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Breeding Waterbirds on the Salt Lagoon Islands, South Australia

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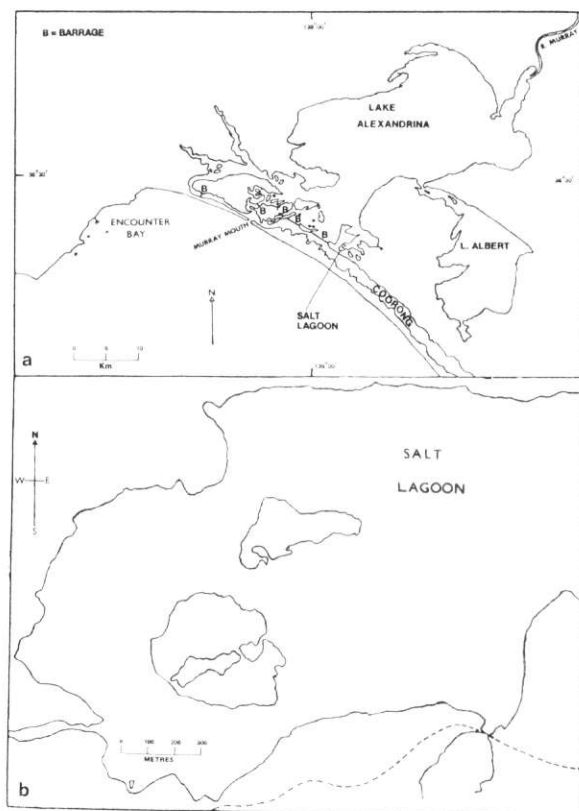
Breeding activity on the Salt Lagoon Islands was surveyed in c. 50 visits between October 1962 and November 1979. Observations are presented on the timing, abundance and (in most cases) habitat of the breeding of 26 species of birds, with special attention to nine species of ardeiformes and four of *Phalacrocorax*. Results are given of a three-year survey of the breeding cycle of the *Phalacrocorax* species, and fish samples are described. Comments are made on the decline in breeding numbers of larger waterbirds.

Description of the Islands

The Salt Lagoon Islands are located at 35°36'S., 139°04'E., and are 14 km south-east of Narrung (see Figure 1). Their status is that of a Conservation Park under the National Parks and Wildlife Service of South Australia, from whom an entry permit is required.

The lagoon has been part of Lake Alexandrina since a series of barrages (completed in 1940) separated the lake from the sea. Before this the lagoon was saline: hence the now inappropriate name. The depth of water was usually c. 1.5 m in 1973-4.

The terrain and vegetation were briefly described by Beruldsen (1963). The vegetation of the north island, which is similar to that of the south, is illustrated in Figure 2. The plant-life of the islands and surrounding water has changed considerably in the period under review (1962-1979). It has been found that the widespread tea-trees (see Appendix 1 for scientific names) are quickly defoliated, then stripped of twigs, and eventually destroyed by nesting birds, but that they quickly regenerate.



● Figure 1. Map (a) showing location of Salt Lagoon Islands and (b) Location of islands in the Salt Lagoon.

For example large areas of them on the south island were found to be dead in 1969, but to have "regenerated completely" in 1972 (J.M.B.). On the north island, few of the tea-trees of over four m in height that existed in 1974 were standing in 1979, by when there was denser undergrowth, which included numerous young tea-trees, boobyalla, boxthorn, lignum, mingled with unidentified creepers and herbaceous plants (see Figure 3).

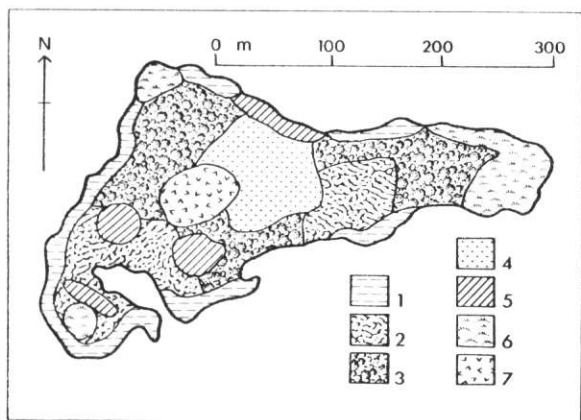
The reeds and rushes around the south island expanded in area by 10 m in places between 1969 and 1975, and now screen both ends of the lagoon which bisects the south island, as well as the landing place used by Beruldsen in 1962. Salt Lagoon was choked with weed in 1973-4, but has been free of it from November 1975 or earlier until the present. This change is widely attributed to the increasing density of European Carp, which was first found near the Murray mouth in November 1970, but is now abundant in Lake Alexandrina. It is said (T. D. Scott *et*

al. 1974) that the carp "threatens native fish apparently because it destroys water plants by stirring up bottom mud while feeding". The diminution of weed may have been hastened however by a comparatively large influx of sea water in 1974, as a result of an unusually high tide while the locks were open.

Ornithological History

G. R. Beruldsen inspected the islands between 27 October and 9 December 1962, and reported his and his companions' observations in the *Emu*, where the locality is not named. Following his and other recommendations, the islands were proclaimed a prohibited area by the State government. Reports to the appropriate Minister on breeding activity — mainly of larger waterbirds — have been made in most years since then, and have been used in compiling this paper. Beruldsen reported on a visit on 5 November 1966, and J.M.B. reported on visits (made in company with C. E. Rix or others) on 2 November 1963, 15 October 1964, 30 October 1965, 18 September 1966, 19 November 1967, 2 November 1969, 14 November 1971, 12 November 1972, 18 November 1973, 10 November 1974, 23 November 1975, 7 November 1976 and 23 October 1977. J.M.B.'s report of 1966 was published in the *South Australian Ornithologist*. Numerous visits to band* young birds have been made since 30 December 1967, by M.H.W., D.H.C., D.J.C. and assistants. Yellow-billed Spoonbills, Great Egrets and Little Egrets were banded in 1967-8; but since 1969 banding has been confined to Great, Little Black and Little Pied Cormorants. The banding totals are as follows (all chicks): Great Egret — 200; Little Egret — 10; Yellow-billed Spoonbill — six; Great Cormorant — 2 859; Little Black Cormorant — 3 659. The dispersal of cormorants from this and other sites has been analysed by van Tets *et al.* (1976).

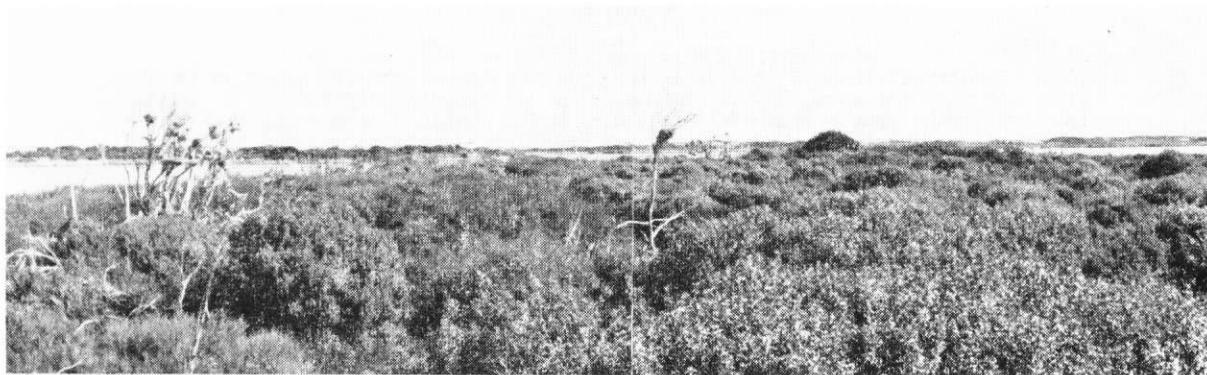
Notes on the breeding activity of the cormorants (and, less comprehensively, of other species) were made during 20 visits to the north island (19 of them led by D.H.C., one by A. Suljagic) from 27 February 1971 to 26 January 1974. As can be seen from Table 1, the visits were so spaced that few if any major bouts of breeding activity are likely to have gone unrecorded.



• Figure 2. Vegetation of the north island, June 1971. Key to Figure 2 —

1. Dead tea-trees, five-seven m high, with thick trunks and branches, usually standing in shallow water.
2. Dead tea-trees, six-eight m high, with many thin branches, usually in mud.
3. Mixture of dense, half-dead tea-trees (four-six m high), boobyalla (c. two m high), usually standing in mud or dry ground.
4. Mainly boobyalla, two-three m high, on dry ground.
5. Lignum in mud or water.
6. Reedmace and reed in water and mud.
7. Limestone knoll, two-three m above water level, crowned with bare grass.

* Bands used were provided by the Australian Bird-banding Scheme, Division of Wildlife Research, CSIRO.



● Figure 3. North island, August 1979, from platform c. 60 m east of knoll (obscured), looking west-south-west. The south island and the dunes of Younghusband Peninsula are in the background.

Breeding Birds, Status and Habitat

General comments on larger waterbirds: The following comments apply to the egrets, spoon-bills, ibis, night herons and cormorants which have given these islands their importance. Although each species has shown certain preferences with regard to nesting habitat, it has been found nesting in close proximity to, or intermingled with, others. In the tea-trees, at about four m or higher, have usually been found nests of Great Egrets, Royal and Yellow-billed Spoon-bills, Rufous Night-Herons and Great, Pied and Little Black Cormorants. At intermediate levels of one to four m, in tea-trees and boobyalla, nests of Pied, Little Pied and Little Black Cormorants and Glossy Ibis have been found. Nearer to ground or water level Straw-necked and Sacred Ibis (these two often in close association) and, again, Great Cormorant have been found.

Since 1969 the south island has been abandoned by all these species except for a few Great Cormorants. Earlier — certainly before 1967 — the south island was the main breeding area for most of these species. The transfer may have been caused by the deterioration of tea-trees, and their consequent inability to supply shelter, physical support or nesting material. It should be noted, though, that various species have bred in tea-trees for some years after they have ceased to show signs of life.

In the following notes “nests” means nests that were lined and ready for laying, or that contained eggs or dependent young. The number

of active nests of a species can usually be taken to equal the number of breeding pairs, although occasionally (e.g. in the case of Little Black Cormorants) more than one clutch of eggs were found in a nest.

Darter — Two nests were found on 24 November 1962, four on 2 November 1963, eight (all with eggs) on 5 November 1966. There have been no subsequent breeding records of this species, which is uncommon in this region.

Cormorants — The three-year survey of breeding activity (see above) consisted of visits made primarily for banding purposes. Therefore the notes on breeding activity were limited by lack of time, and were confined to the number and distribution of occupied nests, and, occasionally, the composition of fish samples. The numbers of nests were estimated with more precision than was possible during the visits of G. R. Beruldsen and J.M.B. As the proportions of eggs and chicks of different ages were roughly noted, banding totals could often be used as a check on estimates made by direct counting of nests.

The timing and scale of breeding are shown in Table 1. Every species has been both catholic, and unpredictable, in choice of breeding time. Each species has repeatedly bred in large numbers (100 + nests) in different parts of the year. No species has bred regularly in any season. During the three-year survey, *P. carbo*, *varius* and *sulcirostris* bred most of the time, although sometimes in small numbers. Further

TABLE 1

Cormorant Breeding Data: Timing and Abundance

Notes: Numbers are those of active nests, i.e. containing eggs or dependent young, or freshly lined and ready for laying. The conjectural figures are conservative deductions by D.H.C. from necessarily vague estimates by G. R. Beruldsen or J.M.B. A dash means that no information was available for that visit. Banding figures are given when no other information is available. The stage of the breeding cycle is indicated, when the information is available, and of particular relevance.

Dates of visits	Great	Pied	Little Black	Little Pied
27.10 – 9.12.62	"A few"	"Not plentiful".	Apparently c. 50	"Many hundreds"
2.11.63	100	Breeding, no estimate	Apparently 200 +	Breeding, no estimate
15.10.64	200	50	Apparently 1000 +	100
30.10.65	50	50	50	50
18.9.66	Apparently 1000 +	Apparently 500 +	Apparently 400 +	Apparently 200 +
5.11.66	Fewer than before	Fewer than before	Apparently 1000 +	Apparently 1000 +
19.11.67	Apparently under 50	Apparently under 50	Apparently 500 +	Apparently 500 +
30.12.67	--	--	--	100 chicks banded
21.12.68	--	34 chicks banded	50 chicks banded	340 chicks banded
21.1.69	--	--	--	185 chicks banded
2.11.69	Not breeding	No birds	Not breeding	Not breeding
31.5.70	60 chicks banded	--	20 chicks banded	--
27.2.71	950	Breeding, no estimate	Breeding, no estimate	--
16.5.71	200	50	500	Not breeding
20.6.71	50–100	50–100	900–10000	Not breeding
11.7.71	50	50	600	Not breeding
23.8.71	20	30	200	Not breeding
21.11.71	50 (mainly with large chicks).	300 (mainly with large chicks)	20 (mainly with large chicks)	200 (mainly with large chicks)
16.1.72	20	200	200 (most with eggs)	Birds present, not breeding
5.3.72	300	200	600	100
7.5.72	200	100	250	Not breeding
18.6.72	275	50	350 (only a few with eggs)	Not breeding
24.9.72	20	40	No birds	A few birds, not breeding
12.11.72	Not breeding	Not breeding	Not breeding	Not breeding
28.11.72	Not breeding	Not breeding	Not breeding	Not breeding
14.1.73	c. 10	Not breeding	Not breeding	Not breeding

Dates of visits	Great	Pied	Little Black	Little Pied
18.2.73	50	Not breeding	Not breeding	Not breeding
29.4.73	200 (majority with eggs)	20	10	Not breeding
1.7.73	150	Breeding, no estimate	50	Not breeding
27.10.73	200	150	250	250
18.11.73	20 (most with large young)	20 (most with large young)	Apparently c. 500	Apparently 200 +
26.1.74	60	150	300	40
10.11.74	Numerous	Numerous, less than Great	Numerous	Numerous, less than Great
2.3.75	19 chicks banded	—	—	—
6.4.75	—	—	90 chicks banded	—
7.11.75	Not breeding	4	Not breeding	Not breeding
11.4.76	80 chicks banded	—	—	—
29.8.76	—	—	200 chicks banded	—
7.11.76	100	100	50–100	50–100
11.1.77	No birds	No birds	No birds	No birds
23.10.77	Not breeding	Not breeding	Not breeding	Not breeding
7.12.77	Few, with large young	Few, with large young	Not breeding	Not breeding
7.6.78	Not breeding	Not breeding	Not breeding	Not breeding
7.11.78	Not breeding	Not breeding	Not breeding	Not breeding
6.4.79	26 chicks banded	—	50 chicks banded	—
29.8.79	c. 25, with large young	c. 25 with large young	Not breeding	Not breeding
10.11.79	Not breeding	Not breeding	Not breeding	Not breeding

comments are made tentative by the shortage of autumn-winter data outside the three-year survey. But *carbo* seems to have preferred the months February-June, and *varius* and *melanoleucos* the months October-March. *Sulcirostris* has shown no apparent preference, but has repeatedly bred in large numbers (200 + nests) in every quarter.

What is especially noteworthy is the occurrence of large-scale breeding by all four species between February and August. Table 1 shows this to be true of *carbo* and *sulcirostris* in four

years, *varius* in two years, and *melanoleucos* in one. Serventy *et al.* refer to the occurrence of autumn, but not winter, breeding by the four species. The list of confirmed freshwater (or inland) breeding records for the four species in Parker *et al.* (1979) is confined to the months September-January. They wrote (p.29): "That in South Australia the coastal colonies of *P. melanoleucos* and *P. varius* breed chiefly in Jan.-June and the inland colonies chiefly in Sept.-Jan. seems not to have been previously remarked (see also under *P. sulcirostris*)". The divergence of the Salt Lagoon birds from this

tendency may be due to the proximity of salt-water food supplies. The difficulty about this explanation is that freshwater fish prevail in the samples, which were taken in May-August.

Some large-scale synchronisation of breeding was found. At different times, 100 + nests of *carbo* and *sulcirostris* respectively were found in close proximity, with breeding evidently synchronised to within a few days. This is likely to have happened in the case of *melanoleucos* also. But on the majority of visits, eggs and chicks of each species were found in many stages. Consequently a major bout of breeding by any species lasted four months or more. On at least two occasions the breeding cycle of many birds was found to have been arrested. On 2 November 1969, no cormorants were breeding, and an unusually large proportion (c. 5%) of disused nests of unidentified cormorants contained dried remains of large chicks. On 29 April 1973, a group of 50-100 nests of *carbo* had been recently lined but deserted. They contained nothing but slightly soiled and withered greenery. Many adult birds were roosting near the nests, without showing interest in them.

The habitat and distribution of nests were plotted on maps after most visits in the survey. Most birds nested close (within three m) to others of their own species. But no species colonised apart from the others; and on occasion the nests of all four species were found juxtaposed.

The fish samples were collected either from, or immediately below, occupied nests, when there was no doubt about the specific identity of the birds which had caught the fish. As one might expect in a cormorant colony situated in freshwater, but adjacent to the sea and the hypersaline Coorong, the samples included marine fish (Pilchard, Tommy Rough, Short-headed Worm-Eel), as well as freshwater fish (Tench, Bony Bream, Native Trout, Southern Goby, Golden Carp) and one of mixed habitat (Congolli).

Except when specified, the following notes refer to the north island (see Figure 2).

Great Cormorant — This was the most catholic in choice of nesting habitat. Its nests were usually found between 2.5 and seven m above land or water in the sturdier tea-trees. But some-



• Nests of Great Cormorants on lignum on north island, June 1972.

times many (50 +) nests were concentrated within one m of the water's edge, on lignum or flattened reeds. Nests were built of material taken from the trees or plants in which they were placed. When containing eggs, or ready for laying, the nests were sparsely lined with fresh greenery of different kinds — waterweed, lignum or reeds. When in the same tree as those of *sulcirostris* or *melanoleucos*, those of *carbo* were nearly always placed above them — typically near the top. *P. carbo* was the only species found nesting more than c. 50 m from any other cormorant, e.g. on large isolated tea-trees on the south island.

A random sample of 50 occupied nests on 29 April 1973 contained the following (E = eggs, Y = young, N = nests): 3E — 5N; 4E — 15N; 5E — 4N; 4E + 1Y — 1N; 2Y — 1N; 2E + 2Y — 1N; 3Y — 7N; 1E + 3Y — 4N; 2E + 3Y — 1N; 4Y — 4N; 1E + 4Y — 3N; 5Y — 4N.

Fish samples were collected on 16 May 1971, 18 June 1972 and 29 April 1973. They comprised: Bony Bream (numerous), Short-headed Worm-Eel (two), Tommy Rough (one), Congolli (two), Golden Carp (six identified with certainty), unidentified carp — either the former species or European Carp (numerous), Tench (numerous, including one of astonishing size, at least one kilogram).

Pied Cormorant — Nests were usually found at the top of live, bushy tea-trees and boobyallas, c. three m high, over land in the east-central part of the island. Some were also noted at c. four m in tea-trees near nests of Great Egrets north of the knoll. When nesting in the same trees as *sulcirostris* and *melanoleucos*, *varius*, like *carbo*, placed its nests higher.

Fish were collected only on 29 August 1979, and consisted entirely of Bony Bream, which was then, clearly, the dominant or sole food.

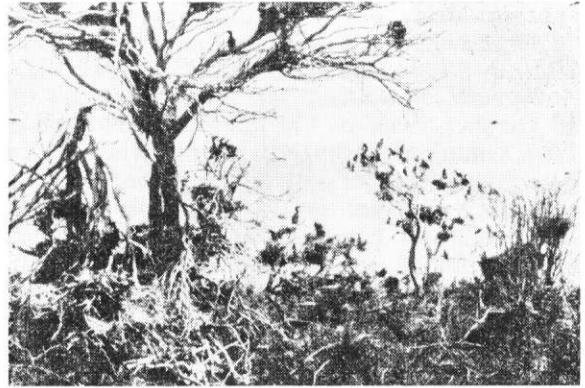
Little Black Cormorant — Nests were usually between 1.5 and seven metres above ground or water, in tea-trees over all parts of the island except the eastern sector. Sometimes many nests were found less than two m above the ground in dense boobyallas, tea-trees and boxthorn just north of the knoll. The nests, being noticeably smaller than those of *carbo*, were placed on flimsier branches.

Fish were collected on 16 May 1971, 20 June 1971 and 11 July 1971. They comprised: Pilchard (one), Bony Bream (several), Native Trout (c. 10), Hardyhead sp., probably Dannevig's (c. 10), Flathead (one), Southern Goby (one), Golden Carp (one). On 5 March 1972 shrimp-like crustacea were abundant in nests.

Little Pied Cormorant — Most nests were at one or two m above the ground in bushy tea-trees and boobyalla, usually to the north and north-east of the knoll. Nests of this species were especially likely to be found intermingled with those of others. No food samples were taken.

Cattle Egret — Two nests, one with four chicks and the other with three were found on 14 November 1971. (*Bird Talk* 1(1):12). Two active nests were again found on 18 November 1973, among those of White Egrets. The species may have been breeding on 10 November 1974, when a pair in breeding plumage flew over the egret colony. These are so far the only known breeding records in South Australia (Parker et al. 1979).

Since 1971, substantial numbers have frequently been seen on the mainland nearby, usually among cattle: e.g. 16 on 16 March 1972, and eight (including three in breeding plumage) on 12 January 1973.



● Great Egrets, Great and Little Black Cormorants on the north island, January 1974.

Great Egret — The timing and abundance of breeding were as follows: 50 + nests on 24 November 1962; apparently more on 2 November 1963; c. 50 breeding pairs on 15 October 1964, and again on 30 October 1965; c. 100 nests on 5 November 1966; c. 100 breeding pairs on 21 November 1967 and 140 chicks banded on 30 December 1967 (when there were 30 broods of one chick each, 43 of two, and eight of three); 60 chicks banded on 21 December 1968; none breeding on 2 November 1969; numerous nests on 14 November 1971; a few nests still with dependent young on 5 March 1972; none breeding on 12 November 1972; numerous nests on 10 November 1974 (apparently 50-100 nests); nine or more breeding pairs on 7 November 1976.

The structure and situation of nests in 1962 were described by Beruldsen (1963:229).

Little Egret — A nest containing one egg, and four adult birds, was seen, on 19 November 1967. Ten chicks were banded on 30 December 1967 (two broods of three and two of two). The species was perhaps breeding again on 14 November 1971, when an adult in breeding plumage was seen among nests of Great Egret. No other instances of breeding are known in South Australia (Parker et al. 1979).

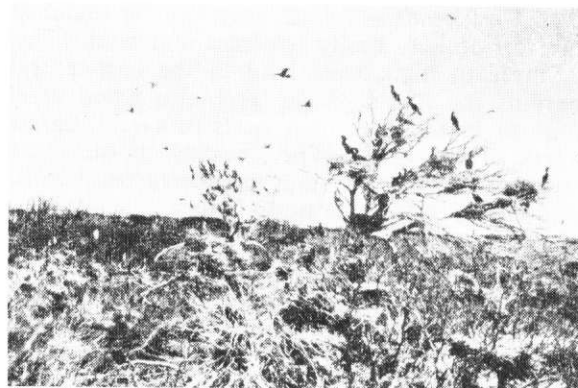
Rufous Night Heron — Because this species has tended to nest in dense cover (of tea-tree, boobyalla and perhaps boxthorn), the numbers of nests were hard to estimate. The timing and

apparent abundance of breeding were as follows: "a large colony" of breeding birds in October-December 1962, and again on 2 November 1963; c. 20 nests on 15 October 1964, and again on 30 October 1965; c. 100 nests on 5 November 1966, containing young or recently vacated; an unrecorded number on 19 November 1967; a substantial number on 14 November 1971; a few immatures noted among c. 50 birds flying over the island on 12 November 1972; an unrecorded number on 18 November 1973; none breeding on 10 November 1974; an unrecorded number on 7 November 1976; three nests (and possibly more) with incubating adults on 29 August 1979.

Glossy Ibis — The timing and abundance of breeding were as follows: 250-300 occupied nests (some with newly hatched young) on 28 October 1962, and many new nests, some with eggs, on 24 November 1963; 12 breeding pairs and a flock of 25 on 15 October 1964; 400 nests, all with eggs, on 30 October 1965; 270 nests counted on 5 November 1966, and over 100 more estimated to be present (most nests apparently still being built, but some containing young); unrecorded numbers breeding on 19 November 1967; a "small colony" on 2 November 1969; at least 11 clutches of eggs on 21 November 1971; three downy chicks seen on 19 March 1972; none known to breed since then.

The situation and structure of nests in 1962 were described by Beruldsen (1963:226). In November 1971, D.H.C. found the nests in dense tea-tree, boobyalla and boxthorn, one-three m from ground-level, and intermingled with nests of Little Black and Little Pied Cormorants.

Sacred Ibis — The timing and abundance of breeding were as follows: Two large mixed colonies of this species and Straw-necked Ibis in October-December 1962; c. 80 breeding pairs in small colonies scattered over the south island on 15 October 1964; 50 breeding pairs (with eggs and grown chicks noted) on 30 October 1965; c. 50 nests on 18 September 1966, and many nests with fresh eggs on 5 November; unrecorded numbers breeding (with many grown chicks) on 19 November 1967; large numbers breeding on 2 November 1969; small numbers breeding on 4 November 1971; 400-500 nests of this



• *Great Egrets, Pied and Little Pied Cormorants on the north island, January 1974.*

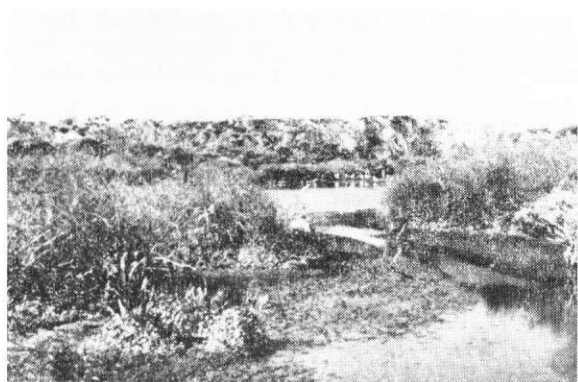
species intermingled with those of Straw-necked Ibis on 24 September 1972; several small breeding colonies on 18 November 1973; small numbers breeding on 10 November 1974; 50 breeding pairs on 7 November 1976.

The nests of this species, and of the Straw-necked Ibis, have usually been found on lignum, but some were found on bare ground in September 1972.

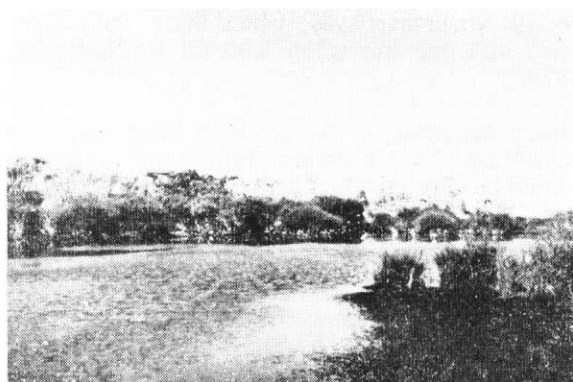
Straw-necked Ibis — For the timing and abundance of breeding, see under the preceding species, and also the following: c. 40 breeding pairs on 15 October 1964; c. 500 nests with eggs and young in all stages on 30 October 1965; numerous nests on 18 September 1966, and many with fresh eggs on 5 November; 500 + nests on 19 November 1967; very many nests on 2 November 1969, and again on 18 November 1971.

Small numbers breeding on 18 November 1973, and again on 10 November 1974; 100 nests on 7 November 1976.

Royal Spoonbill — The timing and abundance of breeding were as follows: c. 50 breeding pairs in October-December 1962; similar numbers on 2 November 1963, 15 October 1964, 30 October 1965 and 18 September 1966 respectively; larger numbers on 19 November 1967, and larger numbers again on 2 November 1969; an unrecorded number of nests (with young in various stages) on 14 November 1971; a few nests on 5 March 1972; a few immatures on 12 November 1972;



● *Spoonbills and ibis, in the waters inside south island, November 1967.*



● *Ibis and spoonbills in the waters inside south island, November 1967.*

an unrecorded number (with many large young) on 18 November 1973, and again on 10 November 1974; c. 50 breeding pairs (with young in various stages) on 7 November 1976.

In some years, some nests of this species were widely scattered over one or both islands, while some were concentrated. Although usually high in the taller tea-trees, one was found in 1974 c. one m above water, built of lignum twigs and scantily lined with fresh water weed.

Yellow-billed Spoonbill — The timing and abundance of breeding were as follows: c. 50 breeding pairs in October-December 1962, and again on 2 November 1963; 30 breeding pairs on 15 October 1964; 40 on 30 October 1965; an unrecorded number on 18 September 1966; fewer on 18 September 1967; six chicks banded (one brood of one, one of three, one of two) on 21 December 1968; breeding in larger numbers than ever before on 2 November 1969; a few dependent young in May-June 1971; many pairs breeding (with young in various stages) on 14 November 1971; large numbers again on 12 November 1972, and on 18 November 1973 (with young in all stages); an unrecorded number breeding on 10 November 1974; c. 50 breeding pairs with young in various stages on 7 November 1976; a few nests with eggs on 29 August 1979.

The siting of nests was similar to that of the previous species.

Black Swan — Many nests were found in October-December 1962; two on 15 October 1964; one pair with five cygnets on 30 October 1965; a pair with six cygnets and a nest with three eggs on 18 September 1966; a few empty nests and many cygnets on 18 November 1973; one nest with eggs on 29 August 1979.

Pacific Black Duck — One nest with nine eggs on 2 November 1963, probably several nesting pairs on 15 October 1964, and a nest with eggs on 5 November 1966.

Chestnut Teal — An occupied nest was found in October-December 1962. This species has been recorded on at least three other occasions, including 30 October 1965, when there were "hundreds".

Australasian Shoveler — One nest on 2 November 1963. The species was also recorded in October-December 1962, 30 October 1965, and 5 November 1966.

Whistling Kite — Two active nests in October-December 1962, and one on 29 August 1979.

Marsh Harrier — A nest with three eggs was found on 9 December 1962.

Spotless Crake — One active nest was found on 2 November 1963. The species was also recorded on 5 November 1966, when it was numerous.

on 19 November 1967, when there were three birds and one immature, and on 10 November 1979.

Dusky Moorhen — A nest with seven eggs was found on 24 November 1962, and unknown numbers were reported as breeding on 5 November 1966. One bird (juvenile?) was then seen being taken by a large Tiger Snake.

Eurasian Coot — This species was reported as breeding on 5 November 1966.

Willie Wagtail — A nest with four eggs was found on 15 October 1964, and another nest with eggs on 30 October 1965.

Little Grassbird — Found breeding on 2 November 1963.

Australian Magpie-lark — A nest with three young on 15 October 1964.

Other Birds Recorded

This list is confined to birds recorded on the islands or surrounding waters, within c. 200 m.

Great Crested Grebe	Caspian Tern
Hoary-headed Grebe	Crested Tern
Australasian Grebe	Horsfield's Bronze-Cuckoo*
Australian Pelican	Welcome Swallow
White-faced Heron	Grey Shrike-thrush
Australasian Bittern	Grey Fantail
Australian Shelduck	Clamorous Reed Warbler*
Grey Teal	Golden-headed Cisticola
Pink-eared Duck	Superb Fairy-wren*
Hardhead	White-browed Scrubwren*
Blue-billed Duck	Brown Thornbill*
Musk Duck	Spiny-cheeked Honeyeater
Baillon's Crake†	Singing Honeyeater
Australian Crake*	White-fronted Chat
Purple Swamphen	Silvereye*
Silver Gull	House Sparrow
Whiskered Tern	Grey Butcherbird
White-winged Tern	Little Raven

† Rarely recorded in this region. One was seen on 24 November 1962 (Beruldsen 1963), and an unrecorded number on 17 November 1964.

* Especially likely to have bred on the islands.

Factors Affecting Status of Breeding Birds

Predators of birds which are known to frequent the islands include Whistling Kite, Marsh Harrier, Little Raven and Tiger Snake. Little Ravens have frequently been numerous around the islands, and have been seen on at least three

occasions flying with stolen eggs in their beaks. In addition, Rufous Night Herons have been seen (by J.M.B., 1966) to eat cormorant chicks.

Another natural hazard is injury by leeches to the eyes of swimming birds: this has been noticed in the case of young, unfledged cormorants. None of these factors is likely to have seriously affected the breeding success of any species.

There has been a general decline in breeding activity, the reasons for which are not clear. Large-scale breeding was known to occur in all nine years for which there are records between 1962 and 1971. Since then, large-scale breeding, by species other than Great and Little Black Cormorants, seems to have taken place only in 1973, 1974 and 1976. Some breeding has been recorded outside the spring months October–November, but on a relatively small scale, again except for the two cormorant species. These, too, have bred in relatively small numbers since 1975 or earlier.

The decline in breeding on the north island is accounted for by the disappearance of large trees. But why has breeding not revived on the south island, where the tea-trees have recovered? There has not been a sufficient increase in human disturbance — in the form of occasional visits by fishermen, shooters, tourists, amateur naturalists and photographers — to account for the decline. Indeed disturbance has decreased in recent years, largely because of the re-routing of the track to the barrage so as to by-pass the lagoon. There has been no apparent correlation of breeding with rainfall. For example the spring of 1967, when large-scale breeding occurred, followed an unusually dry winter. The immense increase in European Carp may have diminished the food of some species. It has been blamed by a local fisherman (pers. comm. to J.M.B.) for the decline of yabbies, which may in turn account for the cessation of breeding since 1972 of the Little Pied Cormorant. However carp themselves (certainly Golden and perhaps European) have been found under the nests of Great and Little Black Cormorants (see above). Straw-necked Ibis have died in large numbers in this area of pasteurella or "fowl cholera". This was diagnosed in 12 of many dead chicks taken from nests in reeds in Narrung Narrows, 17 km north-east of Salt Lagoon, in November 1972, and delivered to the N.P.W.S. Without more research, these explanations are all speculative.

Research is particularly needed into the general breeding distribution of the less common species, such as the egrets and Glossy Ibis. Without more knowledge of this subject, it is hard to assess the significance of their decline in Salt Lagoon. The status of the islands should remain unchanged, with restricted access but regular inspections.

Other Vertebrates Recorded

These consist only of the mainland Tiger Snake (seen on one or two occasions), and the Black-footed race of the Water Rat (seen on two or more occasions).

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APPENDIX 1

Scientific Names of Plants and Vertebrates Referred to in this Paper.

Plants

Reedmace (Bulrush) *Typha angustifolia*
Reed *Phragmites vulgaris*
Lignum *Muehlenbeckia cunninghamii*
Tea-tree *Melaleuca halmaturorum*
Boxthorn *Lycium ferocissimum*
Boobyalla *Myoporum insulare*

Birds

Great Crested Grebe *Podiceps cristatus*
Hoary-headed Grebe *Poliocephalus poliocephalus*
Australasian Grebe *Tachybaptus novaehollandiae*
Australian Pelican *Pelecanus conspicillatus*
Darter *Anhinga melanogaster*
Great Cormorant *Phalacrocorax carbo*
Pied Cormorant *Phalacrocorax varius*
Little Black Cormorant *Phalacrocorax sulcirostris*
Little Pied Cormorant *Phalacrocorax melanoleucus*
White-faced Heron *Ardea novaehollandiae*
Cattle Egret *Ardeola ibis*

Great Egret *Egretta alba*
Little Egret *Egretta garzetta*
Intermediate Egret *Egretta intermedia*
Rufous Night Heron *Nycticorax caledonicus*
Glossy Ibis *Plegadis falcinellus*
Sacred Ibis *Threskiornis aethiopia*
Straw-necked Ibis *Threskiornis spinicollis*
Royal Spoonbill *Platalea regia*
Yellow-billed Spoonbill *Platalea flavipes*
Black Swan *Cygnus atratus*
Australian Shelduck *Tadorna tadornoides*
Pacific Black Duck *Anas superciliosa*
Grey Teal *Anas gibberifrons*
Chestnut Teal *Anas castanea*
Australasian Shoveler *Anas rhyncotis*
Hardhead *Aythya australis*
Musk Duck *Biziura lobata*
Whistling Kite *Haliastur sphenurus*
Marsh Harrier *Circus aeruginosus*
Baillon's Crake *Porzana pusilla*

Australian Crane *Porzana fluminea*
 Spotless Crane *Porzana tabuensis*
 Dusky Moorhen *Gallinula tenebrosa*
 Purple Swamphen *Porphyrio porphyrio*
 Eurasian Coot *Fulica atra*
 Silver Gull *Larus novaehollandiae*
 Whiskered Tern *Chlidonias hybrida*
 White-winged Tern *Chlidonias leucoptera*
 Caspian Tern *Hydroprogne caspia*
 Crested Tern *Sterna bergii*
 Horsfield's Bronze-Cuckoo *Chrysococcyx basalis*
 Welcome Swallow *Hirundo neoxena*
 Grey Shrike-thrush *Colluricincla harmonica*
 Grey Fantail *Rhipidura fuliginosa*
 Willie Wagtail *Rhipidura leucophrys*
 Clamorous Reed-Warbler *Acrocephalus stentoreus*
 Little Grassbird *Megalurus grammurus*
 Golden-headed Cisticola *Cisticola exilis*
 Superb Fairy-wren *Malurus cyaneus*
 White-browed Scrubwren *Sericornis frontalis*
 Brown Thornbill *Acanthiza pusilla*
 Spiny-cheeked Honeyeater *Acanthagenys rufogularis*
 Singing Honeyeater *Lichenostomus virescens*
 White-fronted Chat *Ephianura albifrons*
 Silveryeye *Zosterops lateralis*
 House Sparrow *Passer domesticus*
 Australian Magpie-lark *Grallina cyanoleuca*
 Grey Butcherbird *Cracticus torquatus*
 Little Raven *Corvus mellori*

Fish

Pilchard *Sardinops neopilchardus*
 Bony Bream *Fluvialosa richardsoni*
 Native Trout *Galaxias maculatus*
 Short-headed Worm-Eel *Muraenichthys breviceps*
 Dannevig's Hardyhead *Atherinason dannevigii*
 Flathead *Platycephalus* sp.
 Tommy Rough *Arripis georgianus*
 Congolli *Pseudaphritis urvilli*
 Southern Goby *Lizagobius galwayi*
 Golden Carp *Carassius auratus*
 Tench *Tinca tinca*
 European Carp *Cyprinus carpio*

Other Vertebrates

Mainland Tiger Snake *Notechis scutatus*
 Black-footed Water Rat *Hydromys chrysogaster fulvolavatus*