, for 2 it is between 12% & 40% and for 3 it is over 40%.

C: Breeding records of species recorded under B.

Habitat: The habitats where species are likely to be found are indicated with the following codes: S (freshwater swamps, creeks, creek verges) - P (pastures, fields, grasses), F (forest, woodland), M (mangroves), C (coastal, including intertidal areas).

Food: The food preferences of species are indicated with the following codes: - V (vertebrates - terrestrial), I (invertebrates - terrestrial), H (plant material other than seeds), S (seeds), A (aquatic invertebrates, F (fish). N.B. Habitat and feeding preferences are largely compiled from information in Atlas of Australian Birds (Blakers et al. 1984).

Species		A	B	C	Habitat [S P F M C]	Food [V I H S A F]
Pelicanidae	Pelecaniformes:					
Pelecanus conspicillatus	Australian Pelican		3		[. . . . *]	[. . . . . *]
Sulidae						
Morus serrator	Australasian Gannet		1		[. . . . *]	[. . . . . *]
Anhingidae						
Anhinga melanogaster	Darter		3		[. . . . *]	[* . . . . . *]
Phalacrocoracidae						
Phalacrocorax carbo	Great Cormorant		2		[. . . . *]	[. . . . . *]
Phalacrocorax varius	Pied Cormorant		3		[. . . . *]	[. . . . *.*]
Phalacrocorax sulcirostris	Little Black Cormorant		3	#	[* . . . . *]	[. . . . . *]
Phalacrocorax melanoleucos	Little Pied Cormorant		3	#	[* . . . . *]	[. . . . . *]
Ardeidae	Ciconiiformes:					
Ardea novaehollandiae	White-faced Heron		3	#	[* . *. . *]	[* . *. . *.*]
Egretta alba	Great Egret	CJ	3		[* . *. . *]	[* . . . . *.*]
Egretta garzetta	Little Egret		2		[*.*. . *.*]	[* . . . . *.*]
Egretta intermedia	Intermediate Egret		2		[* . *. . *]	[*.*. . . .]
Butorides striatus	Striated Heron		2		[. . . *.]	[. . . . *.*]
Plataleidae						
Threskiornis aethiopica	Sacred Ibis		3		[* . . . . *]	[* . . . . *.]
Platalea regia	Royal Spoonbill		3	#	[* . . . . *]	[. . . . *.*]
Anatidae	Anseriformes:					
Anas superciliosa	Pacific Black Duck		3	#	[* . . . .]	[. .*.*.*.]
Anas gibberifrons	Grey Teal		2		[* . . . *]	[.*.*.*.*.]
Anas castanea	Chestnut Teal		3	#	[* . . . . *]	[.*.*. .*.]
Pandionidae	Falconiformes:					
Pandion haliaetus	Osprey		2	#	[* . . . . *]	[. . . . . *]
Accipitridae						
Elanus notatus	Black-shouldered Kite		3	#	[.*.*. .*]	[*.*. . . .]
Haliastur indus	Brahminy Kite		3	#	[* . .*.*.*]	[*.*. . .*.*]
Haliastur sphenurus	Whistling Kite		3	#	[* . .*. .]	[* . . . .*.]
Accipiter fasciatus	Brown Goshawk		1	#	[. .*. .]	[*.*. . . .]
Haliaeetus leucogaster	White-bellied Sea-Eagle	C	2	#	[* . . . .*]	[* . . . . .*]

Table 1 contd. over page

Species (Table 1 ctnd.)		A	B	C	Habitat [S P F M C]	Food [V I H S A F]
Haematopodidae	Charadriiformes:					
Haematopus longirostris	Pied Oystercatcher		2	#	[. . . .*]	[. . . .*.]
Charadriidae						
Vanellus miles	Masked Lapwing		3	#	[*.*. . .*]	[.*. .*.*.]
Pluvialis squatarola	Grey Plover	CJ	1		[. . . .*]	[. . . .*.]
Pluvialis dominica	Lesser Golden Plover	CJ	2		[*.*. . .*]	[.*. . .*.]
Charadrius mongolus	Mongolian Plover	CJ	2		[. . . .*]	[. . . .*.]
Charadrius leschenaultii	Large Sand Plover	CJ	2		[. . . .*]	[. . . .*.]
Charadrius ruficapillus	Red-capped Plover		2	#	[*. . . .*]	[.*. .*.*.]
Recurvirostridae						
Himantopus himantopus	Black-winged Stilt		3	#	[*. . . .*]	[. .*. .*.]
Recurvirostra	Red-necked Avocet		1		[*. . . .*]	[.*. . .*.]
Scolopacidae						
Arenaria interpres	Ruddy Turnstone	CJ	2		[*. . . .*]	[. . . .*.]
Numenius madagascariensis	Eastern Curlew	CJ	3		[. . . .*]	[. . . .*.]
Numenius phaeopus	Whimbrel	CJ	3		[. . .*.*]	[. . . .*.]
Tringa brevipes	Grey-tailed Tattler	CJ	3		[. . .*.*]	[. . . .*.]
Tringa hypoleucos	Common Sandpiper	CJ	2		[*. . .*.*]	[. . . .*.]
Tringa nebularia	Greenshank	CJ	2		[*. . . .*]	[. . . .*.*]
Tringa stagnatilis	Marsh Sandpiper	CJ	3		[*. . . .*]	[. . . .*.]
Tringa terek	Terek Sandpiper	CJ	3		[*. . .*.*]	[. . . .*.]
Limosa limosa	Black-tailed Godwit	CJ	2		[*. . . .*]	[. . .*.*.]
Limosa lapponica	Bar-tailed Godwit	CJ	3		[. . . .*]	[. . . .*.]
Calidris canutus	Red Knot	CJ	3		[. . . .*]	[. .*. .*.]
Calidris tenuirostris	Great Knot	CJ	2		[. . . .*]	[. . . .*.]
Calidris acuminata	Sharp-tailed Sandpiper	CJ	3		[*. . . .*]	[.*. .*.*.]
Calidris ruficollis	Red-necked Stint	CJ	2		[*. . . .*]	[. .*.*.*.]
Calidris ferruginea	Curlew Sandpiper	CJ	3		[*. . . .*]	[*. . . .*.]
Laridae						
Larus novaehollandiae	Silver Gull		3		[*. . . .*]	[. . . . .*]
Chlidonias leucoptera	White-winged Tern	CJ	2		[*. . . .*]	[. . . . .*]
Gelochelidon nilotica	Gull-billed Tern		3		[*. . . .*]	[*.*. . .*.*]
Hydroprogne caspia	Caspian Tern	CJ	3		[*. . . .*]	[. . . . .*]
Sterna hirundo	Common Tern	CJ	2		[. . . .*]	[.*. . . .*]
Sterna albifrons	Little Tern	CJ	3		[. . . .*]	[. . . . .*]
Sterna bergii	Crested Tern		2		[. . . .*]	[. . . . .*]
Columbidae	Columbiformes:					
Columba livia	Feral Pigeon		3	#	[. . . .]	[.*.*.*.*.]
Geopelia humeralis	Bar-shouldered Dove		3	#	[*. .*.*.]	[. . .*. .]
Platycercidae	Psittaciformes:					
Platycercus adscitus	Pale-headed Rosella		3	#	[. .*. .]	[.*.*.*. .]
Psephotus haematonotus	Red-rumped Parrot		1		[. .*. .]	[. .*.*. .]
Cuculidae	Cuculiformes:					
Cuculus variolosus	Brush Cuckoo		2		[. .*.*.]	[.*. . . .]
Alcedinidae	Coraciiformes:					
Halcyon chloris	Collared Kingfisher		3	#	[. .*.*.]	[*.*... .*.]
Meropidae						
Merops ornatus	Rainbow Bee-eater	J	3	#	[. .*.*.]	[.*. . . .]
Hirundinidae	Passeriformes:					
Hirundo neoxena	Welcome Swallow		3	#	[*. .*.*.]	[.*. . . .]
Cecropis nigricans	Tree Martin		3	#	[*. .*.*.]	[.*. . . .]
Cecropis ariel	Fairy Martin		3	#	[*. .*.+.]	[.*. . . .]
Motacillidae						
Anthus novaeseelandiae	Richard's Pipit		2	#	[.*. . .]	[.*.*.*.*.]
Campephagidae						
Coracina novaehollandiae	Black-faced Cuckoo-shrike		3	#	[. .*.+.]	[.*.*.*. .]
Lalage leucomela	Varied Triller		1		[. .*.*.]	[.*.*.*. .]
Pachycephalidae						
Pachycephala rufiventris	Rufous Whistler		3	#	[. .*.+.]	[.*. . . .]
Colluricincla harmonica	Grey Shrike-thrush		3	#	[*. .*.+.]	[*.*. . . .]
Myiagridae						

Table 1 contd. over page

Species (Table 1 ctnd.)		A	B	C	Habitat [S P F M C]	Food [V I H S A F]
Myiagridae ctnd.						
Myiagra rubecula	Leaden Flycatcher	2	#		[. .*.*.]	[.*. . . .]
Rhipiduridae						
Rhipidura rufifrons	Rufous Fantail	2			[. .*.*.]	[.*. . . .]
Rhipidura fuliginosa	Grey Fantail	3	#		[. .*.*.]	[.*. . . .]
Rhipidura leucophrys	Willie Wagtail	3	#		[. .*. .]	[.*. . . .]
Sylviidae						
Megalurus gramineus	Little Grassbird	1	#		[*.*.*. .]	[.*. . .*.]
Cisticola exilis	Golden-headed Cisticola	3	#		[*.*. . .]	[.*. . . .]
Acanthizidae						
Gerygone laevigaster	Mangrove Gerygone	3	#		[. .*.*.]	[.*. . . .]
Climacteridae						
Cormobates leucophaea	White-throated Treecreeper	2	#		[. .*.+.]	[.*. . . .]
Meliphagidae						
Lichenostomus fasciogularis	Mangrove Honeyeater	3			[. . .*.]	[.*.*. .*.]
Zosteropidae						
Zosterops lateralis	Silvereye	3	#		[. .*.*.]	[.*.*. . .]
Passeridae						
Passer domesticus	House Sparrow	3	#		[.*. . .]	[.*.*.*. .]
Ploceidae						
Lonchura castaneothorax	Chestnut-breasted Mannikin	2	#		[*.*. .*.]	[. . .*. .]
Sturnidae						
Sturnus vulgaris	Common Starling	3	#		[*.*.*. .]	[*.*.*. . .]
Grallinidae						
Grallina cyanoleuca	Australian Magpielark	3	#		[*.*.*. .]	[.*. . . .]
Corvidae						
Corvus orru	Torresian Crow	3	#		[.*.*.+.]	[*.*.*. . .]

freshwater marshes but tend to be more restricted to the intertidal area. The forest category (37% of species) relates to many of the species noted under mangroves or freshwater marshes, that will also use eucalypt forest. As mentioned earlier, very little forest cover other than mangroves is left on Fisherman Island.

The remainder of the presentation of results will be largely on the basis of various areas. Appendix E maps the sightings of species in the immediate vicinity of Fisherman Island and should be used together with the text that follows as explanation of the local distribution of species. Note that the data presented on the roost counts and scan counts has not been mapped and some other general comments are not necessarily verifiable from the maps presented.

5.1 Open terrestrial habitats and roost sites

5.1.1 Buildings

Much of Fisherman Island has been cleared or is being cleared and reclaimed as dry land for the establishment of port facilities. Where the change in land use has not been completed, which includes most of the land to the east and north of the railway line, a range of bird species can still be found. In contrast, amongst the developed area to the west of the railway line there is little bird activity other than that of introduced species (Feral Pigeon, House Sparrow and Common Starling). On the shoreline near the wharves, wader activity is confined to two small enclaves (see Section 5.4.4).

5.1.2 Grassed areas, ponds and channels

Behind the bund walls on the eastern side on the railway bird activity has also been curtailed but over much of the remainder of the island birds can still be found and fall into three categories of occupancy. A handful of grassland species live amongst the tall grasses and reeds and include Richard's Pipit, Little Grassbird, Golden-headed Cisticola, and Chestnut-breasted Mannikin. The Double-barred Finch and introduced Nutmeg Mannikin are also likely to be present. These grassed areas are also used by species that move to and from neighbouring tree cover onto the ground (Bar-shouldered Dove, Pale Headed Rosella, Red-rumped Parrot, Willie Wagtail, Australian Magpielark, Torresian Crow and Black-shouldered Kite) or forage out over open spaces (Rainbow Bee-eater, Welcome Swallow, Fairy Martin and Tree Martin). Waterbirds will opportunistically use grassed areas following temporary flooding or where ponding occurs. These species include the egrets, ibises and ducks. However, with the exception of the ponding within the railway loop where Sacred Ibis were seen, and a few waders and egrets along the drainage channels, little of this type of activity was noted during the fieldwork. With the possible exception of Sharp-tailed Sandpipers, the waders tended to forage along the built drains closest to the mangroves on the eastern side of the Island.

5.1.3 Intact claypan

To the south and south east of the Island the natural claypan behind the mangroves is

still very extensive and in use by both foraging and roosting birds. In addition to feeding activity of several species at the roost site in the extreme south east (Section 5.1.4.1), Sharp-tailed Sandpipers and Red-capped Plovers were prevalent in small groups throughout the claypan in October and much less so in January. Use of the claypan depends on how wet it is from tidal waters and rain and the time of the tide. Several waders (Curlew Sandpiper, Marsh Sandpiper, Red-capped Plover and Sharp-tailed Sandpiper) were using the claypan when conditions were suitable as an auxiliary feeding area to the intertidal mudflat. Several flocks of up to 20 Sharp-tailed Sandpipers were seen feeding throughout the claypan area during a high tide in October (not mapped). Activity on the claypan tended to be concentrated towards the south east where there is a roost and to a lesser extent towards the prong of mangroves that run up beside the railway line where small flocks of White-faced Heron, Sacred Ibis and larger groups of Sharp-tailed Sandpipers were seen (see Appendix E - occurrence of 24 Sharp-tailed Sandpipers at this site). The intact substrate and more regular presence of what seems to be freshwater near this prong of mangroves serves to attract birds.

5.1.4 Roost sites

5.1.4.1 Claypan in the south east

A concentration of roosting birds occurs on the south eastern section of claypan which is surrounded on three sides by mangroves (Figure 1). The site was visited on at least one occasion during each of the periods of fieldwork and birds were always there at high tide. Even at low tide, a residual number were present either resting or feeding in and around the shallow, wide pools at the site. It is a regularly frequented high tide roost that especially caters for the Eastern Curlew and Sharp-tailed Sandpiper but also a number of other species. The counts made are summarised below.

In winter the diversity of waders at the site was low but 212 Eastern Curlew were roosting there over a high tide together with 110 Black-winged Stilt and 12 Sharp-tailed Sandpiper.

In October, more species were noted including 4 Greenshank, 30 Whimbrel, 55 Curlew Sandpiper 15 Bar-tailed Godwit in addition to 6 Black-winged Stilt, 42 Sharp-tailed Sandpiper, and 87 Eastern Curlew. Another 212 Eastern Curlew were counted on the same high tide in partially disturbed claypan behind the main cove on the east of the Island (Appendix E). That is, about 300 Eastern Curlew were roosting on Fisherman Island at the time and this Figure is used in Section 6 for estimating the number of other species in the area.

Similarly, in summer the site was intensively used by a variety of species including 75 Australian Pelican, 25 Crested Tern and small numbers of Caspian Tern, Great Egret, Little Egret, Greenshank and Lesser Golden Plover. Waders that were present in high

numbers included 190 Eastern Curlew, 131 Bar-tailed Godwit, 50 Whimbrel, 60 Black-tailed Godwit, 38 Black-winged Stilt, 20 Sharp-tailed Sandpiper, 30 Curlew Sandpiper, 25 Red-necked Stint and 15 Marsh Sandpiper.

5.1.4.2 Back of the cove

Another location nearby was also serving as a high tide resting place for birds but mostly a different set of species. Many egrets, spoonbills and ibises were spending the high tide just at the back of the main cove on the east of the island and simply moving out from here at low tide to forage on the mudflat and seagrass, or under the mangroves. Birds were either on the main wall that was recently constructed just behind the cove, in the dead or dying trees that surrounded this road at the southern end of the base of the cove, or around the open ponds that formed as a consequence of bunding for the road.

In this area, there were invariably groups of up to 10 or more White-faced Herons, Great Egrets, Little Egrets, Sacred Ibis, Black-winged Stilts, and irregular occurrences of a number of wader species including as many as 60 Curlew Sandpiper and 40 Sharp-tailed Sandpipers in summer. Furthermore, Little Pied Cormorants and Little Black Cormorants were using the dead trees here as roosting sites and in one tree a pair of Ospreys have nested. Similarly, Tree Martins and a Pacific Black Duck were noted nesting in this patch of trees. Sightings of the Brahminy Kite, Whistling Kite and White-breasted Sea-eagle were made in the vicinity.

5.1.4.3 Bishop Island and northern tip of Fisherman Is.

The main wader roost and seabird roost on Fisherman Island is at the northern end of the island, and on Bishop Island. The whole area is considered together because it forms a single dispersed roost site that is changing all the time as a result of ongoing filling and road construction. When Bishop Island was separate from Fisherman Island, birds would mostly roost on the isthmus running off to the east of Bishop Island but they have slowly started to predominantly roost on Fisherman Island with scattered enclaves of various species on open sand or near mangroves on Bishop Island. More recently, Bishop Island has been joined in two places with Fisherman Island and the water in between is now a lagoon that has restricted tidal flow. Previously, on low tide the mudflat between the two islands attracted considerable feeding activity but this is no longer possible because the water does not drain away. Presumably the whole lagoon is to be reclaimed through the pumping of sand as fill to make the islands contiguous.

The counts of roosting birds is given in Table 2 and some indication of general distribution of roosting birds is shown in Figure 1. Also, since 1989 a number of cannon netting exercises have been undertaken at this roost and the resulting captures are summarised in Table 3. All birds were banded under the Australian Bird and Bat Banding

Table 2. Counts of birds made on 5 occasions at the Fisherman Island/Bishop Island roost and once at the Lytton roost.

Date-->	13	10	24	16	17	Lytton	Totals
Species (wader)	Aug	Oct	Oct	Jan	Jan	17 Jan	
Haematopus longirostris.....Pied Oystercatcher	79	64	21	22	11		197
Pluvialis squatarola.....Grey Plover		98	12	46	82		238
Pluvialis dominica.....Lesser Golden Plover			9				9
Charadrius mongolus.....Mongolian Plover	+	50	12	35	248		345
Charadrius leschenaultii.....Large Sand Plover		+	16	95	176		287
Charadrius ruficapillus.....Red-capped Plover		10			+		10
Himantopus himantopus.....Black-winged Stilt	123	19	19				161
*Recurvirostra novaehollandiae*Red-necked Avocet	22	30	52	95	130		329
Arenaria interpres.....Ruddy Turnstone		23	16	4			43
Numenius madagascariensis..... Eastern Curlew		473	8		8	30	519
Numenius phaeopus..... Whimbrel		28	3	10		50	91
Tringa brevipes..... Grey-tailed Tattler		3	25			330	358
Tringa nebularia.....Greenshank						40	40
Tringa terek.....Terek Sandpiper			5	+			5
Limosa limosa.....Black-tailed Godwit			350		146	130	626
Limosa lapponica.....Bar-tailed Godwit	167	1480	575	423	704	440	3789
Calidris canutus..... Red Knot		150	5				155
Calidris tenuirostris.....Great Knot		2600	1050	545	392	300	4887
Calidris acuminata.....Sharp-tailed Sandpiper		45	8				53
Calidris ruficollis.....Red-necked Stint		+	192	+	40	+	232
Calidris ferruginea.....Curlew Sandpiper	142	201	32		21	50	446
Totals	533	5274	2410	1275	1958	1371	
Species (other)							
Pelecanus conspicillatus.....Australian Pelican		11		34	18		63
Phalacrocorax sulcirostris Little Black Cormorant					19		19
Anas castanea.....Chestnut Teal				+	23		23
Larus novaehollandiae..... Silver Gull	24	47	62	1350	610		2093
Chlidonias leucoptera.....White-winged Tern				95	20		115
Gelochelidon nilotica.....Gull-billed Tern	2		8			8	18
Hydroprogne caspia.....Caspian Tern	31	12	12	74	90		219
Sterna hirundo.....Common Tern	3			27			30
Sterna albifrons..... Little Tern		113	80	14	65		272
Sterna bergii..... Crested Tern	73	110	40	280	209		712

Table 3. Captures of birds at the Fisherman Island/ Bishop Island roost. All birds have been banded and released.

Species	Date--->	17-11 1989	16-1 1990	21-10 1990	19-1 1991	3-4 1991	13-10 1991
Haematopus longirostris Pied Oystercatch.			6				
Charadrius mongolus.....Mongolian Plover		38				2	
Charadrius leschenaultii .Large Sand Plover		3				44	
Arenaria interpres.....Ruddy Turnstone						1	
*Numenius madagascariensis*Eastern Curlew							2
Tringa terek.....Terek Sandpiper		3					
Limosa limosa..... Black-tailed Godwit				31			
Limosa lapponica.....Bar-tailed Godwit		90		5	16	58	51
Calidris canutus.....Red Knot		1		55			1
Calidris tenuirostris.....Great Knot		16		8	9	101	50
Calidris ferruginea..... Curlew Sandpiper				14			3
Gelochelidon nilotica..... Gull-billed Tern							2
Sterna albifrons.....Little Tern		4			1		

Schemes and more recently all of the Bar-tailed Godwits have also been tagged with a small dark green leg flag which is the colour assigned to south east Queensland. En route through Asia and on their breeding grounds these birds can be identified from a distance as non-breeding visitors to Moreton Bay.

The roost is used by the highest number of birds in October, during the southward migration when numbers of migratory waders peak in Moreton Bay. Far fewer species are present in August and the non-migratory species (Black-winged Stilt, Avocet, Pied Oystercatcher and Red-capped Plover) form a significant proportion of the total roost counts. Those migratory species that were counted in August are most likely to be first year birds which during their first austral winter do not return to the northern hemisphere to breed, e.g. Bar-tailed Godwits, Curlew Sandpipers, Sharp-tailed Sandpipers Mongolian Plover, and Eastern Curlews (Table 2 and Section 5.1.4.1). It is possible some of the Eastern Curlews are second year birds which may also not return to breed or some may be adult birds that have in already made the return journey back from their breeding grounds by August.

In October and January, but especially in October, there is a high diversity of birds on the roost with consistently high numbers of Bar-tailed Godwits and Great Knots. Eastern Curlews will occasionally use the site but tend to prefer more secluded locations such as the claypan roost discussed above. The numbers of several other species is also impressive considering that they are generally far less plentiful in Moreton Bay than the most numerous species on the roost, i.e. the Great Knot and Bar-tailed Godwit. These species include the Black-tailed Godwit, Mongolian Plover, Large Sand Plover, Grey Plover, Red-necked Avocet, Ruddy Turnstone, Pied Oystercatcher and Red Knot. The Red Knot does not sustain a summer population in Moreton Bay but passes through to New Zealand and New South Wales (high count in October and refer to Table 2).

The roost regularly sustains as many as 2000 birds and during periods of migration these numbers can easily double. This is in addition to the fairly regular high numbers of Crested and Little Terns and a variety of other species that occur less consistently (Caspian Tern, Gull-billed Tern, White-winged Tern, Chestnut Teal). During the January count a large number of Silver Gull occurred at the roost and it is unclear whether this is to become a normal feature of the site. The changing conditions may well be more suitable to some species than others.

There are two wader species that are common on the surrounding feeding grounds but are not well represented at any of the roost sites already mentioned. Grey-tailed Tattlers and Whimbrels in particular will roost in mangroves over high tide and do not necessarily seek out a ground roost like the majority of species. Consequently, these species become far less obvious over high tide.

5.2 Mangroves

Extensive stands of mangrove are still prevalent on Fisherman Island, especially along the eastern and southern sides of the island including an isolated stand on the south western corner. A long tongue of mangroves extends northward up the centre of the island beside the railway line and forms the western edge of the main area of claypan (Section 5.1.3). All these patches of mangrove are still being used by a typical range of mangrove inhabiting species, although only at one site was a transect count of birds undertaken in each of the three sampling periods (Table 4). Local bird species that are specialist inhabitants of mangroves were present, i.e. the Collared Kingfisher, Mangrove Honeyeater, Mangrove Warbler and Striated Heron. The latter species was not as common as expected and was not recorded during transect counts. However, Mangrove Warblers and Collared Kingfishers were especially abundant

Unexpectedly, a number of other species more typical of eucalypt forest were also abundant in the tallest stands of mangrove which lined the foreshore to a width of up to 200 m. In particular, there was a high population of White-throated Treecreepers which are generally not a mangrove inhabitant and were probably present on Fisherman Island due to the tall stature of the mangroves and the open nature of the understorey. Quite high densities of other species such as the Grey Fantail, Rufous Whistler and Grey Shrike Thrush were indicative of a high diversity and high overall bird abundance in these mangroves, particularly where the stands were tallest around the foreshore. Many Sacred Ibis are also using the open feeding areas beneath the mangrove canopy for foraging as well as feeding out in the open on the mudflats. Where mangroves become shorter or more open, the birdlife is less diverse primarily because the habitat becomes simplified and offers fewer feeding opportunities for typical forest species.

A total of 18 species were recorded during the 3 mangrove transects on Fisherman Island with a minimum of 10 species and 86 total counts from any one transect (Table). In comparison, transect counts of birds I have conducted in a similar fashion in mangroves of Deception Bay and Tin Can Bay yielded totals counts of 33 and 36 respectively and species tallies of 12 and 7 respectively. On the basis of this fairly superficial comparison, the mangroves on Fisherman Island compare very favourably as habitat for birdlife, especially in terms of local population density. A short visit to some of the tallest mangroves between Wynnum and the Boat Passage indicated that a similar type of bird community is inhabiting parts of these forests as occur on Fisherman Island.

Preservation of the mangroves of Fisherman Island would be of considerable benefit to local resident bird populations and to other forest species which would use the site opportunistically in transit along the coast during seasonal movements. That is, species additional to those listed in Table 1 are likely to occur in the mangroves at Fisherman

Table 4. Counts of birds recorded from the transect through mangroves (see Figure 1) for each of the sampling periods. Counts were accumulated over a 1 km transect by stopping 15 times at approximately 65 m intervals and recording birds heard or seen within a 60 m radius for a 5 minute period.

Species		Aug	Oct	Jan	Total
Threskiornis aethiopica	Sacred Ibis	11	12	42	65
Pandion haliaetus	Osprey	3			3
Haliastur sphenurus	Whistling Kite	1		2	3
Platycercus adscitus	Pale-headed Rosella			2	2
Halcyon chloris	Collared Kingfisher	6	17	25	48
Coracina novaehollandiae	Black-faced Cuckoo-shrike		4		4
Lalage leucomela	Varied Triller		3		3
Pachycephala rufiventris	Rufous Whistler	10	2	7	19
Colluricincla harmonica	Grey Shrike-thrush	3	2	8	13
Myiagra rubecula	Leaden Flycatcher		4		4
Rhipidura rufifrons	Rufous Fantail	1	2		3
Rhipidura fuliginosa	Grey Fantail	11	6	12	29
Rhipidura leucophrys	Willie Wagtail	2			2
Gerygone laevigaster	Mangrove Gerygone	22	21	29	72
Cormobates leucophaea	White-throated Treecreeper	9	5	8	22
Lichenostomus fasciogularis	Mangrove Honeyeater		10		10
Zosterops lateralis	Silvereye	7			7
Corvus orru	Torresian Crow			2	2
Totals		86	88	137	311

Table 5. The percentage contribution of species of wader to the scan count totals for the spring survey around Fisherman Island. Data for various sites, as indicated by the column headings, have been combined on the basis of the classification analysis reported on in Section 5.3.2 and Figure 2. These same data have been summarised and graphed in Figure 3.

Species	ABG MPTY	CF	QS	KL	DEH	UV	WX	R	N	O	J	I	Tot
Pied Oystercatcher (po)	2				7	3	5						2
Grey Plover (gp)	2			9	2				20		5	8	3
Lesser Golden Plover (lgp)	1			4			2						+
Mongolian Plover (mp)	+					1			7	3		1	1
Large Sand Plover (lsp)	2				+	3	5		7	1	5	1	2
Red-capped Plove (rcp)r									15		1	1	1
Black-winged Stilt (bws)	+		11	1				5		5	1	2	1
Red-necked Avocet (rna)										8			1
Ruddy Turnstone (rt)	1					12	2		2				1
Eastern Curlew (ec)	6	57	8	21	2	10	7	11	4	6	1		8
Whimbrel (w)	6	6	12	10	6	11	39	5	2	2	4		6
Grey-tailed Tattler (gtt)	31	8	7	18	11	11	19		2	1	4		15
Greenshank (g)	2	4	6	3	1	1	3						1
Terek Sandpiper (ts)	1		1			3		1		7	3		1
Black-tailed Godwit (bltg)	+							5		7	5		1
Bar-tailed Godwit (btg)	17	19	36	19	12	37	17	14	2	15	31	17	19
Red Knot (rk)	+				3	1			7	3	17	14	4
Great Knot (gk)	1				+	1				1	1	20	2
Sharp-tailed Sandpiper (sts)	25	6	17	15	50	3	2	22		12	7	1	20
Red-necked Stint (rns)					2	1			13			1	1
Curlew Sandpiper (cs)	1		2		3	1		36	19	30	16	34	9
Totals	738	89	84	68	322	184	59	99	54	184	166	178	2225

Island from time to time.

5.3 Intertidal scan counts

5.3.1 General analysis of wader counts

The habitat that was given by far the most attention was the intertidal mudflats and seagrass beds adjoining Fisherman Island. A number of nearby areas were also visited.

These areas are feeding grounds for a wide variety of species of migratory waders (e.g. Eastern Curlew, Whimbrel), resident waders (e.g. Black-winged Stilt, Red-capped Plover, and Pied Oystercatcher), the Chestnut Teal, and a variety of ibis, egret and heron (see Appendix A). All of these species tend to feed at low tide under mangroves or out on the mudflats. Moreton Bay generally has high numbers of many of these species and, for the migratory species, Moreton Bay is a major international site.

Perhaps the highest density of waders in Moreton Bay occurs on Luggage Point (Thompson 1990) and the present study indicates a very high feeding density of birds around Fisherman Island. However, the mix of species is quite different from Luggage Point due to a generally muddier substrate and prevalence of seagrass.

Data from the scan counts are analysed in detail to determine zones of different feeding areas around Fisherman Island and the species that characterise such zones. The complete set of data from scan counts at low tide is given in Appendix A but for the time being only the community of waders (i.e. Families of Charadriidae and Scolopacidae) are being considered. In total, for the 3 sampling periods, 47 scan counts (locations in Figure 1) were taken with widely varying total counts. The percentage count for each species from each scan is given in Appendix B. On the basis of these data a classification of scan counts was performed as described in Section 4 and the result was a determination of 3 main groups of scans. The dendrogram is not shown but the general makeup of the groups was as follows. Almost all of the winter sampling was separated off into a group whereas one of the other two groups was made up of just 5 of the counts made in spring. The remaining scan counts formed a third, large group.

5.3.2 Analysis of October wader counts

The broad scale analysis highlighted the seasonal changes that had occurred in the bird community but also tended to cloud a clear assessment of spatial variation in the intertidal feeding areas. Therefore, seasonal aspects are dealt with in Section 5.3.3 and to appreciate the spatial arrangement of feeding areas a second classification was computed using only the spring data which included 25 scan counts (Appendix B). The dendrogram that resulted from this analysis is shown in Figure 2 and has been used as the basis of selecting 12 groupings of the 25 scan counts (Appendix B) made in October.

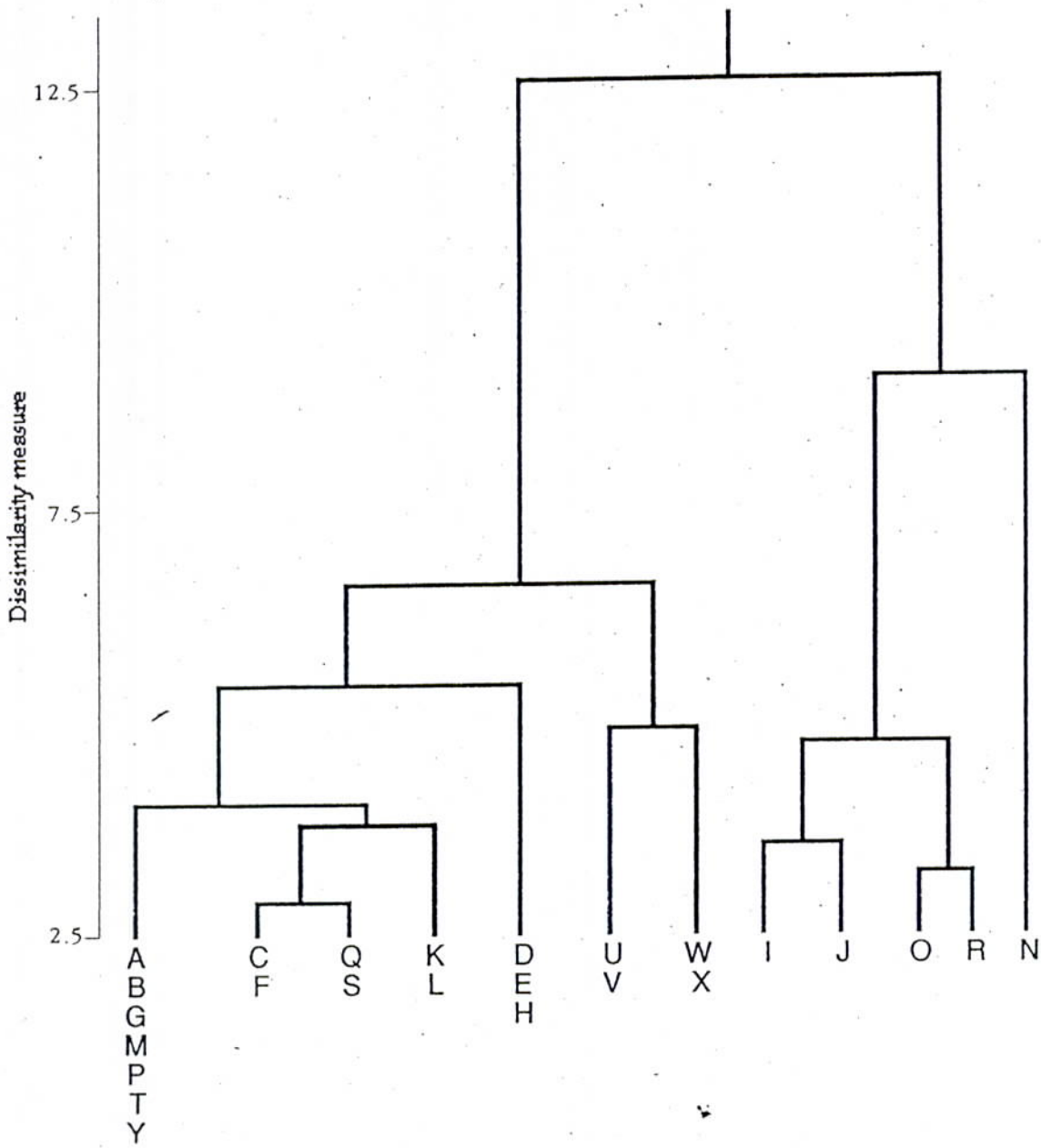

Figure 2. Dendrogram showing the results of a classification of low tide scan counts of waders taken from 25 sites (A to Y) during October 1991 in the vicinity of Fisherman Island. The sites are mapped on Figure 1. Details of the analysis procedure are given in Section 4 and an interpretation of these results is given in Section 5.3.2.

The grouping of sites is indicated by the capital letters beneath the legs of the dengrogram. The percentage contribution made by species of wader to the combined counts for each of the defined groups is given in Table 5 and graphically illustrated in Figure 3.

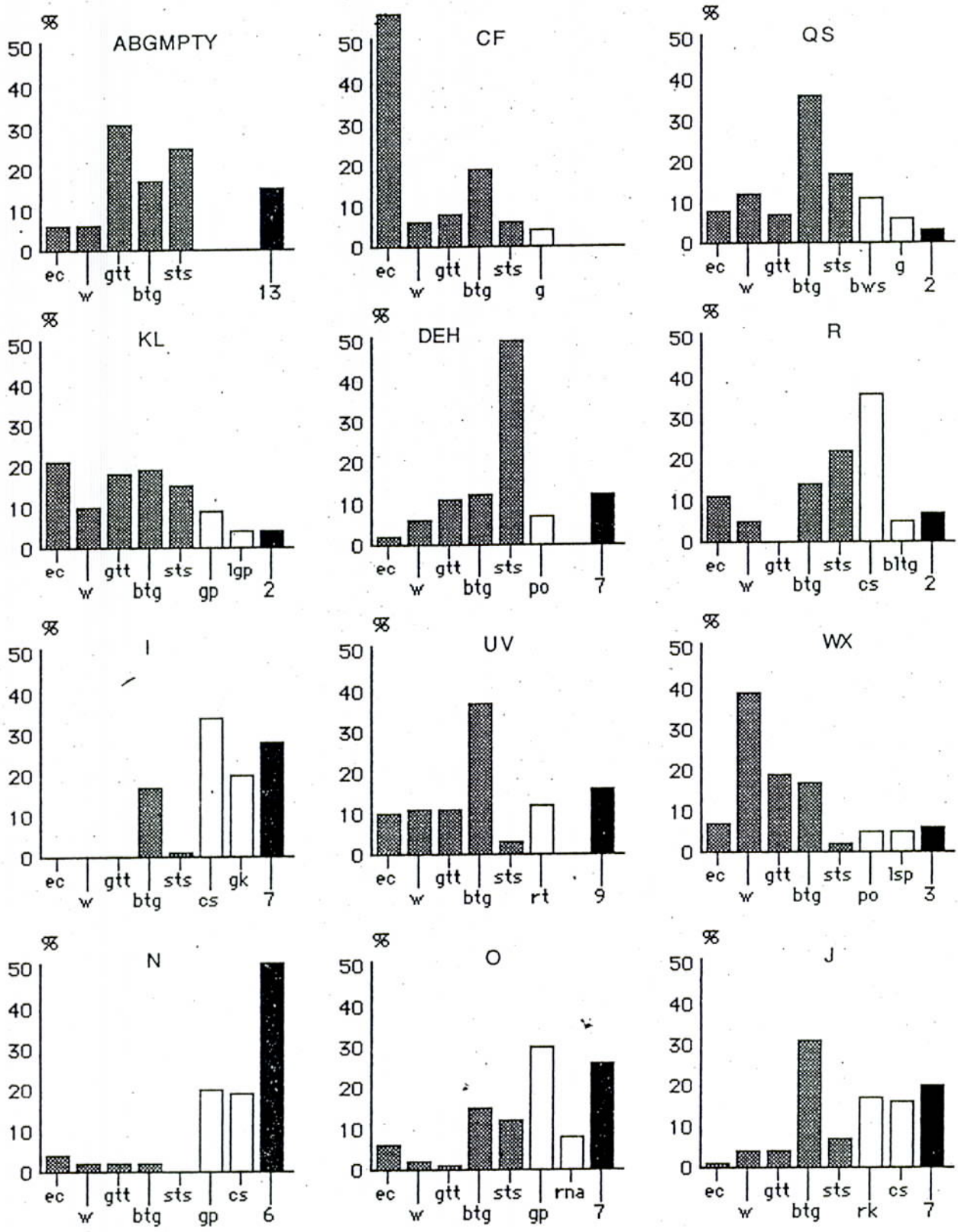

Figure 3. Graphical summary of the percentage contribution of species of wader to low tide scan counts for the 12 site groups defined in the classification of October counts (Figures 1 & 2, and Section 5.3.2). The data are the same as in Table 5 except only the five species that were most common overall are plotted consistently for each group (grey columns) and include the Eastern Curlew (ec), Whimbrel (w), Grey-tailed Tattler (gtt), Bar-tailed Godwit (btg) and Sharp-tailed Sandpiper (sts). Values for a possible two additional species are plotted if their individual contributions exceeded 3% (white columns), whereas the percent contribution for all other species is combined into a single value (black column) and the number of species involved indicated at the base of the column. For the initials of other species refer to Table 5.

The percentage contribution of species to total counts for each of these 12 new groupings is given in Table 5 and illustrated graphically in Figure 3. Based on the analysis, the following interpretation of variation in the intertidal feeding areas for waders is made and a subjective assessment of the intertidal zones that are represented in the analysis is given in Figure 1.

The most extensive and uniform intertidal zone for feeding waders is represented by sites "ABGMPTY" and has a high species diversity with the Grey-tailed Tattler, Sharp-tailed Sandpiper and Bar-tailed Godwit accounting for about 73% of the individuals (Figure 3). This zone is most extensive out from the south eastern corner of Fisherman Island and is mostly shallow seagrass beds on muddy substrate that has a relatively firm sub-surface. In many places the surface varies from firm ridges free of seagrass to deep troughs as a result of large holes dug by fisherman when searching for worms. The implication of this type of disturbance is unclear and although it may create local heterogeneity of substrate and encourage a wider of range of wader species it may also be having long term detrimental effects on the productivity of the area if practised too intensively.

The zone represented by "CF" is deeper seagrass beds that in many tides are only accessible by the larger waders, notably the Eastern Curlew. The White-faced Heron and Sacred Ibis are also quite comfortable feeding in this deeper water. The zone will vary with the tide height but even on the lowest tides is still quite extensive lying along the eastern perimeter of the intertidal areas of Fisherman Island and down the shoreline towards Wynnum.

The next zone is not well defined and may be an artifact of transient high densities of birds, notably Bar-tailed Godwits, as they disperse more widely onto feeding areas. Nevertheless, the two locations that have been grouped, Q (north eastern Fisherman Island) and S (eastern side of mangroves at Lytton), were similar, in that they were close inshore and had relatively firm substrate with little seagrass.

The area to the south eastern side of the Boat Passage, represented by "KL" had fairly even counts in the range of 10-20% for 6 species and could be considered a combination of the two major zones around Fisherman Island, i.e. "ABGMPTY" and "CF". The sites "DEH" could also be considered a localised variation of the main feeding area where Sharp-tailed Sandpipers are very abundant. This tended to occur amongst the seagrass beds but where the seagrass was least dense.

All of the remaining scan count sites for October have been clearly separated from sites already mentioned and could be considered to offer quite different conditions to that found in areas of seagrass around Fisherman Island. Sites "UV" and "WX" are from St

Helena Island and Green Island respectively and will be mentioned later in dealing with these islands. Site R is representative of feeding conditions at the back of the cove on the eastern side of Fisherman Island. This area was difficult to sample which is why only one scan count was taken but a special effort was made in January to collect more data from here (Appendix B). The combination of species using this site is different from elsewhere around Fisherman Island and this is most likely due to the lack of seagrass and very muddy substrate which favours Terek Sandpipers and Curlew Sandpipers and is less frequented by Grey-tailed Tattlers. In both October and January this area had high densities of these and a range of other wader species. It was also an area of high concentrations of the Great Egret, White-faced Heron, Royal Spoonbill and Chestnut Teal during one or more of the sampling periods.

Finally, the sites I, J, O and N will be considered individually. Site O was between Bishop and Fisherman Island and N was out from the spit off Bishop Island. The array of species at both sites was strongly influenced by the fact that the area is a high tide roost and birds will inevitably remain near the roost over low tide if conditions are suitable. Grey Plover were well represented at both sites as were a number of other species (sand plovers, Black-tailed Godwits, Avocets, Red Knots) that were generally infrequently recorded out over more extensive feeding areas. The area between Bishop and Fisherman Island (site O) is being filled and is no longer tidal or of use to the same range of feeding birds. Similarly as a result of recent earthworks site N has totally changed in character and offers fewer feeding opportunities.

Site J, on the south side of the Boat Passage, was atypical because it acted as a staging area for birds moving on and off their high tide roosts and was not simply a feeding site for birds. This explains the high diversity of birds at the site and the unusual combination of species that would change depending on the movement of flocks at the time. Birds would congregate on this site on the rising tide and move onto one of the roosts on Fisherman Island, or flocks would travel to the south east towards the roost at Lytton or perhaps elsewhere.

Finally, Luggage Point was sampled on one occasion and this extensive feeding area was found to cater for a different mix of species than the major feeding areas around Fisherman Island. In particular, the Great Knot, Red Knot, and Curlew Sandpiper were plentiful which differed from the generally high numbers of Sharp-tailed Sandpipers, Eastern Curlews and Grey-tailed Tattlers that characterise much of the intertidal area to the east and south east of Fisherman Island. The birds using Luggage Point will be considered again in Section 6 when data collected by Thompson is compared with information from this study.

5.3.3 Seasonal changes in wader communities

An assessment of the seasonal changes in the composition of wader communities has been approached through a comparison of the percentage contribution of species to scan counts for the three sampling periods and for different zones, as determined in the last Section 5.3.2 (see Appendix D). Seasonal changes in absolute numbers are not readily determined using scan counts and for this purpose reference should be made to counts of roosting birds (Section 5.1.4).

The principal feeding area around Fisherman Island was represented by the site group "ABGMPTY" for the October sampling and by a number of similarly placed sites for August and January. Data from scan counts at these selected sites are combined for each season and illustrated as the percentage contribution of species in Figure 4. The same Figure shows data for each season from all the sites represented in Appendix D.

In August, the Eastern Curlew (probably overwintering birds), the non migratory Pied Oystercatcher and Black-winged Stilt (combined totals) were the most prevalent waders. During the southward migration (October), the Grey-tailed Tattler, Bar-tailed Godwit and Sharp-tailed Sandpiper exhibit an influx of numbers and tend to predominate, although a range of less common species are also present and the species diversity is highest on the mudflats at this time of year.

Sampling in January represents a more stable pattern that probably persists from December to February when migratory movements have ceased and Grey-tailed Tattlers are the principal users of the major feeding area around Fisherman Island that are characterised by seagrass. Nevertheless, four other species (Eastern Curlew, Whimbrel, Bar-tailed Godwit and Sharp-tailed Sandpiper) each contribute over 10% to the total number of birds on these feeding grounds in January. The Pied Oystercatcher and Lesser Golden Plover are also well represented. Eight more species were recorded on the "ABGMPTY" zone (see Appendix D, Figure 4). For all zones combined (summer), the pattern differs from the "ABGMPTY" zone in that the prevalence of Eastern Curlews in deeper water, and Bar-tailed Godwits on a wide range of substrates, tends to influence the relative proportion of species. A moderately high population of the Sharp-tailed Sandpiper persists through the summer, although their numbers are highest during the migration as they move through on their way farther south.

5.3.4 Counts of species other than waders

High densities of species other than waders (Families Charadriidae and Scolopacidae) occurred on the intertidal areas around Fisherman Island. The raw counts of these species are given in Appendix A for each of the scan counts and reference will be made to the general mapping of observations of all species (Appendix E). The Australian Pelican was recorded in large groups on roost sites (tip of Fisherman and claypan site)

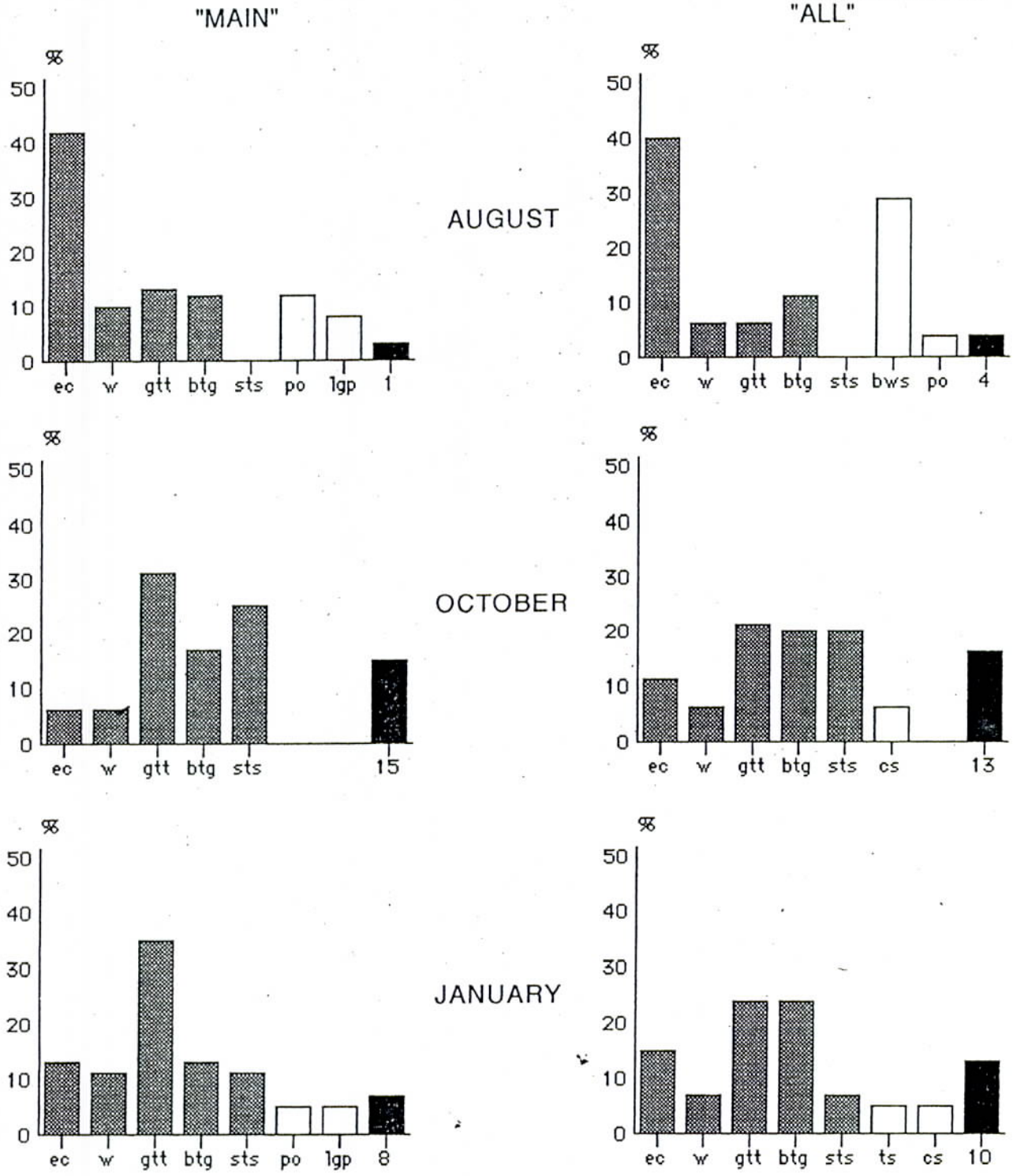

Figure 4. A seasonal comparison of scan counts using a summary of the percentage contribution of species of wader to low tide scan counts for the "MAIN" feeding area (based on the "ABGMPTY" group of Figure 2) for each of the 3 sampling periods (see Section 5.3.3). For each of the same 3 sampling periods, values for "ALL" feeding areas around Fisherman Island are also plotted. The data are the same as in Appendix D except only the five species that were most common overall are plotted (grey columns) consistently for each group and include the Eastern Curlew (ec), Whimbrel (w), Grey-tailed Tattler (gtt), Bar-tailed Godwit (btg) and Sharp-tailed Sandpiper (sts). Values for a possible two additional species are plotted if their individual contributions exceeded 3% (white columns), whereas the percent contribution for all other species is combined into a single value (black column) and the number of species involved indicated at the base of the column. For the initials of other species refer to Table 5.

and in smaller groups on the edge of the mudflats around Fisherman Island. Similarly, other fish eating species, the Pied and Little Pied Cormorants were regularly recorded during scan counts loafing on intertidal mudflats or roosting at high tide on mangroves or artificial structures (Appendix E). The Silver Gull and four species of tern (Appendices A and E) were similarly seen on or around the mudflats, although with the exception of the Little Tern, were less often seen feeding. Flocks of the Little Tern fed as the tide rose around the Boat Passage and out over the main area of seagrass to the south east of Fisherman Island and in the cove to the east of the Island.

White-faced Herons, Great Egrets, Little Egrets, Sacred Ibis and Royal Spoonbills were all common on the mudflats in densities I would judge to be equal to, or higher than in other parts of Moreton Bay. Royal Spoonbills were most prevalent in August at a time when inland freshwater feeding areas were perhaps relatively scarce. Similarly, Chestnut Teals were present in very high numbers at this time and both species had congregated around the edges of the cove on the eastern side of Fisherman Island.

The White-faced Heron and Sacred Ibis were abundant during all three sampling periods although most common in August. They primarily fed amongst the intertidal seagrass but also used the mudflat closer to mangroves and fed beneath the mangroves. Like the Eastern Curlew, they could tolerate feeding in fairly deep water and were distributed not only to the east and south east of Fisherman Island but down the mangrove lined foreshore of Whyte Island towards Wynnum. Their density was probably highest around the cove at Fisherman Island and on the southern side of the Boat Passage.

There was a small colony of Great Egrets that was based on the southern side of the cove (eastern Fisherman Island) and they were noted roosting back from the shoreline on the ground or in dead trees (Section 5.1.4.2) or feeding out in front of the mangroves and amongst the seagrass. Little Egrets are more solitary and were occasionally encountered on the mudflat during scan counts, mostly close to mangroves. Note the records of Collared Kingfishers that venture out to feed on the open mudflats (Appendix A). The density of this species was particularly high throughout tall mangroves in the area.

5.4 Additional intertidal areas

5.4.1 Mud Island

Birds, particularly cormorants, were noted around mud Island at high tide, roosting on piles of coral debris on the south east, east and north of the island but mainly in the south east. Scattered individuals and small groups of cormorants were also noted in mangroves. On a sand bar extending out from mangroves on the western side of the island, a group of Grey-tailed Tattlers was noted. Other species of wader occurred on the piles of rubble. The low tide feeding areas around Mud Island were not assessed.

The approximate counts of birds on a round trip of the island at high tide in August were:

Australasian Gannet 1
Brahminy Kite 1
Caspian Tern.....60
Common Tern 98
Crested Tern.....15
Eastern Curlew 43
Great Egret 2
Grey-tailed Tattler 230
Little Black Cormorant.....8
Little Egret.....3
Little Pied Cormorant 62
Pied Cormorant.....250
Pied Oystercatcher 18
Red-necked Stint.....210
Ruddy Turnstone.....60
Sacred Ibis.....2
White-bellied Sea-Eagle 1
White-faced Heron.....3

Similarly in October the approximate counts were:

Bar-tailed Godwit.....300
Crested Tern.....?
Eastern Curlew 30
Grey-tailed Tattler .....?
Large Sand Plover.....?
Pied Cormorant.....1500
Ruddy Turnstone.....?

5.4.2 St Helena and Green Islands

Low tide feeding areas around St Helena were briefly looked at in October and two scan counts taken at the southern end (sites U, V) where the substrate was fairly sandy with very little cover of seagrass. There is a strip of intertidal area all around the island and small high tide roosts occur at the northern end on the narrow beach and amongst the open lagoon under the radio masts. In the south west of the island birds were roosting in the vicinity of the beach that faces into the cove and in mangroves nearby. Some Eastern Curlews possible roost behind mangroves on the south eastern side on the island.

High tide records for roosts at the northern end of St Helena are as follows (underlined entries are for October, plain are for August):

Black-winged Stilt.....2
Chestnut Teal 55
Crested Tern.....25
Grey Plover 10
Grey-tailed Tattler 3
Little Egret.....3
Masked Lapwing 3
Masked Lapwing 4
Bar-tailed Godwit.....50
Osprey.....1
Pied Cormorant.....10
Pied Oystercatcher 46
Pied Oystercatcher.....70
Royal Spoonbill 4
Sacred Ibis.....5
Silver Gull.....15
White-faced Heron.....2
Little Pied Cormorant 37

High tide records for roosts at the southern end of St Helena are as follows (underlined entries are for October, plain are for August):

Black-winged Stilt.....8
Great Egret.....1
Grey Plover 40
Little tern 8
Mongolian Plover.....30
Pied Cormorant.....15

Large Sand Plover.....200	Pied Oystercatcher.....24
Little Egret.....2	Ruddy Turnstone.....45

Ruddy Turnstones, Large Sand Plovers, Mongolian Plovers, Eastern Curlews and Bar-tailed Godwits were all counted at low tide as well as a range of other species. Scan counts from St Helena and Green Island were classified into a different group from those around Fisherman Island (Figure 2) indicating a difference in the mix of species from the two areas (Table 5). There is movement on the falling tide of birds from St Helena to the northern and eastern sides of Green Island. The substrate around Green Island is relatively sandy with scattered patches of broken coral and small areas of muddy substrate. In addition to records from the scan counts the following species were noted during a brief inspection of the western side of Green Island on a falling tide: Chestnut Teal (4), White-faced Heron (4), Great Egret (?), Little Egret (3), Pied Oystercatcher (10), Bar-tailed Godwit (2), Eastern Curlew (9), Sacred Ibis (?).

5.4.3 Wynnum

Two visits were made to parts of the eastern foreshore of Whyte Island and south towards Wynnum. In August, on a rising tide birds roosting in mangroves were counted along this strip of foreshore with the following results:

Chestnut Teal 84	Royal Spoonbill 6
Great Egret.....+	Sacred Ibis.....6
Little Pied Cormorant 90	Striated Heron.....+
Pied Cormorant.....+	White-faced Heron.....5

Furthermore, a scan count was taken on the mudflat out from the "Lytton" roost past the mangroves (site S) and another looking out from Wynnum (site T). The actual counts are given in Appendix A and in the classification analysis site T was grouped with the main grouping of sites around Fisherman Island (ABGMPTY) whereas site S together with Q were considered anomalous (Section 5.3.2).

5.4.4 S-W Fisherman Is. and western side of the River

Formal scan counts were not made in the muddy cove within the block of mangroves in the south west of Fisherman Island. However, feeding activity was quite intense at times in this cove with as many as 23 Sacred Ibis, 6 Black-winged Stilt, 5 Black-tailed Godwit, 20 Bar-tailed Godwit, 30 Red Knot, 50 Great Knot being recorded there on one occasion in October.

On the other side of the mangroves (Pelican Banks) some small gatherings of birds were noted including one large flock of Black-winged Stilts (see Appendix E). The mangroves themselves were not visited but birds were seen in the area from a distance and included flocks of roosting Sacred Ibis.

Feeding of waders on the western side of the Brisbane River was moderately intense

around the foreshores of the entrance cove to Boggy Creek. At times reasonably large flocks in excess of 30 birds were seen moving around and included Sharp-tailed Sandpipers, Bar-tailed Godwits and Black-winged Stilts. A number of other species were noted in the area (see Appendix E) and Pied and Little Pied Cormorants were recorded loafing on the rock walls to the east of Bulwer Island.

6. General Features of the wader community

6.1 Movements

Fisherman Island and the surrounding intertidal flats, are an integral and important part of a complex mosaic of bird habitat that includes areas around Luggage Point, Whyte Island, Lytton, Wynnum, and the western foreshore of the Brisbane River. It is possible that birds using Mud, St Helena and Green Islands also cross between here and Fisherman Island but no movements were noted despite some careful observations. Movement between Mud, St Helena and Green Islands was apparent, especially between the latter two islands.

Perhaps the most significant regular movement to and from Fisherman Island is of birds that feed around Luggage Point and roost on the northern end of Fisherman Island. Flocks of Bar-tailed Godwits, Black-tailed Godwits and Great Knot can be regularly seen moving between these sites before and after high tide. Even though there is roosting behind the mangroves at Luggage Point, the favoured roost site for several species is Fisherman Island.

Birds feeding to the south of the Boat Passage also seek out high tide roosts on Fisherman Island. Flocks of Bar-tailed Godwit, Great Knot and Curlew Sandpiper were noted moving from the staging site on the south side of the Passage (site J) to Fisherman Island (either the claypan or shoreline roost to the north). Birds from the same staging site were seen flying south to either the Lytton roost or beyond. That is, only a proportion of the birds that feed on the northern and eastern sides of Whyte Island, roost on Fisherman Island. The Lytton roost appears to cater for birds that come in from the Wynnum foreshore as well as around Whyte Island. The Lytton roost is at times unsuitable for roosting either because of too little or too much water when, only the birds with longest legs (Godwits and Eastern Curlew) remain at the site. The only alternative at such times may be Fisherman Island but more observations are needed around Lytton to clarify what movements are occurring.

Birds feeding around Fisherman Island tend to roost on the Island. Very little movement was seen away from these feeding areas to more distant roost sites. The most direct movement on and off feeding grounds was noted for Eastern Curlews which come straight off the claypan roost (south-west Fisherman Island) across the mangroves into the "cove" as the tide falls. Similarly, Royal Spoonbills, Sacred Ibis and egrets were

making a similar short journey from roosts at the back of the cove.

6.2 Feeding densities

There is no attempt here to give absolute numbers to birds other than waders. A number of waterbirds were locally very abundant and reference should be made to Section 5.3.4. It is difficult to gauge how many of the waders roosting on Fisherman Island are using the neighbouring feeding areas, rather than those at Luggage Point or Whyte Island. However, of all the species of wader observed, the Eastern Curlew is probably more often feeding and roosting in the vicinity of Fisherman Island.

For scan counts taken out from Fisherman Island in October (sites ABCDEFGHMPQRY, Figure 1) 119 Eastern Curlew were counted and this is undoubtedly an underestimate of the numbers feeding through the intertidal area to the east and south east of Fisherman Island mainly because the deep water seagrass zone (CF) was not sampled fully and many Eastern Curlew were feeding there. At the time, there were over 200 birds on the claypan roosts (Section 5.1.4.1), therefore, 160 birds is chosen as a conservative estimate of the number of Eastern Curlew feeding around Fisherman Island at the time.

For the combined scan counts from the same sites, Eastern Curlews represented 10% of feeding waders. Therefore, the total number of waders is estimated as 10 x 160, or 1,600 birds on the intertidal area to the east and south east of Fisherman Island. Of this total the following species collectively represented about 13% or just over 200 birds: Pied Oystercatcher, Grey Plover, Lesser Golden Plover, Mongolian Plover, Large Sand Plover, Red-capped Plover, Black-winged Stilt, Ruddy Turnstone, Greenshank, Terek Sandpiper, Black-tailed Godwit, Red Knot, Great Knot, Red-necked Stint. Individually, these species were represented by up to 3% of the total, or about 50 birds. The more common species were: Eastern Curlew (160), Whimbrel (96), Grey-tailed Tattler (304), Bar-tailed Godwit (256), Sharp-tailed Sandpiper (496) and Curlew Sandpiper (80).

The numbers of birds are conservative estimates and pronounced seasonal changes in numbers occur (refer to Section 5.3.3). As noted above, the roost sites on Fisherman Island are catering for greater numbers of birds that come in from other feeding areas. Furthermore, there is considerable spatial variation in the type of feeding area around Fisherman Island.

6.3 Habitats

Three distinctly different zones are apparent and each caters for a different mix of species (see Section 5.3.2). The zones include an area towards the back of the large cove to the east of Fisherman Island which is particularly muddy and lacks seagrass. On either side of this zone and extending right out beyond the south eastern corner of Fisherman Island is the most widespread type of feeding area around Fisherman Island which is mostly exposed at low tide and includes a mix of seagrass with smaller patches of sandier

substrate. Finally, fringing this zone to the east and north are seagrass beds that are less often exposed at low tide but are nevertheless feed upon by larger species including Eastern Curlews.

The mangroves of Fisherman Island are still quite extensive and not only offer protection for birds roosting behind them on claypans, but cater for a diverse forest bird fauna and act as roosts for a range of waders, waterbirds and seabirds.

The roost sites, the claypan where many birds feed, and to a lesser extent, the thickly grassed areas on Fisherman Island, all represent significant resources that help to sustain a wide range of species and for some, a locally abundant population.

6.4 Significance of the area

The study area is of local and even regional significance to birdlife. In the most recent proposals for a Moreton Bay Strategy Plan (Qld Govt, 1991), the eastern part of Fisherman Island and neighbouring seagrass areas are included in a "Habitat Protection" zone which is acknowledgement that the area has biological significance. This is explained in terms of seagrass beds and mangroves but no specific reference is made to the birdlife. The "Habitat Protection" zoning would not necessitate complete protection but rather suitable controls over recreational, commercial and extractive uses to prevent further habitat losses. Directly alongside this area and over the remainder of Fisherman Island the primary activity is designated as "Port and Industrial".

The proximity of the proposed "Habitat Protection" and "Port and Industrial" zoning on Fisherman Island raises special management issues. There is either direct overlap or little buffering between areas that are intensively used by birdlife and areas that are planned for port facilities. There are many other management issues in relation to the study area but reconciling the current use of the Island by birds with future developments is especially critical.

Appendix F gives a summary of work undertaken by Thompson and Kikkawa for the Dept of Heritage and Environment over the last few years documenting details of the use of Moreton Bay foreshores by waders. Their assessment of mainland roost sites led to speculation that the loss of roosting habitat through foreshore development has created fragmentation of what were once much larger roosts into smaller, scattered collections of birds that are more susceptible to disturbance (Thompson and Kikkawa 1988). It is likely that this progressive loss of amenity for roosting by birds has caused a decrease in the use of feeding grounds.

The bird roosts on Fisherman Island cater for significant numbers of birds, as many as any site on the mainland foreshore of Moreton Bay. Thompson and Kikkawa (1988) list Deception Bay, Hay's Inlet, Nudgee, Luggage Point, Thornside, Oyster Point and Lytton

as roosting areas for waders. At the time, they had no knowledge of the Fisherman Island roost sites but my experience of these other areas is that they mostly cater for fewer birds than Fisherman Island.

The species of wader that are common on the feeding grounds around Fisherman Island are not necessarily common in other parts of Moreton Bay. Thompson and Kikkawa (1989) note that areas of very muddy substrates along the mainland shore are preferred by species that are much less common in central Moreton Bay. Species such as the Terek Sandpiper, Marsh Sandpiper, Sharp-tailed Sandpiper, Black-tailed Godwit, Black-winged Stilt and Lesser Golden Plover are absent or rarely seen in the North Stradbroke and Moreton Island feeding areas. The same species occurred regularly around Fisherman Island. In particular, Marsh Sandpipers and Black-tailed Godwits are generally uncommon in Moreton Bay but were regularly recorded on or around Fisherman Island. Furthermore, the high density of the Sharp-tailed Sandpiper at Fisherman Island is unmatched elsewhere in the Bay. It was regularly recorded as one of the five most abundant species in scan counts yet in a survey of 13 sites throughout the mainland shore of Moreton Bay by a team of people over one weekend (Thompson 1990) only 121 Sharp-tailed Sandpipers were counted out of 16,895 birds. The Fisherman Island area was not included in the count. The species does occur at Luggage Point in patches at reasonable density but Fisherman Island appears to represent a major concentration of this particular migratory species.

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Appendix A. Scan counts of all species recorded during low-tide surveys around Fisherman Island in winter (cols. a-k), spring (cols. A-Y) and summer (cols. 1-11). The locations where counts were taken are shown in Figure 1. The sampling effort for each count is not standardised and the data are most appropriate as the basis of other tables of selected species showing the percentage contribution of species to totals for each count. (see Tables 5 and Figures 3 and 4.). Species marked with an asterisk are those used in the classification analyses in Sections 5.3.1 and 5.3.2.

Species	a	b	c	d	e	f	g	h	i	j	k	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	1	2	3	4	5	6	7	8	9	10	11	Tot
Australian Pelican									1	1							1				2																4			11										20
Darter																									6																								6
Pied Cormorant																	1																				1												2
Little Pied Cormorant	3		9		1			4								1																	2	1		1	1	2	1			2						28
White-faced Heron	4	1	6		4	3	14	38	29	51	10	8	4	30		1	6	6	3			4	9	4						2			1	3		10	8	3	4	2	10	15	6	1			300
Great Egret									16	5	1						2																			17			2		1							44
Little Egret										2	1															1		1	2					1							1	2						11
Striated Heron																															1																1
Sacred Ibis	2	2	17		14			38	29	144	68	51	9	2	3	1	2	19	1	1	11		19	25										2	1					6				1			468
Royal Spoonbill									104	5			6		1		2									2			2	2										4	25			1				154
Chestnut Teal	6		17		27			5	9	85	34	6			6	1				24				1				6		2	9																238
Osprey							1																																									1
Brahminy Kite									3	1																																						4
Pied Oystercatcher *			1		8	2	5	4				4			2	9		2	10					1								3	3	2	1	6		10	7			1	5				86
Grey Plover *												5	1		1	1		3	6	15	9	4	2	7	11																						65
Lesser Golden Plover *					2	10							1									2	1	2										1	3		7	2			6	8						45
Mongolian Plover *	1		8									1								1				1	4	6						2											1					25
Large Sand Plover *			1									2	4					1	1	2	8			4	4	1						3	3	1	2	7			1			18		4	2	3	5	77
Red-capped Plover *																				2	2				8																								12
Black-winged Stilt *			40	2						126										4	1	1			9		2	5	7	3											12							212
Red-necked Avocet																									15																								15
Ruddy Turnstone *																									1						2	10	12		1	2											28
Eastern Curlew *	1	8	16	3	9	1	17	37	34	77	25	22	10	33	1	1	18	3	5		2	9	5	9	2	11	1	3	11	4	1	1	18	1	3	1	3	22	5	8	7	60	21	10	16	3	1	559
Whimbrel *			1				8	8	2	12	1	21	10	2			3	2	18		6	3	4	6	1	3	3	3	5	7	1	2	19	2	21	1		3	1	8	2	3	34	10	4	4	3	247
Grey-tailed Tattler *						9	1	10			13	72	31	5	7	11	2	14	19		6	12		26	1	2	6			6	54	13	8	8	3	29		20	22	6	64		61	51	5	10	8	615
Common Sandpiper																																	1															1
Greenshank *					1	1		2	1			5	3	3	1	1	1	1	1			2		4			1	3		2	2		1		2			1			11	4		4	3	1	3	65
Marsh Sandpiper																																											2						2
Terek Sandpiper *													6								5			1		12		1	1			1	5					1		2	30			10	8		83
Black-tailed Godwit *																					8			2		13			5														9		1		38
Bar-tailed Godwit *			23	2	7	2	2	8			19	34	25	15	20	6	2	9	13	30	51	7	6	13	1	27	3	18	14	12	20	29	39	10		19		8	18	33	51	46	15	16	34	24	2	733
Red Knot *															4	5			1	25	29			3	4	5						2															78
Great Knot *													7		1					36	2					1						2				2						1					52
Sharp-tailed Sandpiper *												45	36		35	68	5	24	59	1	11	8	2	22		23	17	11	22	3	15	5		1	26			2			12	19	26		2	10	510
Red-necked Stint *															2	4				1					7								1											6			11	32
Curlew Sandpiper *												1			5	3		1	1	61	26			1	10	56		1	36	1		2			5			2	3	22	13	2	1	3	4		260
Silver Gull			1				10	5		1	4		1			1	3			1	2				8					12	1				7	1	1	4	3	3	1						70
Gull-billed Tern														2																		1								1	1			1				6
Caspian Tern			2					2			3						1								3								2				1											14
Little Tern												12			2	2					3												2			4		12	4	3	1							45
Crested Tern								1		2	2														6							1	2	4			4											22
Collared Kingfisher			2		4			5		7	3		1																2	1																		25
Totals	17	11	144	7	77	28	96	158	343	443	167	253	142	94	88	117	66	67	138	214	173	71	54	107	77	187	31	49	105	47	122	78	116	34	40	105	43	82	83	84	178	242	177	160	80	61	43	5299

Appendix B. The percentage contribution of species of waders to the total scan counts of waders recorded during low-tide surveys around Fisherman Island in winter (col. a-k), spring (cols. A-Y) and summer (cols. 1-11). The locations where counts were taken are shown in Figure 1. The data are derived from the raw counts given in Appendix A and used in the pattern analysis reported in Section 5.3.1. Three additional species of wader were recorded during the scan counts (see Appendix A) but have been omitted from the table and the pattern analysis because they were recorded for only one scan count. A "+" indicates the percentage value was less than 0.5% but greater than 0%. The last two rows are the site totals from the percentages were calculated for each species.

Species	a	b	c	d	e	f	g	h	i	j	k	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	1	2	3	4	5	6	7	8	9	10	11	Tot
Pied Oystercatcher			1		30	8	15	6				2			3	8		3	7				1								4	3	8	3	6		14	11				1	3					2
Grey Plover												2	1		1	1		5	4	8	5	8	10	7	20																								2
Lesser Golden Plover					7	40							1									4	5	2										3	3		10	3				4	5					1
Mongolian Plover	50		9									+								1				1	7	4					3											1					1
Large Sand Plover			1									1	3					2	1	1	5			4	7	1					4	3	4	6	7			2			9		3	3	5	12	2
Red-capped Plover																				1	1				15																							+
Black-winged Stilt			44	29						59										2	1	2				5		5	5	17	3									6							6
Ruddy Turnstone																									2						2	13	11		3	2											1
Eastern Curlew	50	100	18	43	33	4	52	54	92	36	43	10	7	57	1	1	58	5	4		1	19	25	9	4	7	3	7	11	10	1	1	17	4	9	1100	31	8	14	4	30	13	7	21	5	2	15
Whimbrel			1				24	12	5	6	2	10	7	3			10	3	13		4	6	20	6	2	2	10	7	5	17	1	3	17	8	60	1	4	2	14	1	2	21	7	5	7	7	6
Grey-tailed Tattler						36	3	14			22	34	23	9	9	10	6	23	14		4	25		25	2	1	19			14	55	17	7	33	9	29		28	36	10	40		38	34	6	17	19	16
Greenshank					4	4		3	3			2	2	5	1	1	3	2	1			4		4			3	7		5	2		1		6		1			7	2		3	4	2	7	2
Terek Sandpiper													4							3				1		7		2	1			1	5					2		1	15			13	13		2
Black-tailed Godwit																				5				2		8			5														6		2		1
Bar-tailed Godwit			26	29	26	8	6	12			33	16	19	26	25	6	6	15	10	17	31	15	30	13	2	16	10	43	14	29	20	39	36	42		19		11	30	57	32	23	9	11	44	40	5	19
Red Knot															5	5			1	14	17			3	7	3						3															2
Great Knot													5		1					20	1					1						3				2							1				1
Sharp-tailed Sandpiper												21	27		44	62	16	40	44	1	7	17	10	22		14	55	26	22	7	15	7			3	26			3			6	12	17		3	23	13
Red-necked Stint															3	4				1					13								1											4			26	1
Curlew Sandpiper												+			6	3		2	1	34	16			1	19	33		2	36	2		3			5			3	5	14	7	1	1	4	7		7
Totals	2		90		27		33		37		58	134			79		31	134		166		20		54		31		99		98		109		35		3	61		159		159		77		43	
		8		7		25		69		215		212		58		109		60		178		48		102		169		42		42		75		24		101		71		58		198		152		60		3822

Appendix C. Raw scan counts of all species for different areas and the 3 different sampling times, August, October and January. The total columns give the species totals of a summation across all locations within each sampling period. The areas referred to are indicated on Figure 1 and have the following codes (see also Appendix D):

? - area sampling only in August on North side of the Boat Passage (sites a,b,c - App. A)
MAIN - area defined from the classification analysis (Section 5.3.2) by group "ABGMPTY"
SEAG - area defined from the classification analysis (Section 5.3.2) by group "CF"
SAND - area defined from the classification analysis (Section 5.3.2) by group "QS"
MIX - area defined from the classification analysis (Section 5.3.2) by group "KL"
COVE - area defined from the classification analysis (Section 5.3.2) by group "R"
STAG - area defined from the classification analysis (Section 5.3.2) by group "J"

	?	MAIN			SEAG			SAND		MIX		COVE		STAG		Tot.			
	Aug	Aug	Oct	Jan	Aug	Oct	Jan	Oct	Jan	Oct	Jan	Oct	Jan	Aug	Oct	AUG	OCT	JAN	Tot
Australian Pelican					2	1	4			11					2	2	3	15	20
Darter																	1	1	2
Pied Cormorant						1	1												
Little Pied Cormorant	3	5		5			1			1				9		17		7	24
White-faced Heron	5	59	24	32	90	36	10		13	6		11	6			160	73	59	292
Great Egret					22	2	17			2		1				22	2	20	44
Little Egret				2	3			1			2	1				3	3	3	9
Striated Heron			1														1		1
Sacred Ibis	4	81	12		263	22			44	6		1	17			365	78	7	450
Royal Spoonbill			6		109	3		2		4	2	26				109	13	30	152
Chestnut Teal	6	32	16		128			8					17			183	24		207
Osprey		1														1			1
Brahminy Kite					4											4			4
Pied Oystercatcher		19	13	23									1			20	13	23	56
Grey Plover			16						6						9		31		31
Lesser Golden Plover		12	6	23					3							12	9	23	44
Mongolian Plover	1		2	1									8			9	2	1	12
Large Sand Plover			18	5				5				23	1	8		1	26	33	60
Red-capped Plover														2			2		2
Black-winged Stilt	2		3		126			9		1		5	12	40	1	168	19	12	199
Red-necked Avocet																			
Ruddy Turnstone			4														4		4
Eastern Curlew	12	64	47	58	136	51	3	7	1	14	15	11	79	16	2	228	132	156	516
Whimbrel		16	44	48	15	5		10	3	7	10	5	11	1	6	32	77	72	181
Grey-tailed Tattler		20	232	154	13	7		6	8	12	70		15		6	33	263	247	543
Greenshank		4	16	5	1	4		5	3	2	11		8			5	27	27	59
Marsh Sandpiper													2					2	2
Terek Sandpiper			7	1				1			2	1	48		5		14	51	65
Black-tailed Godwit			2	9								5	1		8		15	10	25
Bar-tailed Godwit	2	19	123	57	19	17		30	2	13	84	14	104	23	51	63	248	247	558
Red Knot			3												29		32		32
Great Knot			9	1											2		11	1	12
Sharp-tailed Sandpiper			185	47		5		14	10	10		22	14		11		247	71	318
Red-necked Stint				6					11									17	17
Curlew Sandpiper			8	5				2			25	36	20		26		72	50	122
Silver Gull		15	13	3	5	3	7				7		3	1	2	21	18	20	59
Gull-billed Tern						2					1		2				2	3	5
Caspian Tern		2		1	3	1								2		7	1	1	9
Little Tern			16	12							7		1		3		19	20	39
Crested Tern		1		4	4											5		4	9
Collared Kingfisher		9	1		10			1				2		2		21	4		25
Totals	35		827		953		43		43	262		383		173		1486			4210
		359		502		160		96		125		105		144		1491		1233	

Appendix D. Percentage contribution to scan counts of species of wader for different areas and the 3 different sampling times, August, October and January. The total columns give the percentage contribution values for a summation across all locations within each sampling period. The areas referred to are indicated on Figure 1 and have the following codes:

? - area sampling only in August on North side of the Boat Passage (sites a,b,c - App. A)
MAIN - area defined from the classification analysis (Section 5.3.2) by group "ABGMPTY"
SEAG - area defined from the classification analysis (Section 5.3.2) by group "CF"
SAND - area defined from the classification analysis (Section 5.3.2) by group "QS"
MIX - area defined from the classification analysis (Section 5.3.2) by group "KL"
COVE - area defined from the classification analysis (Section 5.3.2) by group "R"
STAG - area defined from the classification analysis (Section 5.3.2) by group "J"

	?	MAIN			SEAG			SAND		MIX		COVE		STAG		Tot.			
	Aug	Aug	Oct	Jan	Aug	Oct	Jan	Oct	Jan	Oct	Jan	Oct	Jan	Aug	Oct	AUG	OCT	JAN	Tot
Pied Oystercatcher		12	2	5										1		4	1	2	2
Grey Plover			2							9					5		2		1
Lesser Golden Plover		8	1	5						4						2	1	2	2
Mongolian Plover	6		+	+										9		2	+	+	+
Large Sand Plover			2	1				12				7		1	5	+	2	3	2
Red-capped Plover															1		+		+
Black-winged Stilt	12		+		41			11		1		5	4	44	1	29	2	1	7
Red-necked Avocet																	+		+
Ruddy Turnstone			1																
Eastern Curlew	71	42	6	13	44	57	100	8	2	21	7	11	23	18	1	40	11	15	18
Whimbrel		10	6	11	5	6		12	7	10	5	5	3	1	4	6	6	7	6
Grey-tailed Tattler		13	31	35	4	8		7	19	18	32		4		4	6	21	24	19
Greenshank		3	2	1	+	4		6	7	3	5		2			1	2	3	2
Marsh Sandpiper													1					+	+
Terek Sandpiper			1	+				1			1	1	14		3		1	5	2
Black-tailed Godwit			+	2								5	+		5		1	1	1
Bar-tailed Godwit	12	12	17	13	6	19		36	5	19	39	14	31	26	31	11	20	24	20
Red Knot			+												17		3		1
Great Knot			1	+											1		1	+	+
Sharp-tailed Sandpiper			25	11		6		17	23	15		22	4		7		20	7	11
Red-necked Stint				1					26									2	1
Curlew Sandpiper			1	1				2			12	36	6		16		6	5	4
Totals	17		738		310		3		43		217		337		166		1244		2858
		154		443		89		84		68		99		90		571		1043	

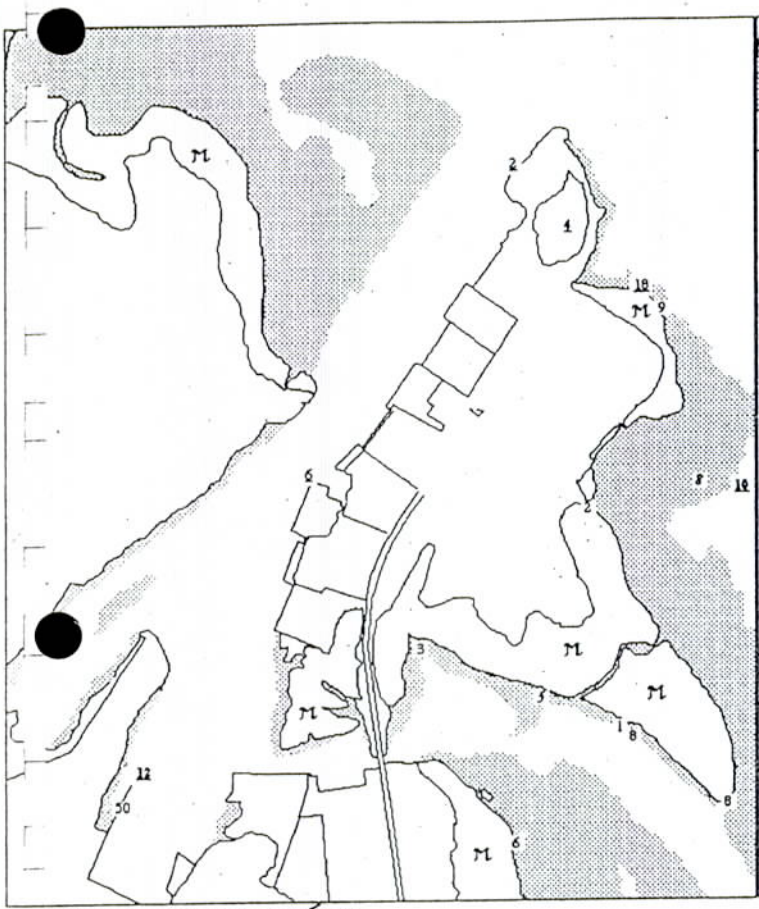
Appendix E

The maps to follow are for miscellaneous sightings of a selection of birds that were recorded during the 3 periods of fieldwork at Fisherman Island. Numbers on the maps are for the number of birds seen at each location and the text style indicates the time the record was made, i.e. plain for August, underlined for October and italic for January. The information being mapped was mostly recorded at mid to high tide levels. Low tide records are given in bold.

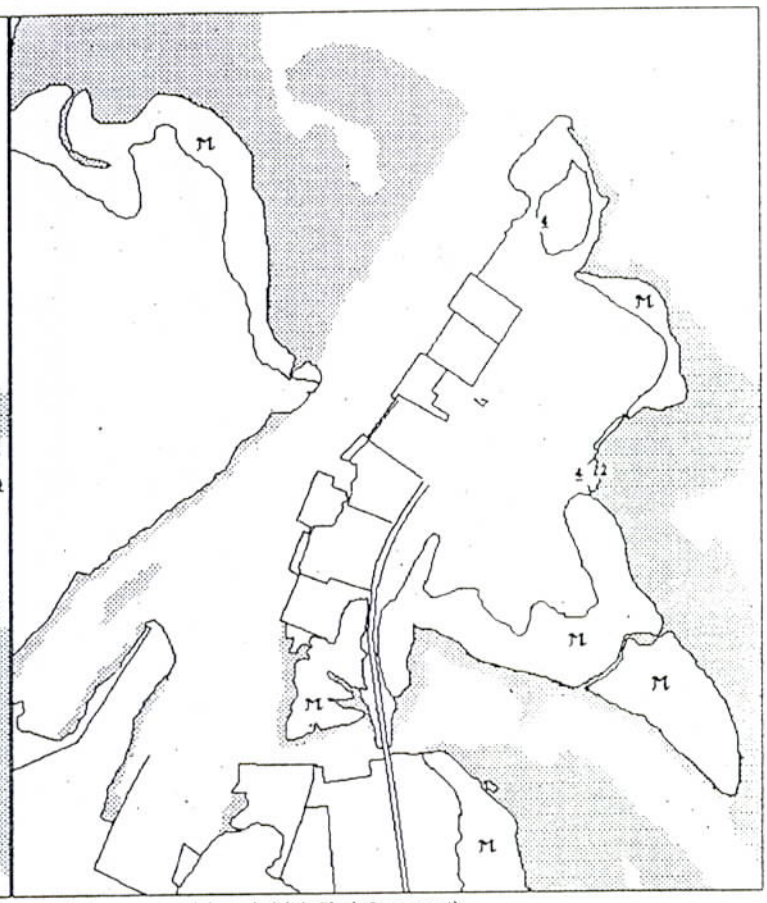
Not all species are represented (see Table 1 for complete list) because for many there were only a few records e.g. White-breasted Sea-eagle, or because this style of presentation was inappropriate, e.g. mangrove birds such as the Collared Kingfisher. Also, the maps do not represent all the observations made of a species and reference should be made to sections in the report dealing with systematic sampling (roost counts, scan counts and transect counts) and to data that was collected outside the range of the maps, e.g. St Helena and Mud Islands. The base map is the same as in Figure 1, i.e. intertidal feeding areas are grey and "M" indicates mangroves.

Pelecanus conspicillatus (Australian Pelican)

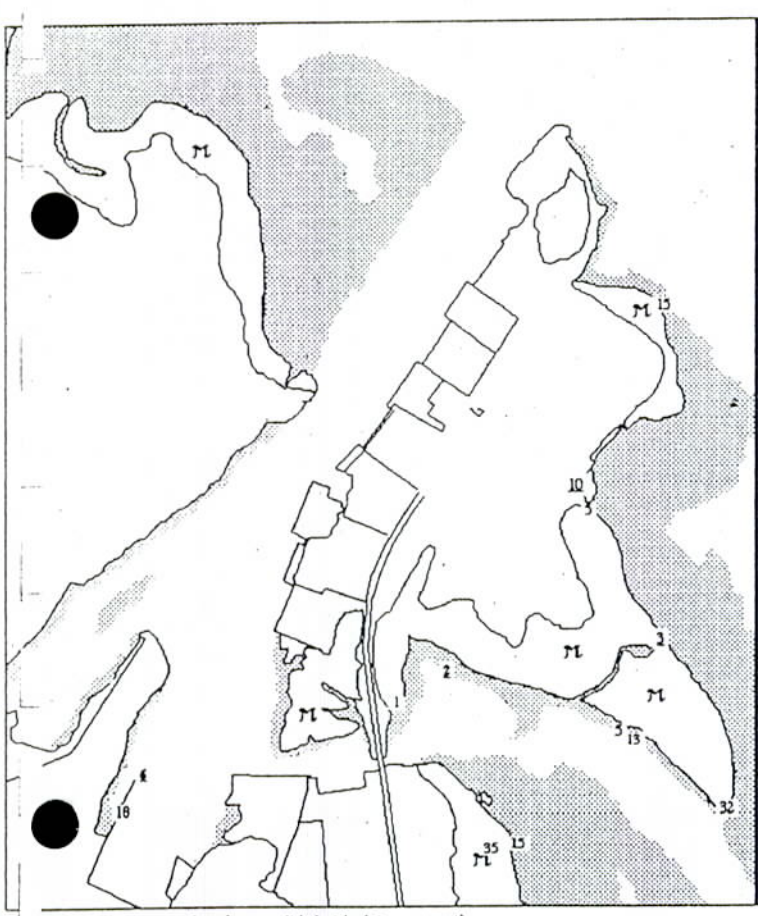
Anhinga melanogaster (Darter)



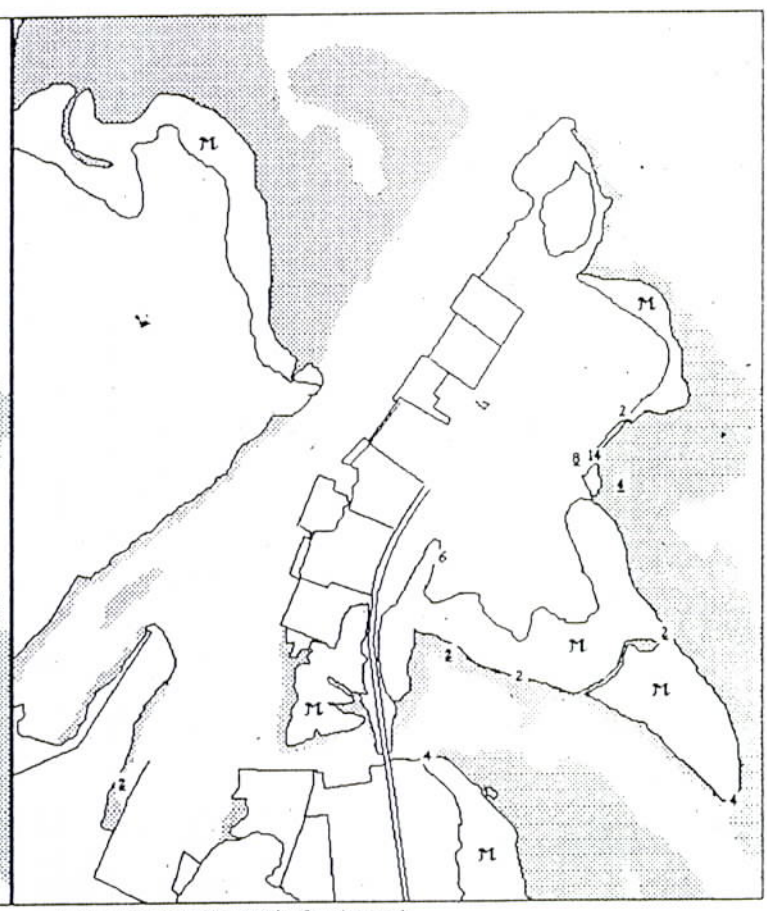
Phalacrocorax varius (Pied Cormorant)



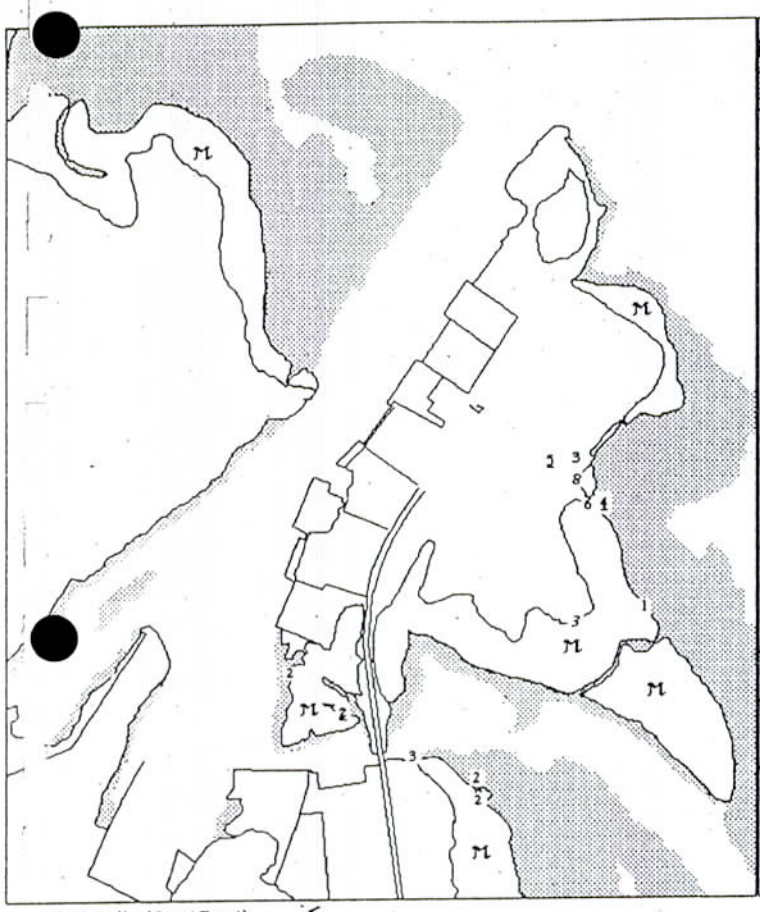
Phalacrocorax sulcirostris (Little Black Cormorant)



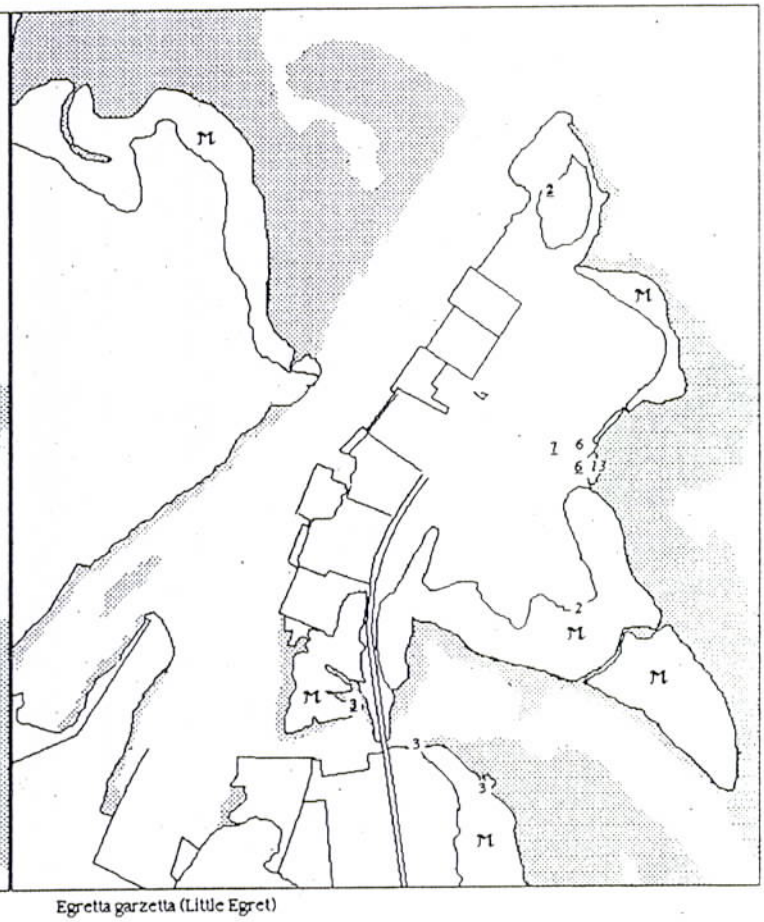
Phalacrocorax melanoleucos (Little Pied Cormorant)



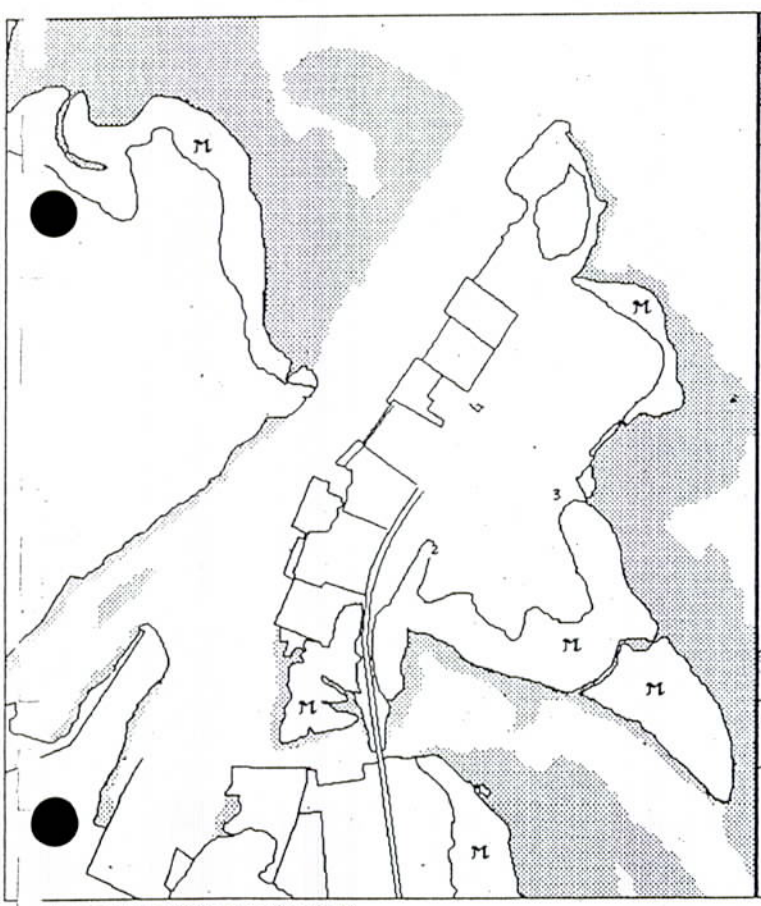
Ardea novaehollandiae (White-faced Heron)



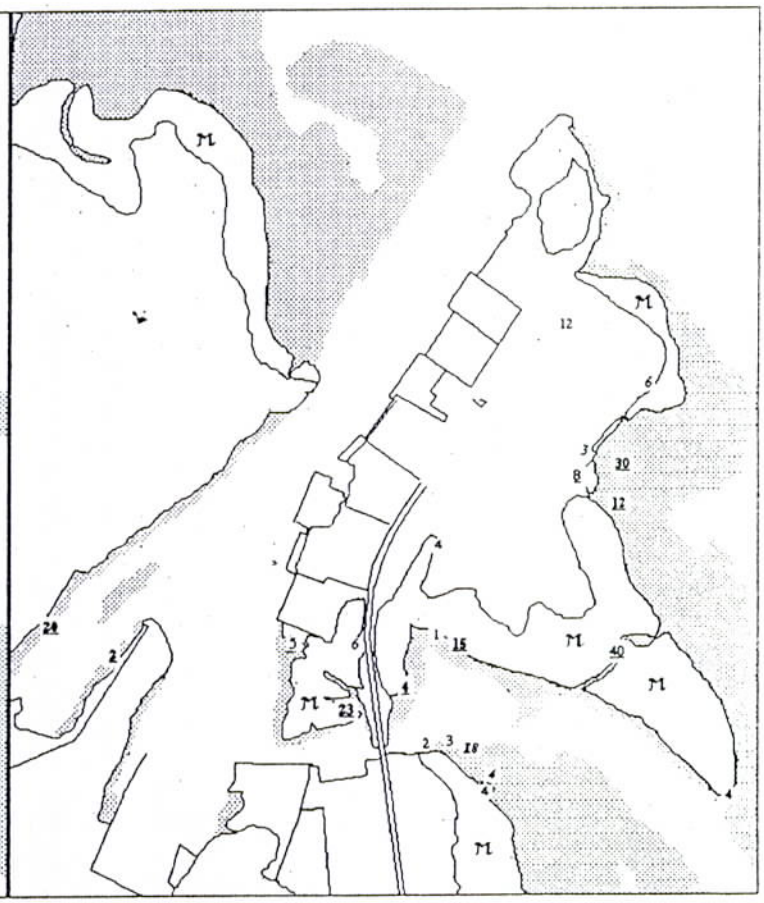
Egretta alba (Great Egret)



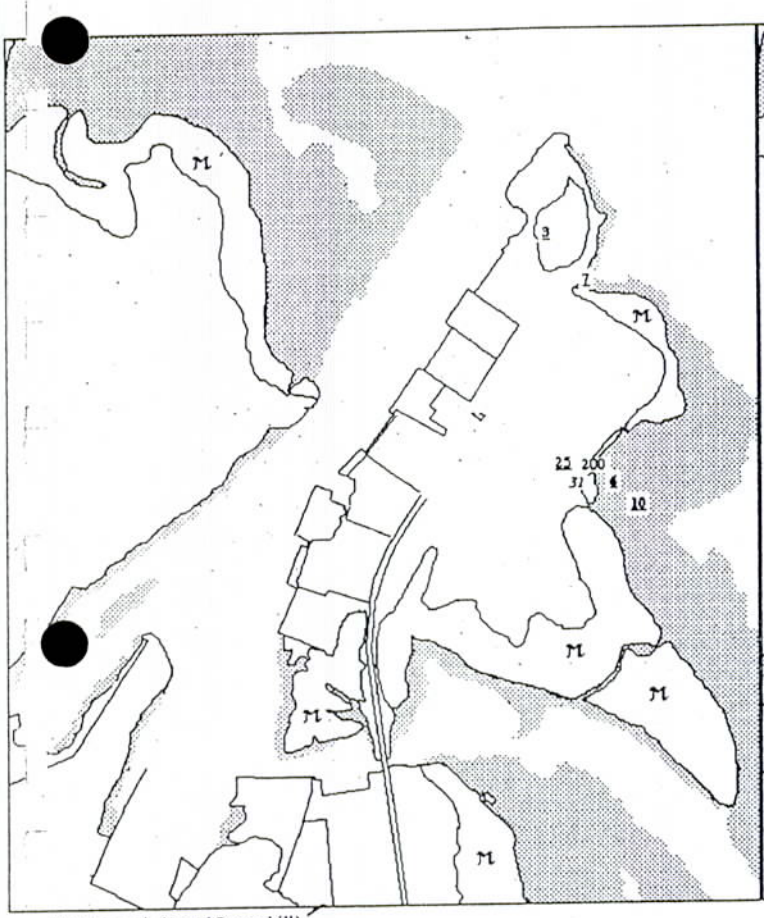
Egretta garzetta (Little Egret)



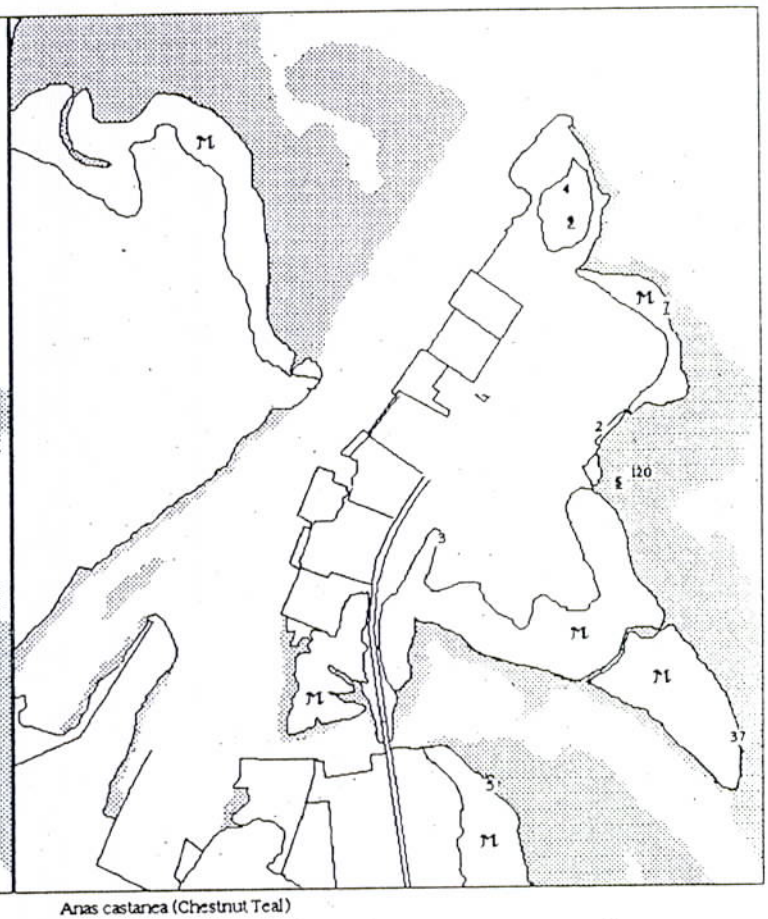
Egretta intermedia (Intermediate Egret)



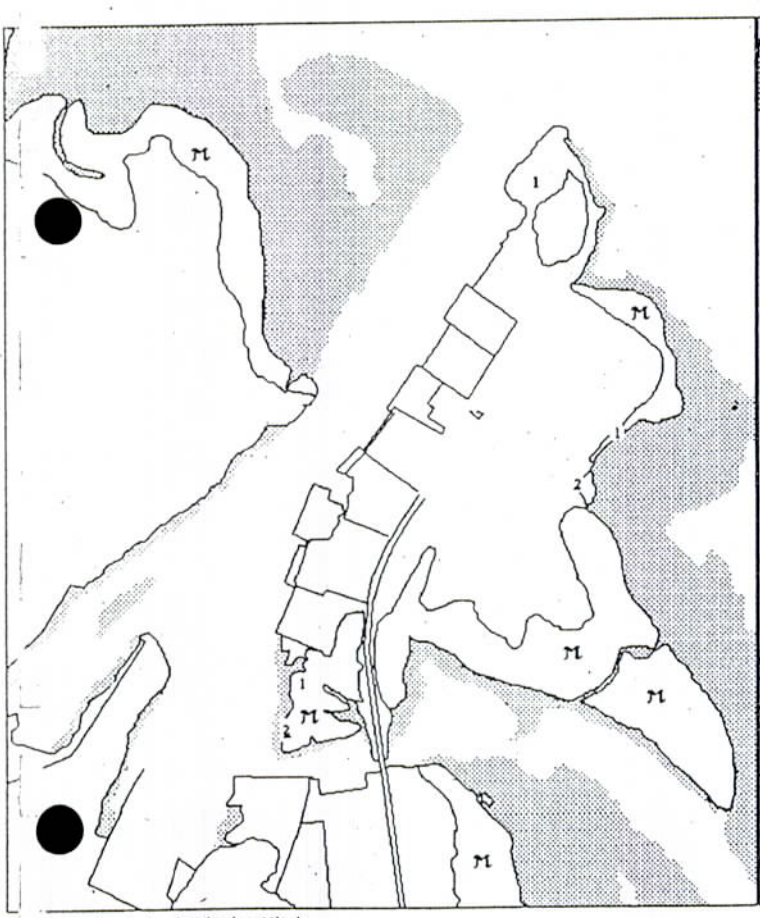
Threskiornis aethiopica (Sacred Ibis)



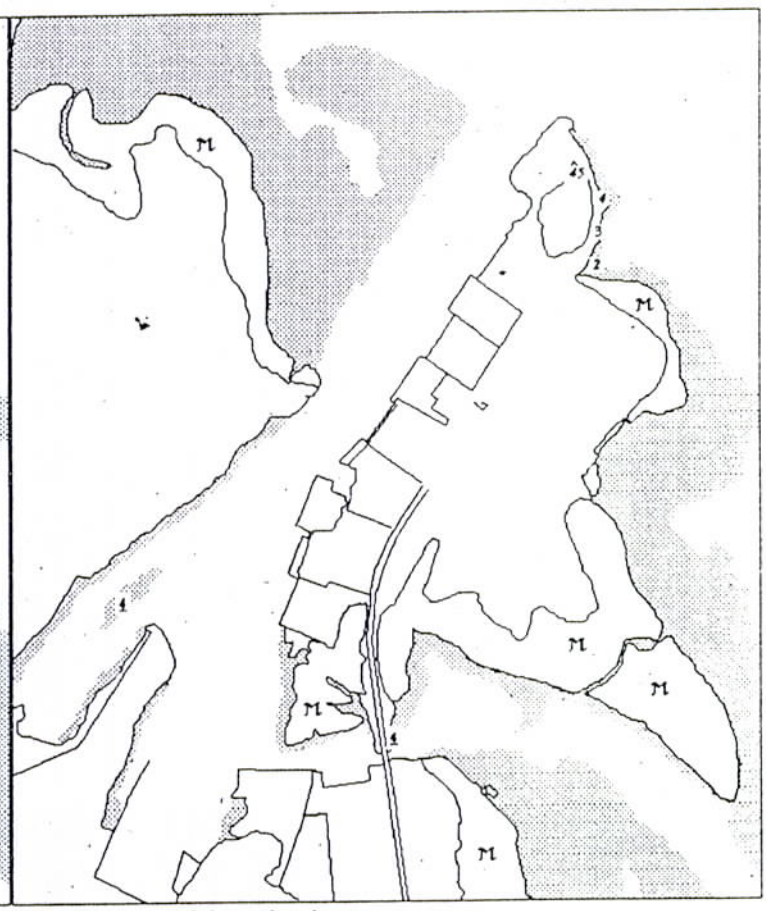
Platalea regia (Royal Spoonbill)



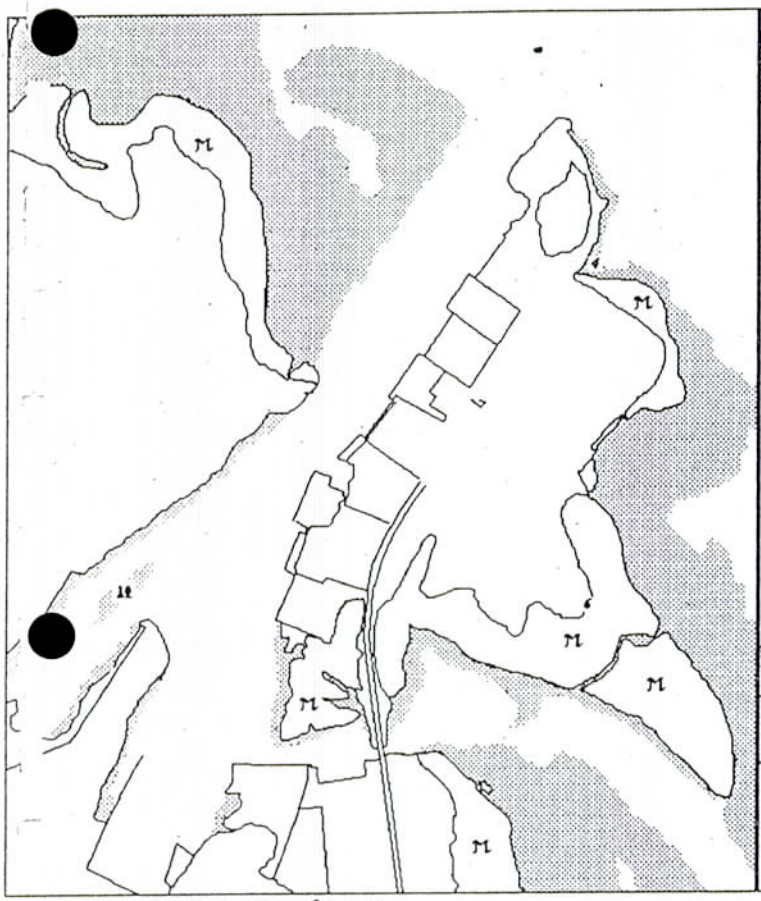
Anas castanea (Chestnut Teal)



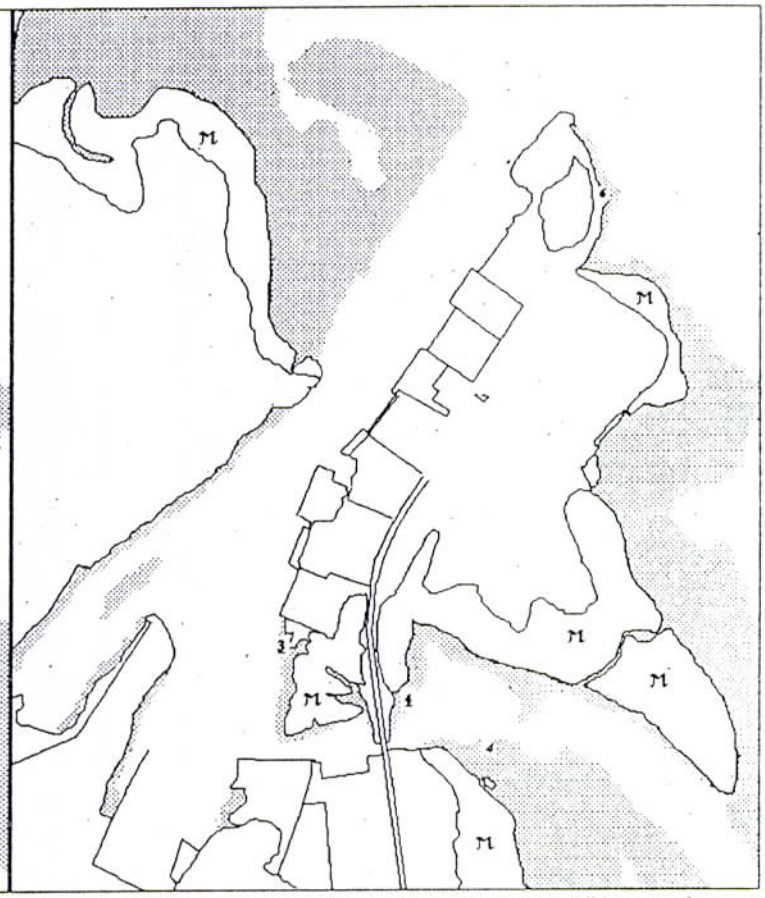
Haliastur indus (Brahminy Kite)



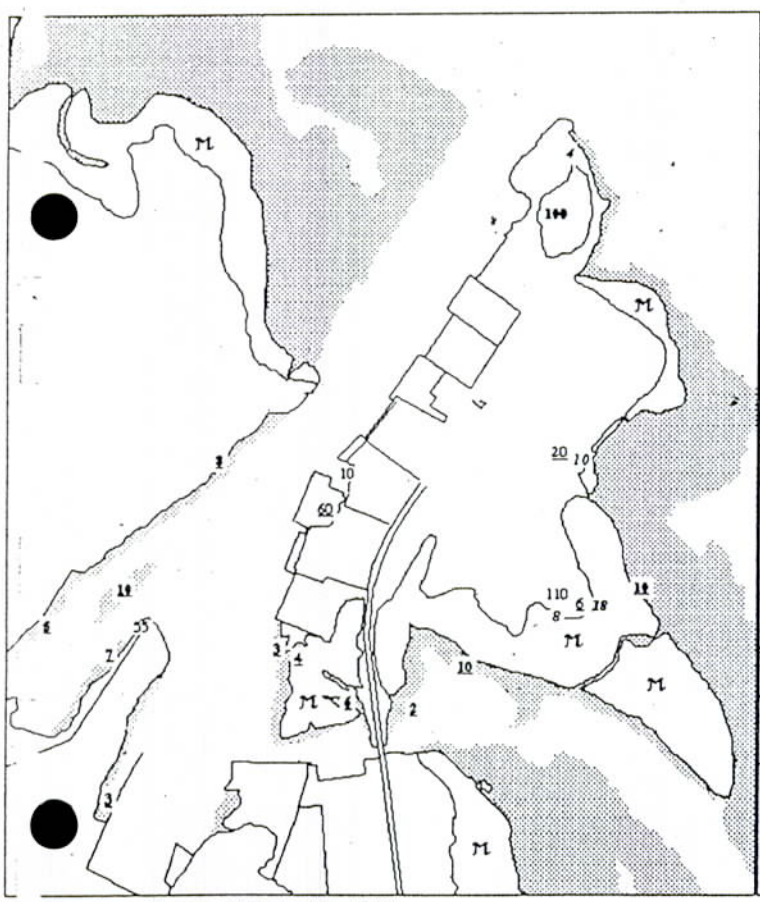
Pluvialis squatarola (Grey Plover)



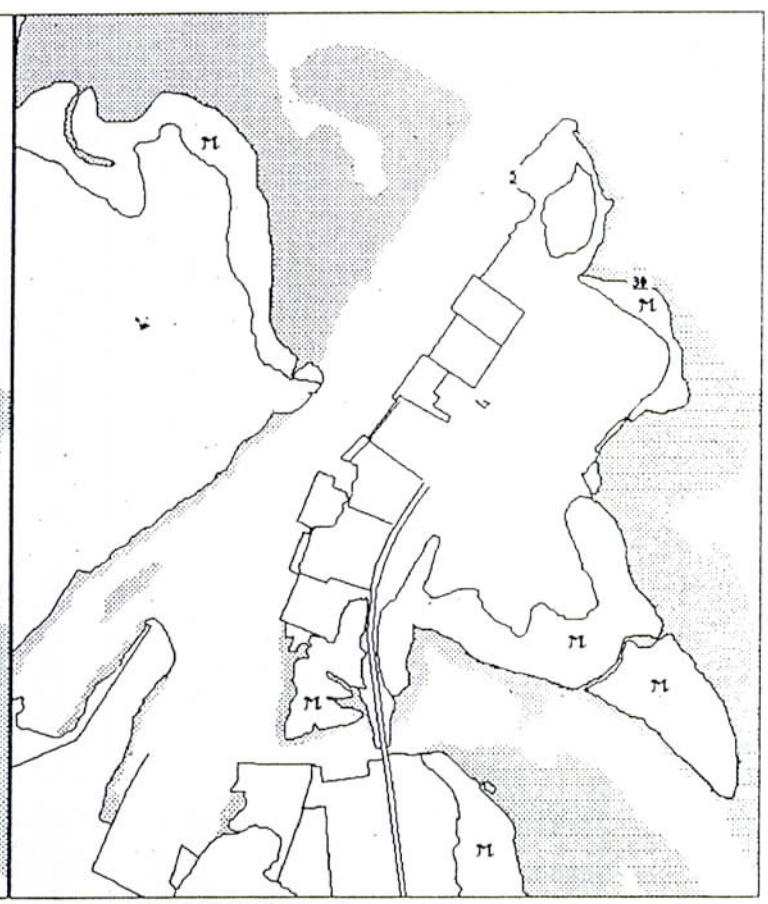
Pluvialis dominica (Lesser Golden Plover)



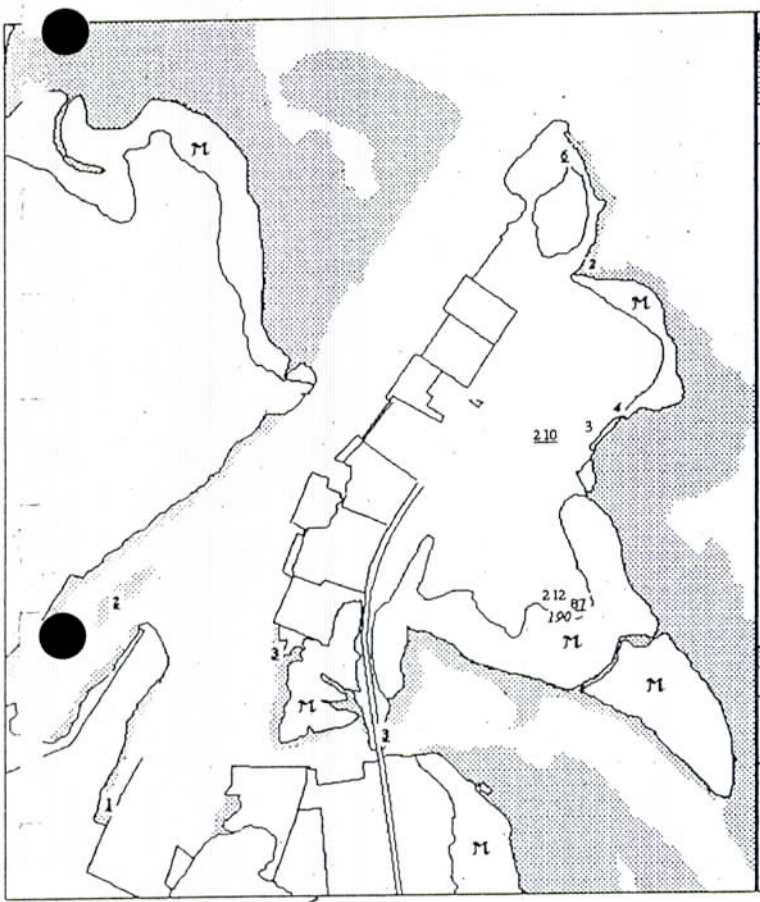
Charadrius mongolus (Mongolian Plover) or Charadrius leschenaultii (Large Sand Plover)



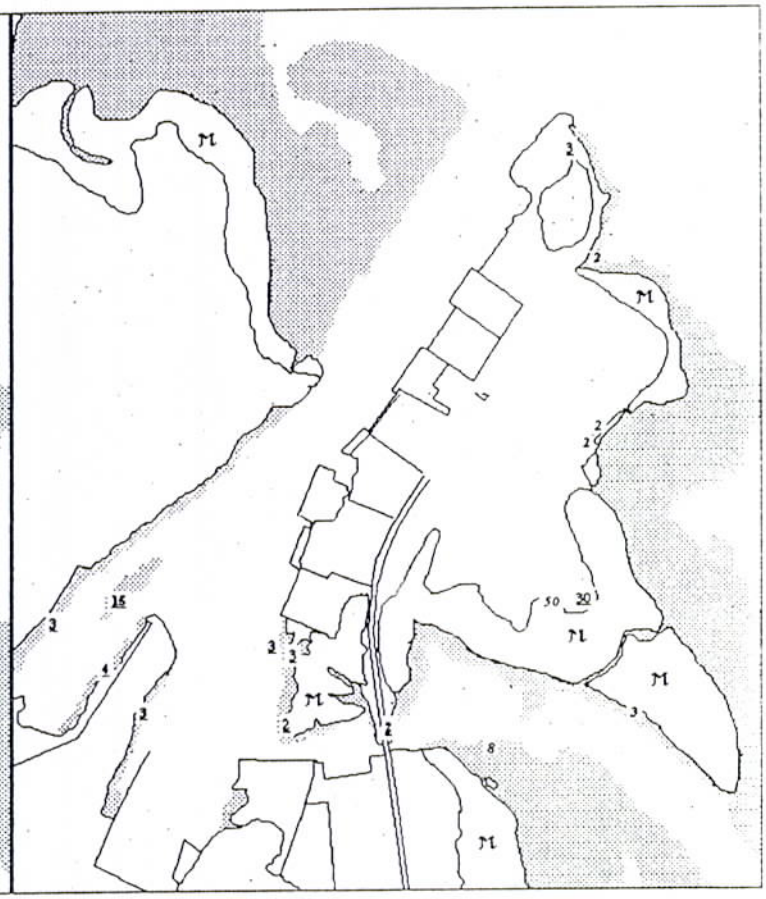
Himantopus himantopus (Black-winged Stilt)



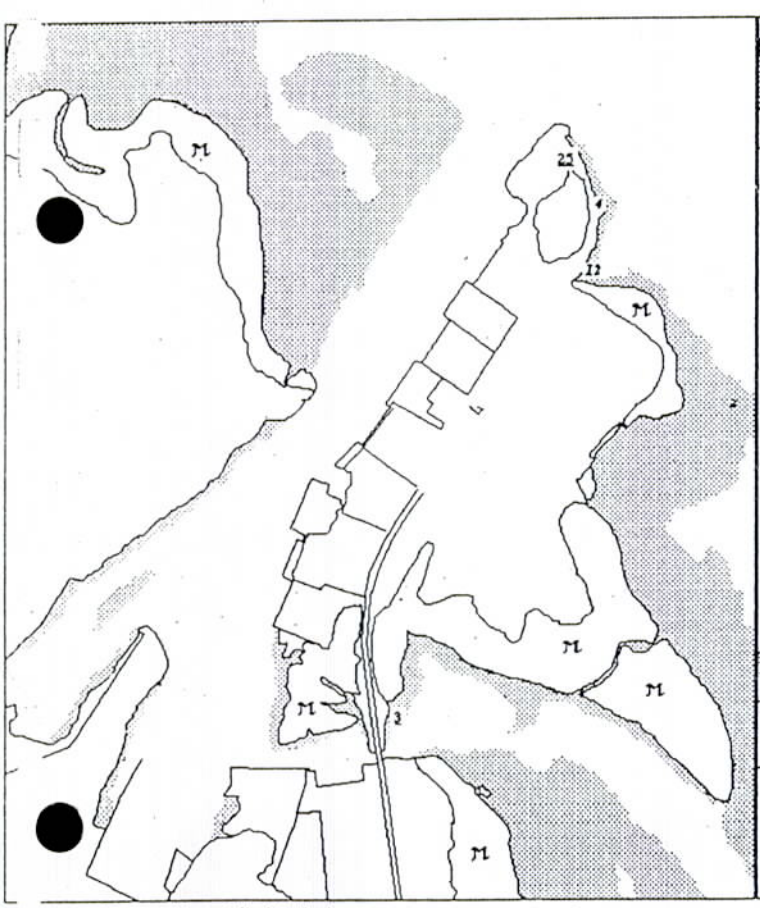
Arenaria interpres (Ruddy Turnstone)



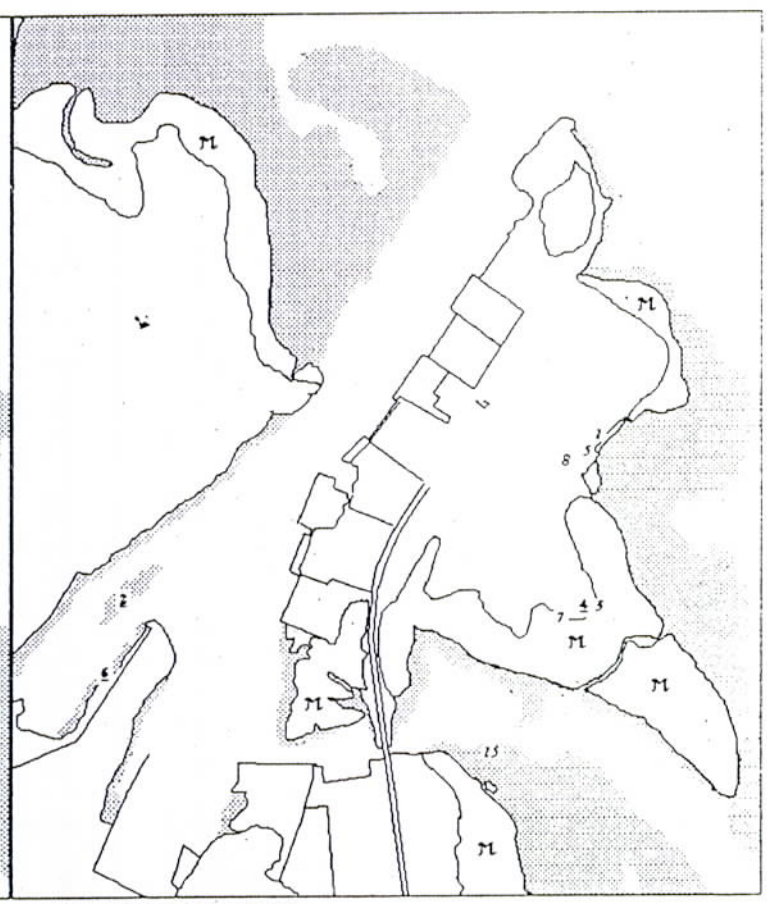
Numenius madagascariensis (Eastern Curlew)



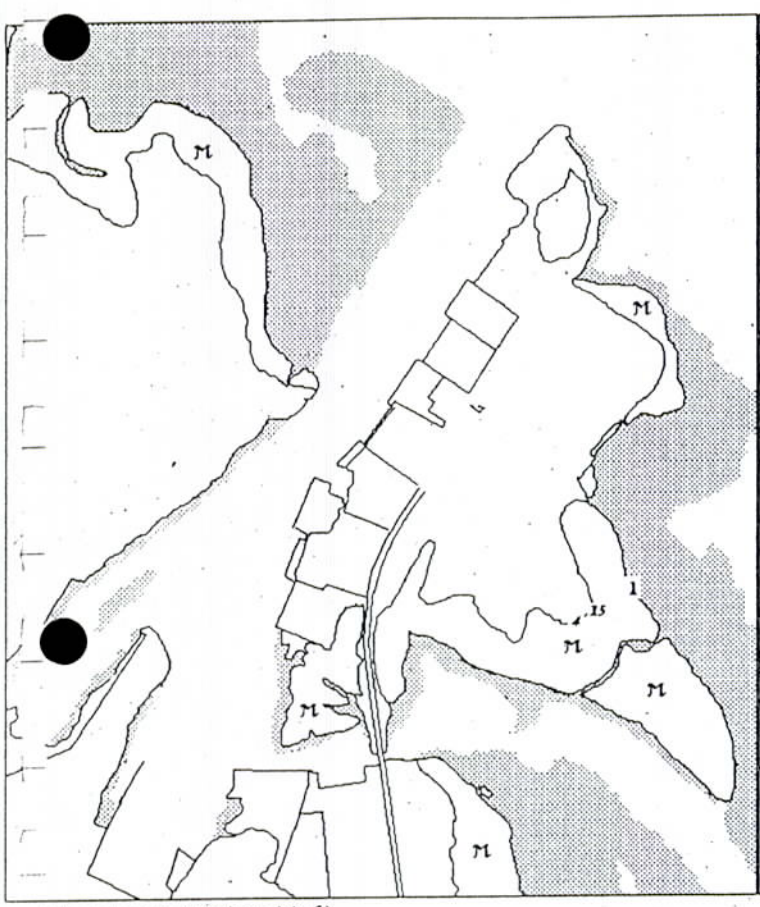
Numenius phaeopus (Whimbrel)



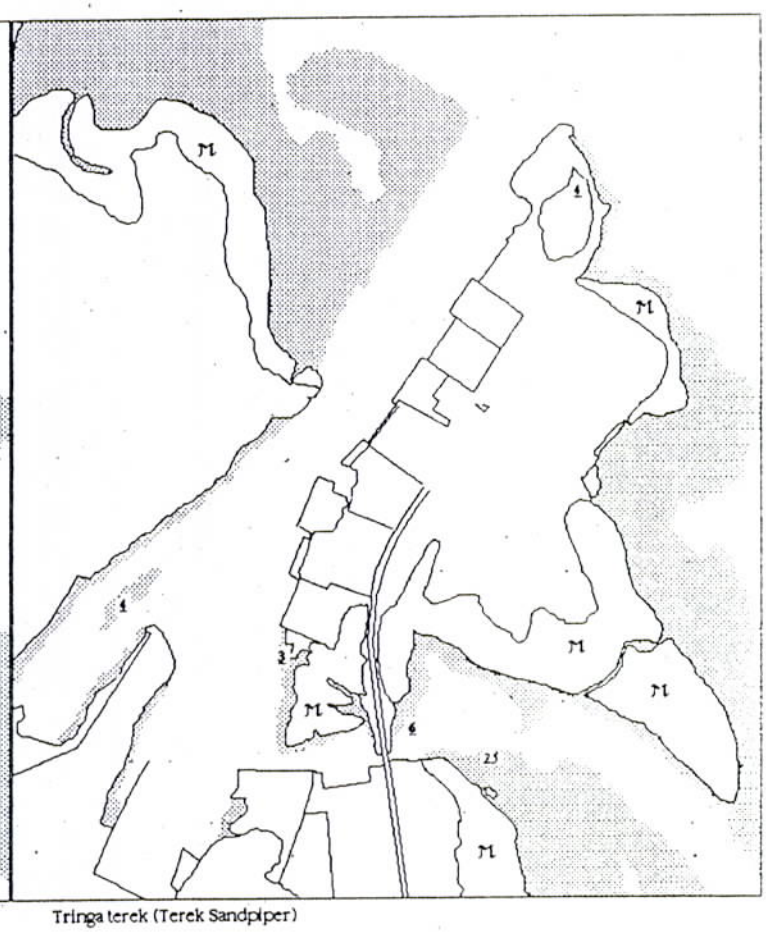
Tringa brevipes (Grey-tailed Tattler)



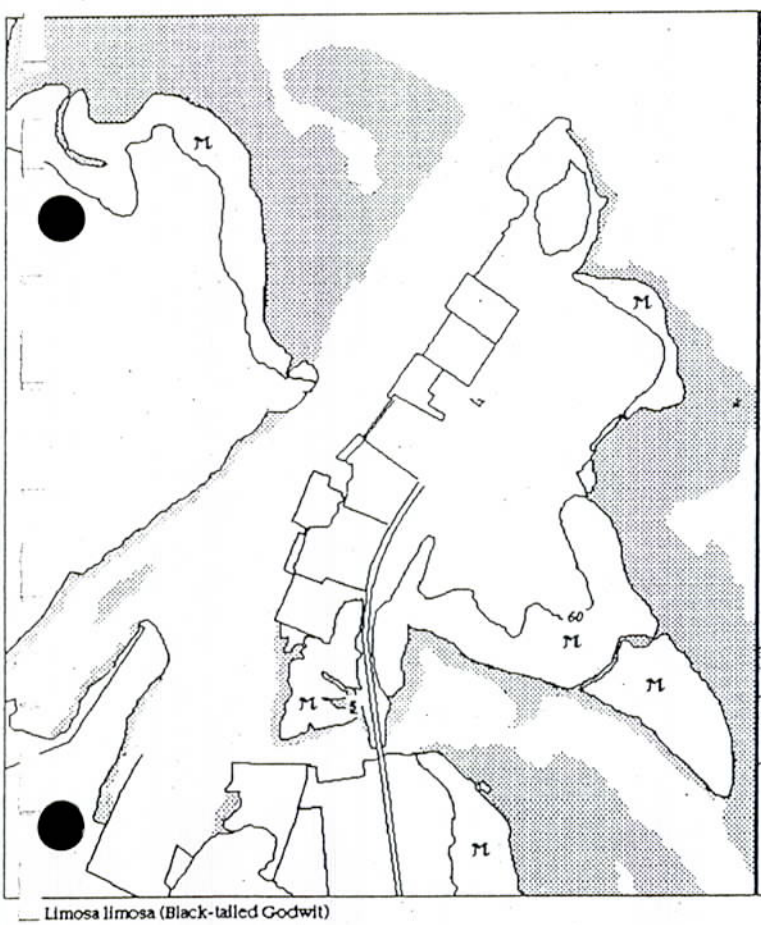
Tringa nebularia (Greenshank)



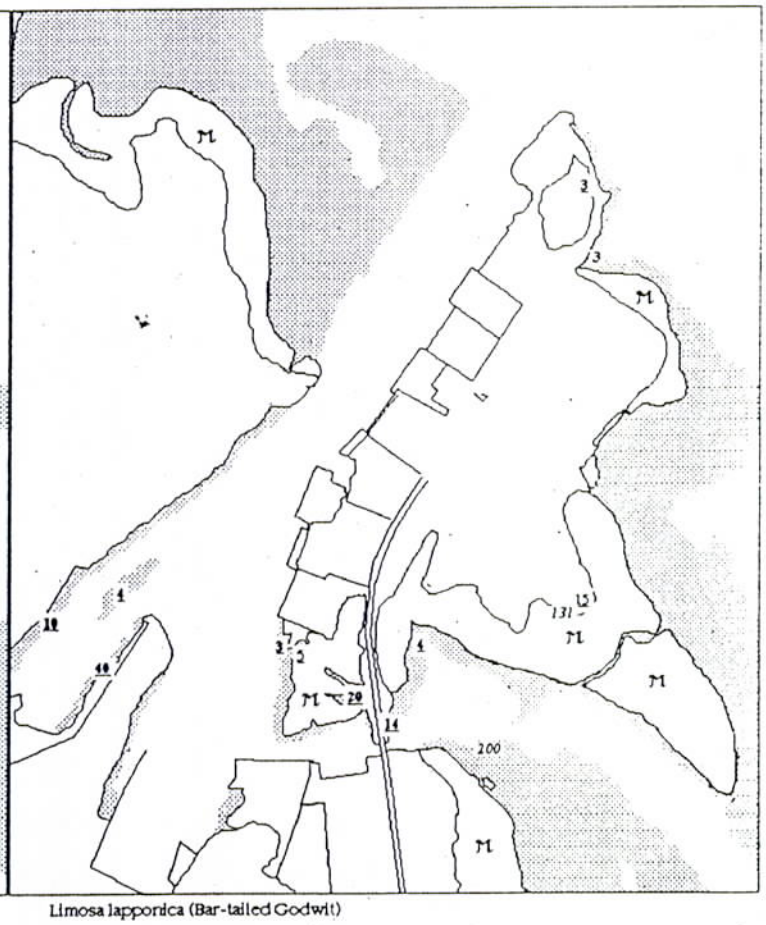
Tringa stagnatilis (Marsh Sandpiper)



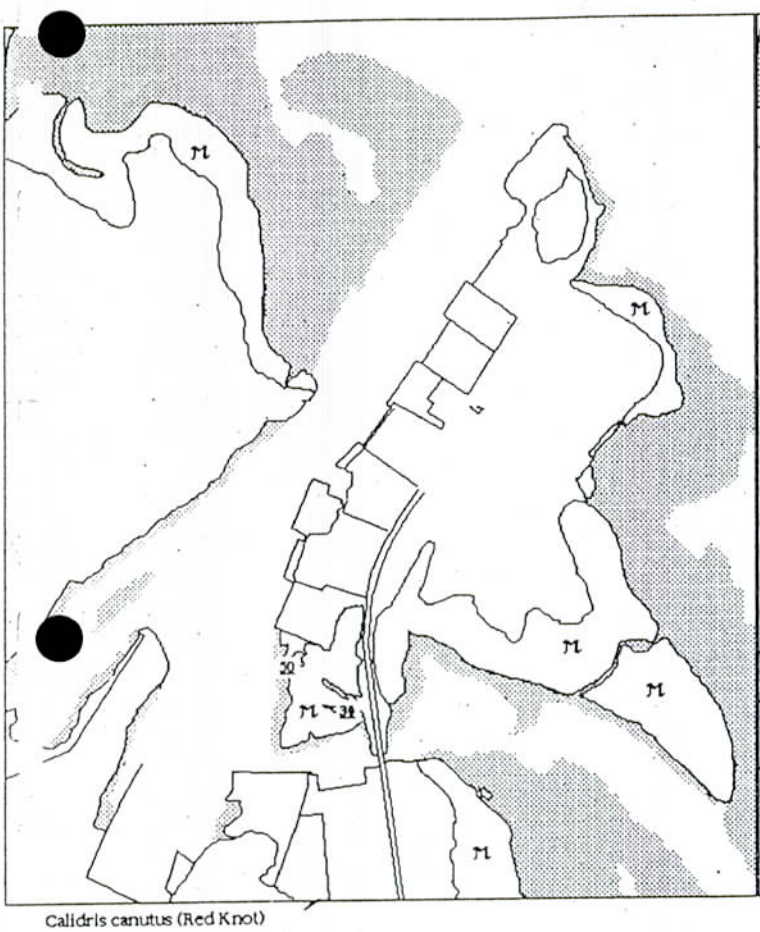
Tringa terek (Terek Sandpiper)



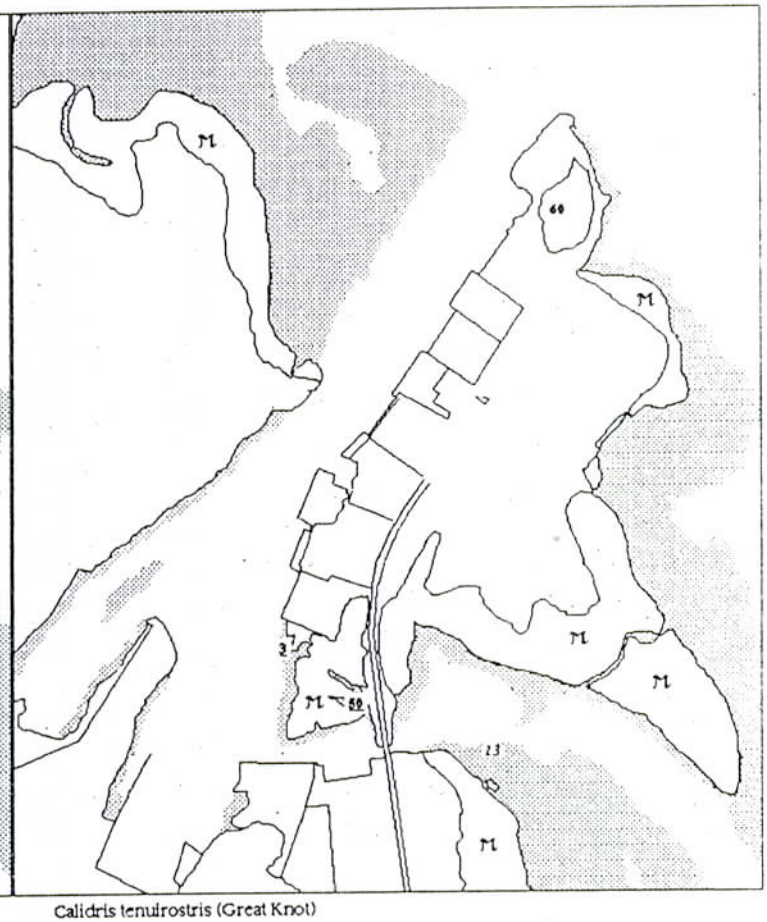
Limosa limosa (Black-tailed Godwit)



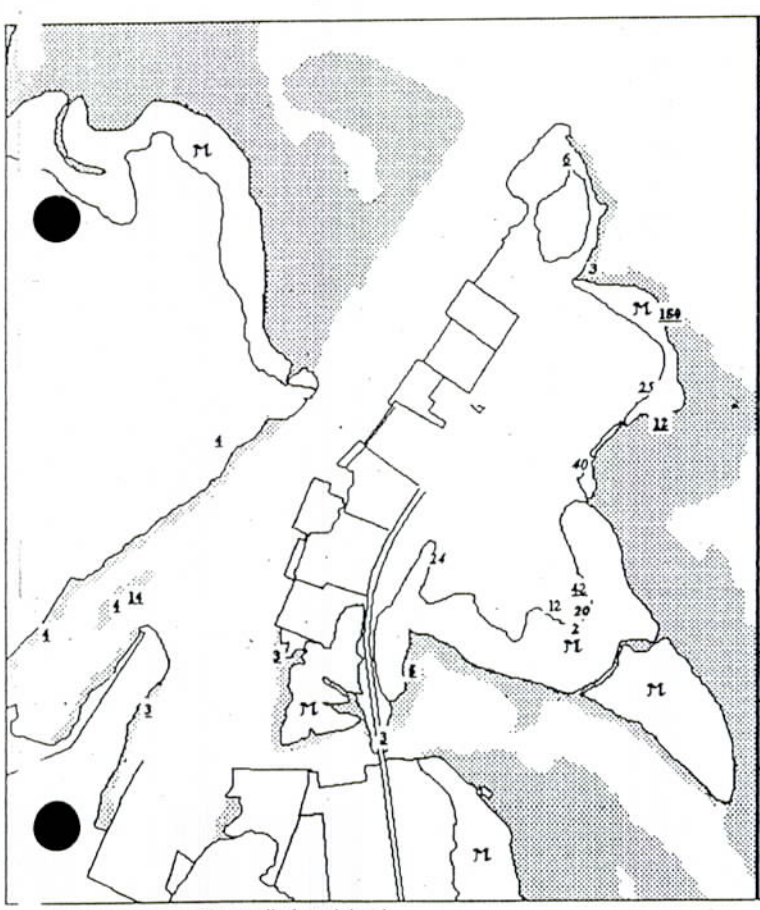
Limosa lapponica (Bar-tailed Godwit)



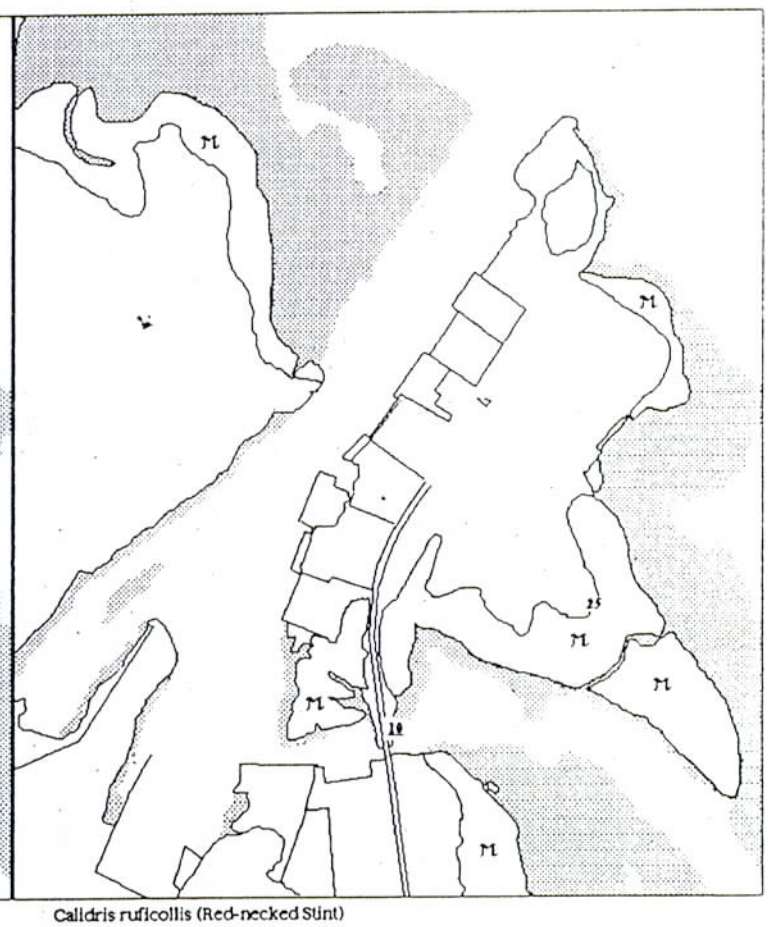
Calidris canutus (Red Knot)



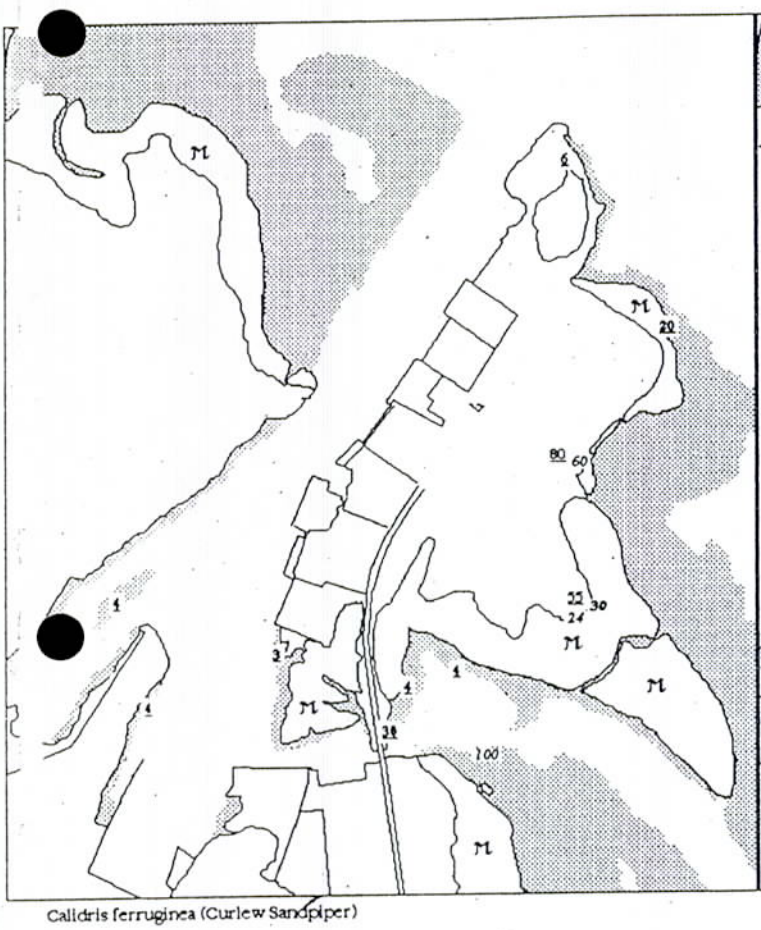
Calidris tenuirostris (Great Knot)



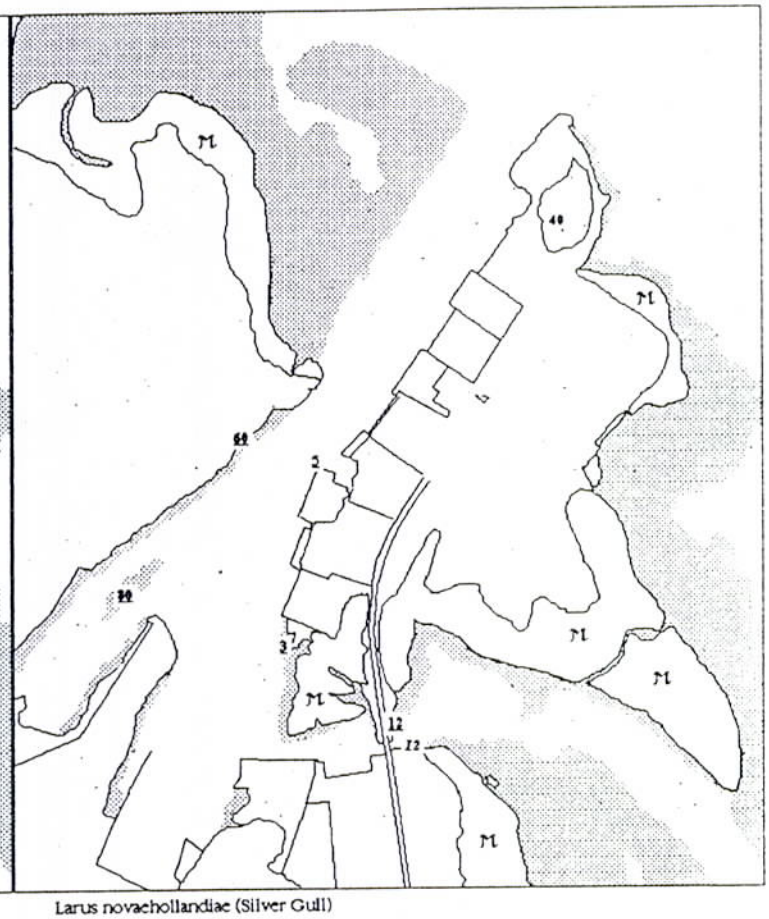
Calidris acuminata (Sharp-tailed Sandpiper)



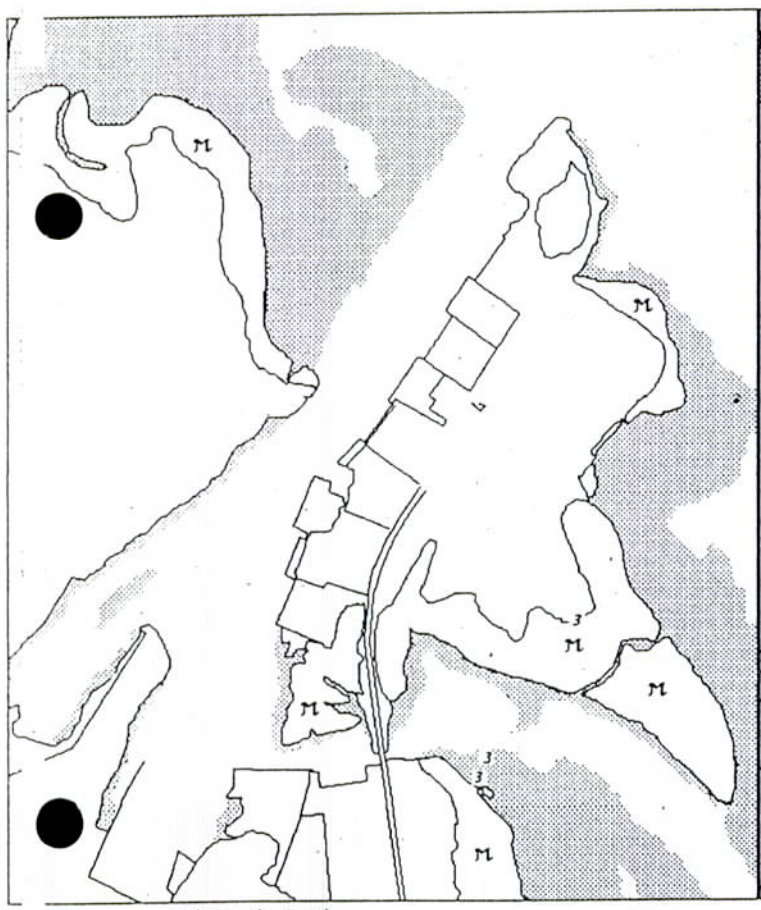
Calidris ruficollis (Red-necked Stint)



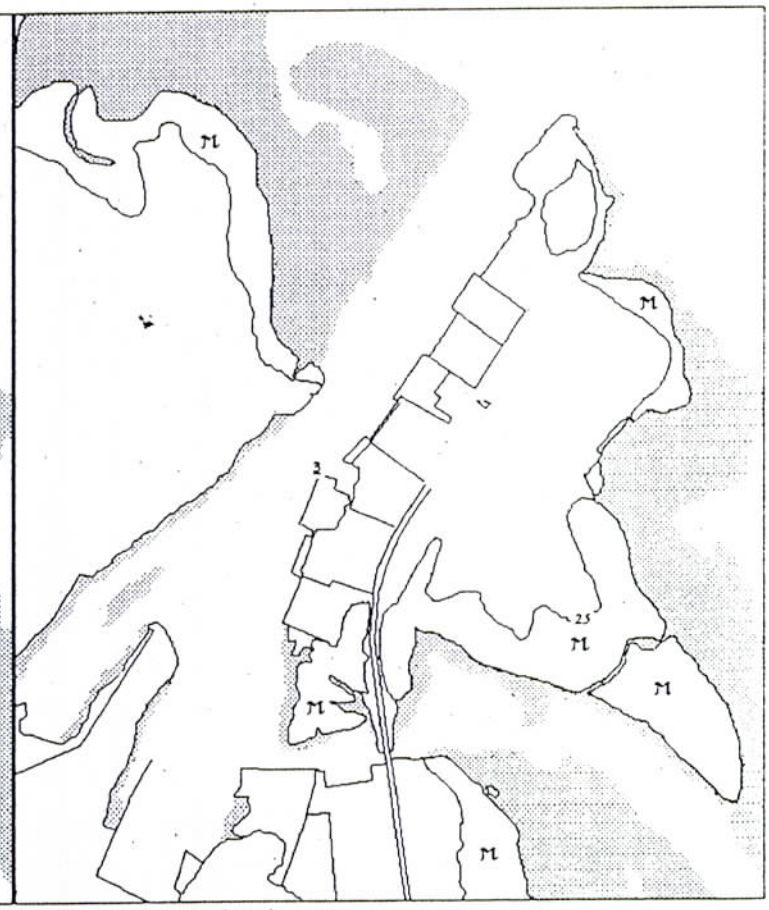
Calidris ferruginea (Curlew Sandpiper)



Larus novachollandiae (Silver Gull)



Hydroprogne caspia (Caspian Tern)



Sterna bergii (Crested Tern)

Appendix F: Summary of Past studies on waders of Moreton Bay

Thompson and Kikkawa (1988a) give details of a survey for the Central Moreton Bay area, from just south of Peel and Bird Islands to just north of Mangrove Island. Their report covers sampling between March and May 1988, during the spring migration. General information on both resident and non resident wader species is given and the authors note differences in the spring and autumn migrations involving the rate of movement of birds and their use of the feeding grounds. Six major roosts are noted in the area where counts were made. The roosts are:

1) Mirapool (north) Island (5000+birds) At very low high tides roosting may alternatively occur on banks beside Days Gutter on the western side of the southern tip of Moreton Island.
2) Reeders Point and Days Gutter (3000+ birds). Often disturbed and the latter no good at higher tides.
3) Amity spit (2500+ birds). Birds are here at all tides but more on the lower high tides.
4) Mirrapool (south) Island (500+ birds). A smaller, more exposed roost used by the larger species.
5) North-west Peel Island (700+ birds). A sand spit off the nth-west corner which is probably no good at spring high tides.
6) Crab Island. Mangrove roosting of predominantly Grey-tailed Tattlers. Counts were not possible. There is a Pied Cormorant rookery on the island also.

Several other small roosts in the area are noted such as on Bird & Goat Islands (Eastern Curlews, Bar-tailed Godwits, Whimbrel and Grey-tailed Tattlers), on the shipwrecks just north of Dunwich, and on Pelican Island. The report mentions the significant loss of roosting areas along the mainland shoreline. Details of the most important feeding areas in Central Moreton Bay are then discussed under criteria such as the number of birds, the extent of seagrass, length of exposure during low tide and the proximity of roosts to feeding areas. For the study area, the authors give an estimate of 10,000 birds at any one time during the autumn migration period. Finally, it is noted that waders will become accustomed to passing boats but people walking near roosts can be disruptive to birdlife. In an appendix they list some of the mainland roosts and feeding areas with results of single counts. The Lytton roost, between the railway line and the old Lytton dump on Whyte Island is mentioned but at the time their was no knowledge of the roost sites on Fisherman and Bishop Islands. Other mainland roosts listed are at Deception Bay, Hay's Inlet, Nudgee, Luggage Point, Thornside and Oyster Point. Appendix 4 of this report gives results of Queensland Ornithological Society counts of birds at several mainland roosts (including those as far north as Toorbul in the Pumicestone Passage) as: 6,476 (total summer 1988), 3,992 (total summer 1987) and 1,845 (total winter 1987). These counts are not complete.

Thompson and Kikkawa 1988b is a continuation of the studies in autumn 1988 and examines the southern migration of waders in the central Moreton Bay region focusing on 6 study plots of 100 m width with 100 m long sections for the purpose of getting absolute density estimates of birds on their feeding grounds. Because Bar-tailed Godwits and Eastern Curlews are large birds that are easy to count at roosts and on the feeding grounds, they are used as indices of the abundance of other, more cryptic species. Food and diet was assessed through observation and by taking sediment samples and sieving for polychaete worms, crabs, shrimps, prawns, molluscs and fish. Furthermore a technique of sediment grain size analysis is described. In conjunction with the coverage of seagrass and other parameters, the grain size composition of sediment is a major determinant of habitat conditions . The report presents data on bird density, food and habitat characteristics at sites and discusses the various feeding preferences of different species of wader. The authors also draw attention to changes in the distribution pattern of birds in winter noting that during winter there is a general confinement of feeding areas. For example, Grey-tailed Tattlers changed from using mangroves on Crab Island for roosting to using nearby sand during winter. The report also mentions a delayed peak in numbers of Greenshank, Great Knot and Large Sand Plovers for the southward migration.

The report by Thompson and Kikkawa (1989a) considers information from all of Moreton Bay noting that areas of very muddy substrates along the mainland shore are preferred by species that are much less common in central Moreton Bay. The report is directed at helping the Qld Govt formulate a strategy plan for Moreton Bay and refers to the past impact of the Raby Bay canal estate and consequences of sewerage enrichment of feeding areas at Luggage Point. Attention is drawn to the significance of the Hays' Inlet area for waders and some additional roost sites are noted (Wellington Pt, Deception Bay & Thornside). In summary the report lists 3 site groups representing broadly different habitats, each catering for a different mix of wader species. The site groups are:

a) Beachmere, Lytton, Sandgate/Nudgee, Bribie Is/Pumicestone Passage, Toorbul, Southport Broadwater.
b) Days Gutter, Myora, Amity, Wanga Wallen, Dunwich, Pelican Banks.
c) Bramble Bay, Thornside, Cleveland, Wynnum-Manly, Scarborough/ Clontarf/ Woody Point, Deception Bay.

The intention of the report by Thompson and Kikkawa (1989b) is to refine and extend previous work undertaken in the Bay. It notes some variation to previous techniques of estimating numbers and considers possible reasons for differences in the northward and southward migration patterns of waders through Moreton Bay. The northward migration for most species proceeds slowly with no marked peak in numbers unlike the southward migration. A possible exception is for the Grey-tailed Tattler which shows an

extended influx of birds into the summer months. Reasons for differences between the migration periods are suggested and include 1) birds by-pass Moreton Bay 2) birds pass through but don't stay for long 3) birds arrive more gradually and are less synchronised on their northward route. Numbers of some species such as Grey-tailed Tattlers, Red-necked Stints, Curlew Sandpipers, Mongolian Plovers, Large Sand Plovers, Red Knots and Great Knots rise in March/April but not to the same extent as in October. Bird densities are compared spatially as well, with particular reference to differences between Luggage Point and "island" sites. The Great Knot is discussed in detail. For some species different parts of the Bay are preferred by different age groups and/or sexes.

A report by Thompson 1990a and a later report by Driscoll (1991) focuses specifically on Pumicestone Passage giving estimates of numbers and details of roost and feeding areas. Pumicestone Passage is ranked together with 9 other major "areas" between Caloundra and southern Moreton Bay in terms of general habitat quality, largely on the basis of the area to perimeter ratio of feeding zones. Also, Pumicestone Passage tends to occur at the "muddy" end of the spectrum for feeding areas in Moreton Bay. There are high numbers of waders in Pumicestone Passage over summer but the rise in numbers in October does not seem to be as dramatic as elsewhere.

Thompson (1990b) focuses on Southern Moreton Bay, noting that it is relatively less important for waders than elsewhere, principally because much of the feeding area is less expansive and confined to narrow strips of comparatively steep mudbank. These strips offer less opportunity for waders to feed along a tide line as the tide changes. The feeding grounds in southern Moreton Bay are very patchy with the best areas around Victoria Point, Point Halloran and Cleveland. South of Redland Bay, densities are generally very low with the exception of Jumpinpin. Swan Bay has the highest density of waders in southern Moreton Bay. Roosts are located at Macleay Island, Cobby Cobby Island, Squire Island, south of Crusoe Island, Swan Bay and the northern tip of South Stradbroke Island. Thompson offers a gross estimate of a minimum of 50,000 waders for Moreton Bay at any one time but this figure hides the fact that many more individuals utilise the region during periods of migration. Moreton Bay has a particularly high diversity of wader species, particularly when compared with other sites within Queensland but also throughout Australia.

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