NUMBERS OF WADERS AND WATER-BIRDS IN RELATION TO SALINITY IN THE SALTFIELDS OF ADELAIDE, SOUTH AUSTRALIA

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INTRODUCTION

In the Adelaide area of South Australia, the late autumn and early winter of 1972 was exceptionally dry. From mid March to late June a weekly census of waders and water-birds was carried out in two census areas in the ICI salt fields north of the city. The original aim of the project was to study seasonal fluctuations. It seems that the salt fields may have been a refuge area for some indigenous species at that time, but the census was not carried out long enough due to factors beyond my control. The data do suggest distinct trends for some species, and these are tested by statistical analysis in some cases. The salt levels in the two sample areas were always different, and the census was a means of investigating superficially what effect this was having on bird distribution.

HABITAT

Originally the area seems to have been a salt-bush plain with a few clumps of mallee, divided from the sea by a narrow belt of mangroves. The salt fields constructed on the plain cover about 65 km^2. Sea water is pumped into huge shallow man-made bays. As the water is evaporated off, the increasingly dense water is moved successively through bays which decrease in size until the salty water, reduced by this stage to brine, reaches the collecting ponds.

The two sample areas were approximately 0.25 km^2. Area B was north of the St. Kilda road which crosses the salt elds, and was in the area of large bays and lower salinity. This simple area was in three sections 0.5 to 2 km apart. Area A was on the area south of the St. Kilda road, in the section of small bays and very high salinity. Areas A and B were centred at different ends of the salt fields, so that though salt levels varied, there was always a considerable difference between them.

METHODS

The methods used in censusing were the same as those used at Darwin (Crawford, in

TABLE 1.

* MONTHLY MEANS FOR 24 COMMON SPECIES IN 1972

SPECIES	AREA							
	A. HIGH SALINITY				B. LOW SALINITY			
	March	April	May	June	March	April	May	June
Hoary-headed Grebe *(Podiceps poliocephalus)*	0	0	0	0	4.0	31.7	89.5	49.5
Pelican *(Pelecanus conspicillatus)*	0	0	0	0	5.0	12.7	21.5	8.2
Little Black Cormorant *(Phalocrocorax sulcirostris)*	0	0	0	0	3.5	95.7	115.5	70.5
Little Pied Cormorant *(P. melanoleucos)*	0	0	0	0	3.0	1.2	45.0	4.7
White-faced Heron *(Ardea novaehollandiae)*	0	0	0	0.25	4.5	4.5	15.3	16.2
Little Egret *(Egretta garzetta)*	0	0	0	0	1.0	1.5	5.5	2.0
White Egret *(Egretta alba)*	0	0	0.25	0	0	0	14.0	1.7
Royal Spoonbill *(Platalae regia)*	0	0	0	0	6.5	9.2	23.5	19.5
Black Swan *(Cygnus atratus)*	0	0	0	0	34.5	46.0	34.5	53.2
Mountain Duck *(Tadorna tadornoides)*	4.0	6.2	6.5	14.2	20.5	31.0	14.7	2.0
Chestnut Teal *(Anas castanea)*	0	0.75	0	0	25.5	70.0	156.0	31.0
Grey Teal *(Anas gibberifrons)*	4.0	0	0	0	248.0	257.7	392.2	273.7
Spur Winged Plover *(Vanellus miles novaehollandiae)*	16.5	8.2	7.5	2.2	2.0	7.5	12.2	0.5
Red-capped Dotteral *(Charadrius alexandrinus)*	30.0	87.5	119.2	78.0	20.5	7.5	6.7	22.5
Red-kneed Dotteral *(Charadrius cinctus)*	0	0	0	0	0	0	2.2	10.2
Greenshank *(Tringa nebularia)*	17.5	20.2	2.2	0	9.0	22.0	16.2	31.0
Curlew Sandpiper *(Calidris ferruginea)*	613.0	1.2	0	0	88.5	6.2	4.7	7.5
Red-necked Stint *(Calidris ruficollis)*	613.0	311.0	74.2	5.5	683.5	247.2	36.2	52.2
Sharp Tailed Sandpiper *(Calidris accuminata)*	22.5	1.2	0	0	231.5	68.7	0.2	0.2
White-headed Stilt *(Himantopus himantopus)*		9.8	32.2	45.2		50.7	741.2	26.0
Banded Stilt *(Cladorhynchus leucocephalus)*	127.0	913.2	303.7	775.0	1.0	78.7	177.5	14.2
Red-necked Avocet *(Recurvirostra novaehollandiae)*	0	25.7	0	1.5	0	8.4	16.2	37.7
Whiskered Tern *(Chlidonias hybrida)*	0	0	0	0	3.0	1.2	45.0	4.7
Fairy Tern *(Sterna neters)*	0	0	0	0	21.0	10.7	11.5	12.2

* Total number of Census during the period was 14.

prep.). The area being censused was roughly divided into parts about 100 m wide. Each part was examined systematically. If there was a large mixed flock in the area, each species was dealt with in turn, starting with the most abundant. In this way the presence of species only represented by a few birds could be casually noted before attempts were made to count them. Block estimations were made when numbers of a species present exceeded 300. This consists of counting a convenient number, usually 100 birds, and using the size and density of this block to estimate the remainder.

A census took about 4 hours, which always coincided with a high tide on the coast, as many migratory waders regularly moved between the salt fields and the coast in response to the tide. This type of daily movement between the coastal salt marshes and the coastal mud flats seems general in southern Australia, but it was not observed to any great extent at Darwin.

RESULTS

MEAN NUMBERS OF SPECIES SEEN PER MONTH (1972)

	March	April	May	June
Area A	7.5	8.0	6.0	6.5
Area B	22.0	21.25	22.25	22.25

MEAN NUMBERS OF BIRDS (ALL SPECIES) SEEN PER MONTH

	March	April	May	June
Area A	843.5	1488.25	540.0	845.5
Area B	1456.5	1091.75	1201.5	790.0

The same sort of "general trends" were indicated in four censuses carried out in the salt fields at Price, at the northernmost extreme of the St. Vincent's Gulf between February and May, 1972.

STATISTICAL ANALYSIS

The levels of variability for the common species seemed to be generally higher than for comparable areas in the Darwin region of the Northern Territory. This suggested that conditions in the census areas may have been particularly variable. This is possibly due to food supply, which might be expected in view of the workings on the salt fields. The apparent increase of White-headed Stilt was supported by a one way analysis of variance (within and between months, census areas being treated as one area. $F = 4.7331$, $P < 0.05$). The tests on the other apparent increase were at best inconclusive. This included the apparent increase of Greenshanks in B area ($F = 1.2429$ and $F0.05(2,11) = 3.98$). The other data for migratory waders were not tested in view of the time of year, that is, decreases were expected due to migration.

DISCUSSION

Salinity can be expected to have a marked effect on the food chains of which the birds form the top. Kinne (1964) says of aquatic animals:

> "Salinity may affect organisms through total osmoconcentration; relative properties of osmo-concentration; relative properties of solutes; coefficients of absorption and saturation of dissolved gases; density and viscosity of the medium and also possibly through the changes in absorption, radiation and transmission of sound and electrical conductivity."

Hypersaline environments give rise to highly specialised ecosystems which tend to support a comparatively small number of species though, at times, the total biomass may be large.

The data suggest that the number of ecological niches available to the birds was lower in Area A (very high salinity) than Area B, even though the two areas seemed to be supporting approximately the same number of birds, allowing for normal variations.

The fact that the period over which the census was conducted was so dry is of importance. Fresh water is less dense than salt water and brine. In saltmarsh situations, the fresh water from rain tends to "float" on top of the denser layers below unless physically mixed. The result is that after rain a steep salinity gradient may be present in the top few cm.

The reverse situation may occur with high evaporation rates, the upper layer developing higher salinity levels. This could be of ecological importance in the area as most aquatic organisms have a distinct salinity tolerance range. The degree of variability from week to week indicated by the census suggests that if results meaningful in terms of seasonal fluctuations are to be obtained, the census areas may have to be larger than those used in this study, or better sited.

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REFERENCE

KINNE, O., 1964. The effects of temperature and salinity on marine and brackish water animals. II. Salinity and Temperature-Salinity Combinations. Oceanogr mar biol Ann. Rev. 2: 281-339.

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