The biology and conservation of the Damara tern in South West Africa

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CONTENTS

ABSTRACT

The endemic Damara tern breeds at several sites along the South West African coast. In view of developments within its restricted range and its apparent scarcity studies were undertaken to assess the status and requirements of the species. Estimates of population size, aspects of the bird's breeding biology, and its conservation are discussed.

1 INTRODUCTION

Siegfried *et al.* (1976 a and b) list the Damara tern *Sterna balaenarum* as one of the twenty South African bird species most in need of conservation action. As such it has recently been the subject of studies by Frost and Shaughnessy (1976) Clinning (1977) and Frost and Johnson (1977). These three papers stressed that the major known breeding sites of the species are confined to the coastal gravel plains of South West Africa from Swakopmund 22°40'S 14°31'E to Cape Cross 21°46'S 13°59'E. The South West African Administration Division of Nature Conservation and Tourism has for some time been aware of the need for an investigation of the status and biology of the Damara tern in view of its restricted range and heavy utilization of the coast where it breeds by tourists. Casual observations of the birds' breeding to the north of Swakopmund were first made in the 1970 / 71 breeding season. The bulk of the data presented in this paper was collected during the 1975 / 76 and 1976 / 77 breeding seasons and where pertinent observations from earlier have been included.

The paper of Frost and Shaughnessy (1976) is taken as a point of departure and an attempt has been made to avoid repetition of their observations except where necessary for discussion.

2 STUDY AREA AND METHODS

The coast north of Swakopmund consists of gravel plains sloping upwards from a narrow belt of 1 – 2 m high *Salsola* sp. hummocks immediately inland of the beach. The only permanent shrubby vegetation on these plains is scattered plants of *Arthrerua leubnitziae* and *Zygophyllum stapfii* (Giess 1968). In some areas there is a considerable growth of lichens of two species, whilst in other areas barren dry salt pans occur. Although most of the coast appears visually similar the terns are restricted to a few chosen areas where they breed. They show marked fidelity to these areas and sites used for breeding during the 1976 / 77 season and were the same as those used during 1970 / 71.

From the beginning of October 1975 (the start of the birds' breeding season as given by Mackworth-Praed and Grant 1963) weekly visits were made to known breeding sites. Although birds were frequently en-

countered during these visits the first occupied nest was not found until 13 November. From this time onward all breeding areas were visited at two-day intervals. Observations of breeding birds were made from a vehicle parked on any of the numerous tracks criss-crossing the breeding areas. During journeys to and from known breeding sites other likely areas were searched for terns but in all cases these searches were fruitless.

At one nest a time lapse camera set to expose one frame every 1,5 minutes was used to monitor activity during incubation, over a three-day period. Originally an attempt was made to capture adults at occupied nests with a walk in trap (see Summers 1975). Only one bird was successfully marked using this method as birds were reluctant to enter the trap and in one case deserted their nest following a trapping attempt. Nest trapping was then discontinued.

3 STATUS IN SOUTH WEST AFRICA

Damara terns occur all along the South West African Coast, where they are present throughout the year. Observation suggests that northward migration to the tropical West African coast (as recorded by Bannerman 1953 and Mackworth-Praed and Grant 1963) involves the young of the year, which are seldom seen along the South West African coast during winter. No recoveries have been made of the small number of birds so far ringed.

Definite breeding records for South West Africa are from Elizabeth Bay (Frost and Johnson 1977), the Meob / Conception area, Sandwich Harbour, Walvis Bay and at fourteen localities between Swakopmund and Möwe Bay (Present study and Frost and Shaughnessy 1976). The area to the north of Möwe Bay has not been visited during the birds' breeding season. During a trip to Cunene Mouth in September 1975 Damara terns were regularly seen along this strip of coast and suitable areas occur there in which the birds could breed. Circumstantial evidence, adults carrying fish inland, suggests a breeding colony in the vicinity of Grosse Bucht at Lüderitz but no nests or young have been found there.

During December 1976 a survey of breeding sites between Swakopmund and Möwe Bay was undertaken. It was estimated at the time that some 1 200 birds were present in this area. To this can be added 50 between Oranjemund and Lüderitz, (Frost and Johnson 1977), 100 in the Meob / Conception area and 50 between Sandwich Harbour and Walvis Bay. The areas between Lüderitz and Meob Bay and between Möwe Bay and the Cunene have not been accurately censused but are known to support additional popu-

PLATE 1: Typical nesting habitat of Damara Tern north of Swakopmund.

lations of Damara terns. The minimum South West African population is then in the region of 2 000 birds and the total population probably not more than 3 500 to 4 000.

4 BREEDING

4.1 Nests and sites

Damara terns normally breed in loose aggregations. In favoured localities up to sixty nests have been found in a single season whilst at other places only single birds may breed. Breeding sites vary considerably and are therefore difficult to characterise. In general the birds choose areas offering good visibility and a firm stoney rather than sandy substrate. At Elizabeth Bay nests were found in slack areas between sand dunes (Frost and Johnson 1977). The now deserted colony just to the south of the Swakop River was in a similar situation. Other known colonies are on gravel plains, the hardened surface of dry salt pans and on bare rocky areas. Nests may be as close as 500 m from the sea or up to 3 km inland. The average distance between nine simultaneously occupied nests and their nearest neighbours in the 1975 / 76 season was 57,1 m (range 32 – 96 m). No territorial interactions were observed among incubating adults, even between closest neighbours. Mobile chicks which wandered on foot into close proximity of incubating adults were mercilessly attacked. The disturbed bird would peck the chick whilst standing beside it or swoop from above pecking the chick at each pass. Parents of chicks attacked in this manner made no attempt to intervene but stood by and called excitedly from some ten metres away.

There is considerable variation among individual nests. In some cases the egg is laid onto the bare ground without any nest being made. Normally however, there is some sort of scrape, frequently decorated with pebbles or bits of lichen around the rim. Nests are never close to bushes or large stones but may be associated with small surface features such as wheel tracks, small stones, discolourous gravel or tufts of lichen. Other than rendering the incubating bird less conspicuous these may aid in nest location in an otherwise somewhat featureless environment.

Nests are actively scraped out by both members of a pair. The birds shuffle with both feet while slowly turning in the chosen spot, and flick pebbles and other small objects from the scrape with their bills. Shuffling is also seen in females immediately prior to copulation and pebble flicking is used by both sexes as a displacement activity when they are disturbed near the nest.

4.2 Eggs and clutch size

In 91 nests found with eggs, clutch size has invariably been one. Another 40 records refer to single chicks.

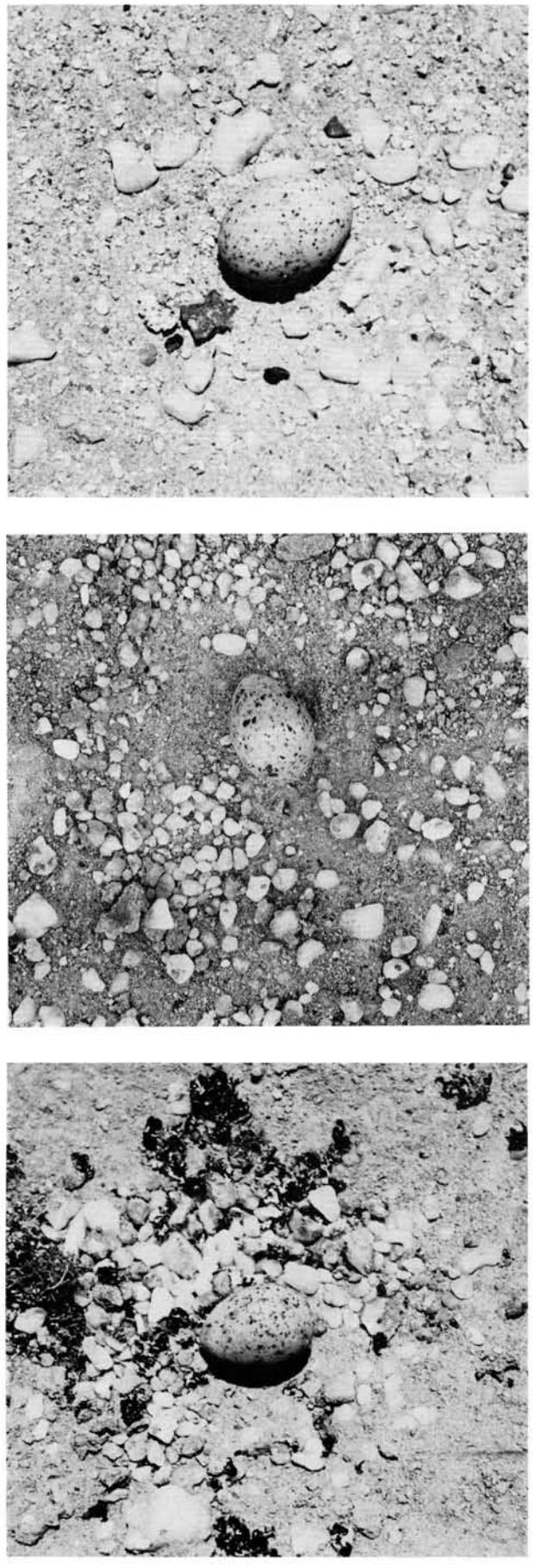

PLATE 2: Damara tern nests and eggs showing varying amounts of pebbles and lichen around nest scrapes.

Frost and Shaughnessy (1976) also only recorded single egg clutches at sites they visited on the South West African coast. McLachlan and Liversidge (1970) and Winterbottom (1971) both record the clutch as being one or two eggs. Two nest record cards on file with the Division of Nature Conservation and Tourism in Walvis Bay each refer to two chicks being fed by a pair of adults. Terns are by nature gregarious and these observations could result from unrelated chicks accompanying each other and being fed by separate parents. As no satisfactory evidence exists for a two-egg clutch it must be accepted that a single egg forms the normal clutch of this species.

Eggs are buff in colour with an even scattering of dark brown and underlying lighter brown speckles. Forty-eight eggs measured (x / S.D.) 33,3 / 0,92 × 23,9 / 0,44 mm (range 31,3 – 35,8 × 23,0 – 25,2). Two fresh eggs weighed 7,8 and 8,2 g respectively.

4.3 Breeding season

Figure 1 shows the number of nests, backdated to time of laying, for the 1975 / 76 breeding season. Earliest and latest egg dates for all seasons are 13 November and 25 February respectively. While there is no direct evidence in support of this the February record is thought to be a replacement clutch laid following the loss of the original egg by predation. The area in which this nest was found was used by a large number of birds which had either left or had large chicks in the area by February. During the 1975 / 76 breeding season two pairs lost eggs early in the incubation period and subsequently new nests were found within a few metres of the original sites. Neither of these pairs was colour marked but again the evidence suggests relaying. A colour marked pair were successful in their first breeding attempt and did not relay as far as is known. Maximum breeding activity appears to coincide with maximum day length in mid December (see Figure 1).

4.4 Incubation

Incubation begins with the laying of the single egg. Both sexes share in this duty and on occasion an incubating bird was fed on the nest without a change-over occuring. Four days of time-lapse photography at a single nest showed that the egg was incubated for an average of 94,3 % of the daylight hours and left uncovered for only 5,7 %. A bird was always present on the nest at sunset and again at sunrise. Continuous periods of incubation varied from a minimum of 3,4 minutes to a maximum of 370,6 minutes, with a mean of 68,8 minutes. The egg was left unattended for periods varying from 1,5 minutes to 66,3 minutes (mean 5,2 minutes). Extremely long periods of incubation may be misleading as change overs at the

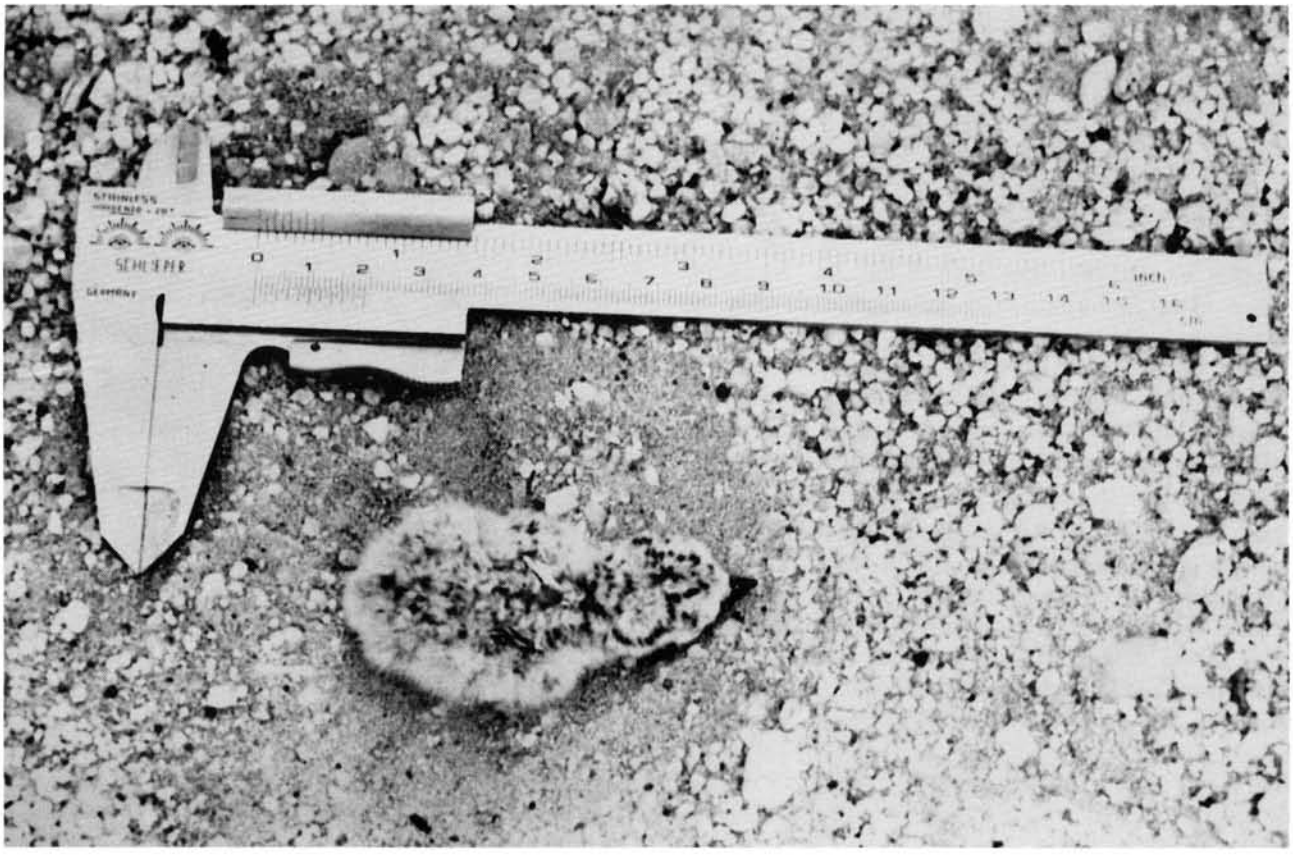

PLATE 3: Newly hatched tern chick still in nest scrape.

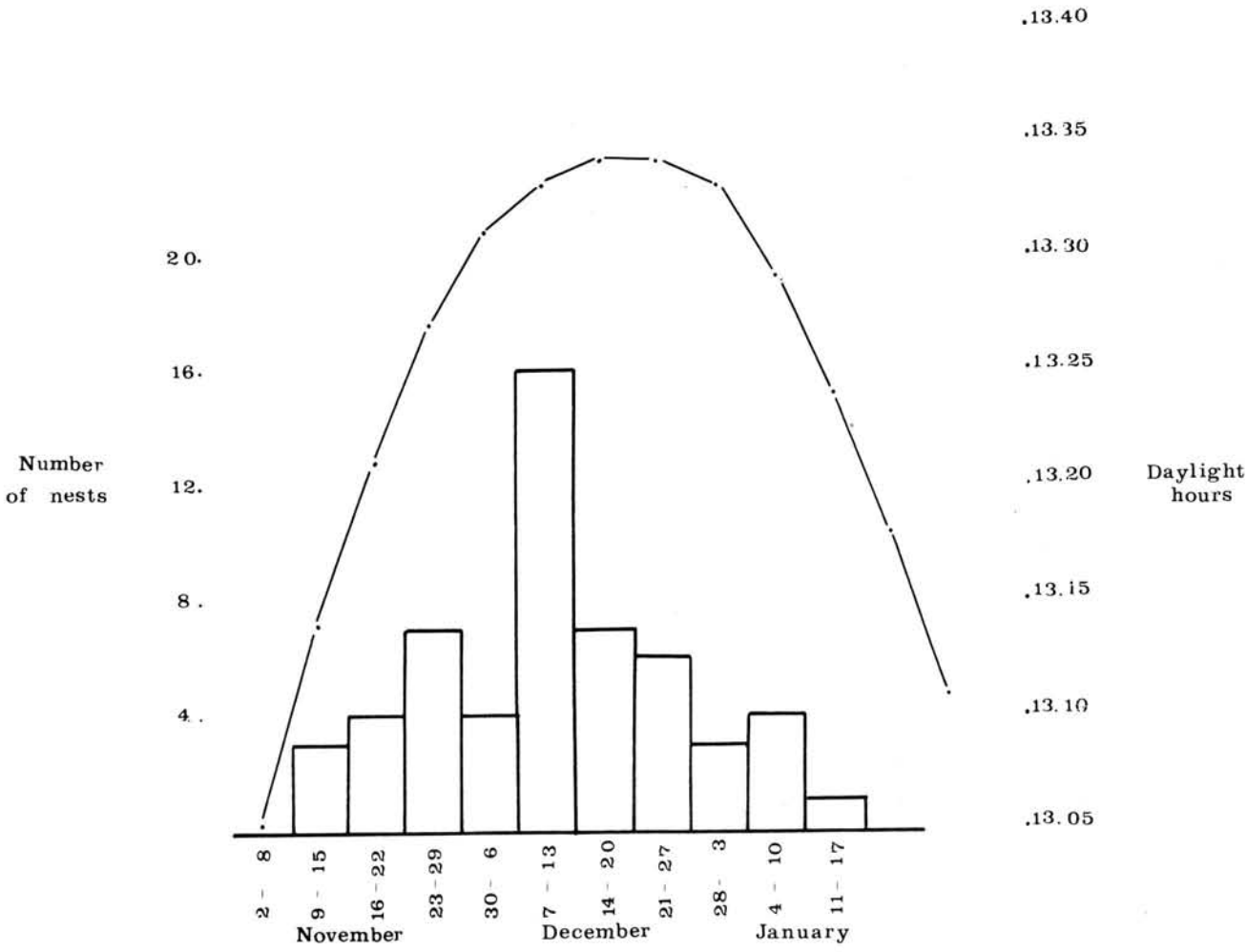

FIGURE 1: Histogram bars indicate number of nests, backdated to time of laying, for each week of the 1975 / 76 breeding season. Curve shows day length.

nest which took place rapidly may not have been recorded. The fact that the egg was left unincubated for a continuous period of 66,3 minutes on the fourteenth day of incubation apparently had no adverse affect on the embryo as it hatched and was raised successfully.

As breeding sites were visited only at two-day intervals it was not possible to determine incubation periods accurately. In the six most accurately determined cases incubation varied from a minimum of 18 days to a maximum of 22 days. This period is fairly consistent with those given for other terns by Parmelee and Maxon (1974), and for the 19 to 22 days given for *Sterna albifrons* by Witherby (1941).

Hatching takes place over a period of at least several hours. At one nest the egg was pipped at 12h00 on 14.3.75 and was still not hatched at 18h00 on the same day. When the nest was next visited on the morning of 16.3.75 the young chick was still in the nest scrape.

4.5 Growth and development of chicks

Newly hatched chicks are pale fawn coloured, with a few dark patches dorsally, and pure white below, as described by Frost and Shaughnessy (1976). Their feet and legs are yellow and bill black with a prominent white egg tooth. Frequently a small fragment of shell membrane adheres to the back of newly hatched chicks and may remain attached for a few days. Plate 3 illustrates a chick still in its nest scrape on the day of hatching.

During this study chicks were marked with a single coloured tarsal ring as soon after hatching as was possible. Thereafter they were weighed, and wing, tarsus and culmen measured on each occasion that individual chicks were encountered. When the tarsus had hardened and thinned sufficiently numbered metal rings were fitted to the leg opposite to that carrying the coloured ring. In this way it was possible to monitor the growth of chicks until they flew. Prior

to weighing, chicks were encouraged to regurgitate any fish they had recently ingested. Figure 2 gives growth rates based on averages of all known age chicks measured.

TABLE 1: Growth and development of Damara tern chicks from hatching up until first flight.

Age (days)	Mean Mass (g)	Mean culmen length (mm)	Mean wing length (mm)	Number of chicks
1	6,5	7,7	–	2
2	8,3	7,8	–	5
3	9,2	8,0	–	4
4	12,8	8,8	–	5
6	16,0	10,2	25	2
7	19,5	10,7	29	4
8	22,0	11,5	29	1
10	29,0	12,8	30	2
11	30,0	13,1	35	1
13	31,5	14,2	59	2
15	36,0	15,4	61	2
17	37,0	16,2	74	1
19	36,0	16,6	83	1
21	40	17,3	88	1

Tarsus measurements were found to be unreliable and are not included in the graphs in Figure 2.

Within two days of hatching chicks have usually left the nest scrape and may be found several metres from it. At this stage they are still brooded more or less continuously by one or other parent. From two days onwards chicks actively seek concealment among stones or bushes if disturbed. Table 1 gives descriptions of chicks during various stages of growth. Feathers first emerge on the scapulars and mantle of chicks, they are a rich chestnut colour but pale with age until in chicks just starting to fly they are fawn with numerous dark speckles. Flight feathers are grey as in adults but the coverts are brown with dark speckles. Young birds do not attain the black crown of adults in their first year but develop a black streak from the base of the bill, broadening through the lores and ear coverts, to the nape. The crown is speckled brown. This juvenile plumage closely resembles that of juvenile *Sterna lorata* as described by Devillers and Terschuren (1976). Plate 4 illustrates a newly-fledged chick.

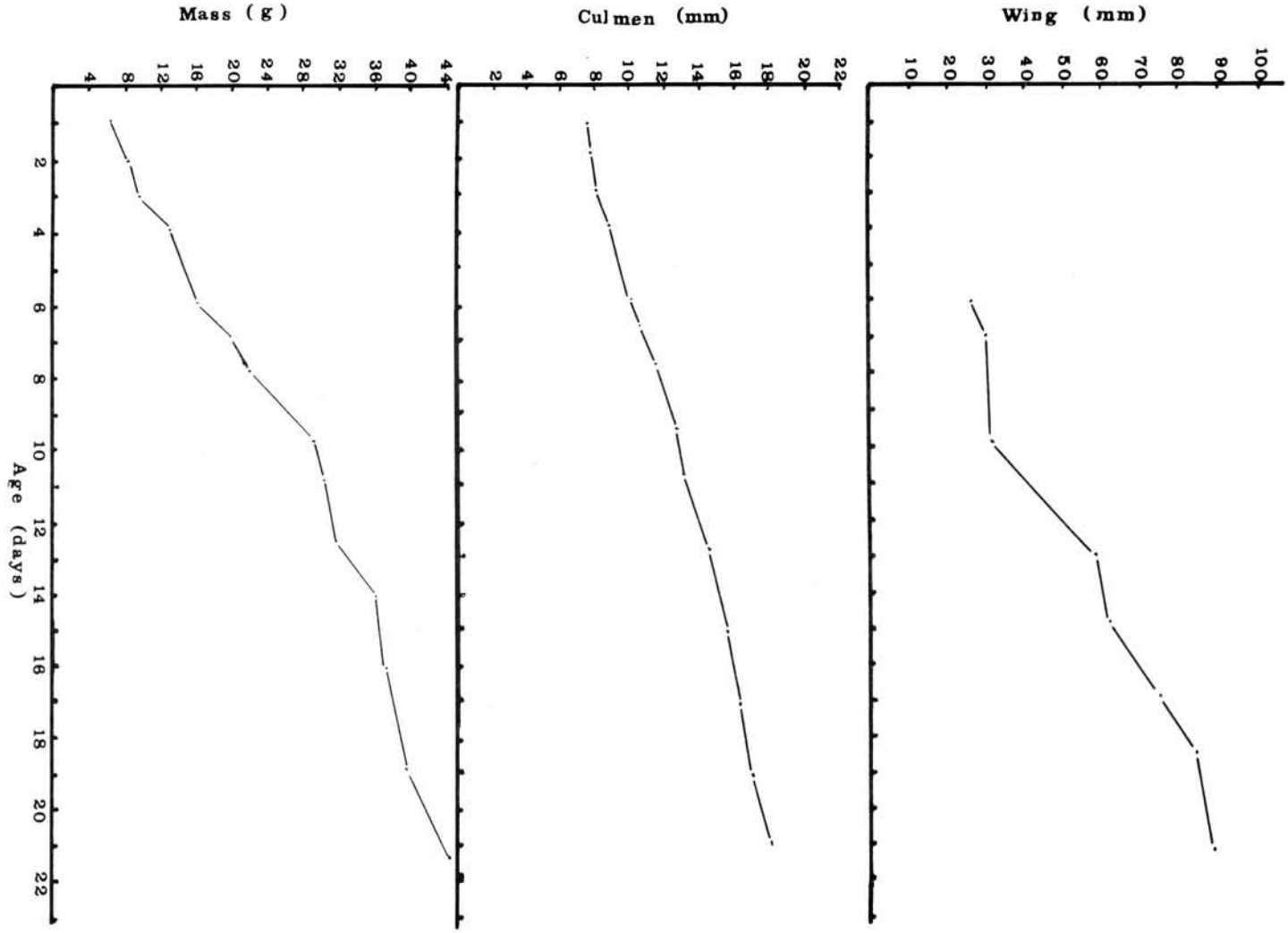

FIGURE 2: Growth rates of mass, culmen and wing. Points are means of all known age chicks measured, for number of chicks of each age see Table 1.

Chicks are first able to fly at 20 days of age. At this stage they are still considerably smaller than adults, averaging some 6 g lighter and with an average culmen length of 19,0 mm as compared to the 30,0 mm of adults. Post fledging dependence periods were not accurately recorded. Young were seen accompanying adults as late as June. The latest recorded hatching date is in mid March, which would give a minimum dependence period of 2½ months.

4.6 Predation and breeding success

Accurate estimates of breeding success were difficult to obtain as in many cases chicks disappeared without definitely having fallen victim to predators. Of 54 eggs found, 18 certainly hatched and a further 21 may have (these chicks were not subsequently found). This gives a minimum hatching success of 33 % and a maximum of 72 %. Of these at least 9 chicks survived to fly and a further 10 possibly reached flying age (16 % to 35 %). The chief natural predator is the Black-backed Jackal *Canis mesomelas*. Other possible predators are crows, gulls and the Brown Hyaena. At least ten of the 54 eggs mentioned above were lost to jackals, a further 4 disappeared without any signs as to cause, but were possibly taken by jackals. Three eggs were lost or deserted as a direct result of human disturbance in the immediate vicinity of the nest. Predation is most critical in the egg stage. Incubating birds are not cryptically coloured and are easily visible at a considerable distance. Eggs and chicks, however, are extremely well camouflaged and adults leave their nests readily at the approach of potential predators.

4.7 Food and feeding

Twenty-two individual food items were collected as regurgitates from chicks handled. Fifteen of these were an unidentified larval Blenny, three were small mullet *Mugil richardsonii*, two were anchovies *Engraulis japonica*, and two were unidentified small squid. Lengths of fish fed to chicks varied from 1,5 cm to 12,5 cm and mass from 2 g to 30 g. This 30 g meal was an anchovy regurgitated by an eighteen-day-old chick which itself only weighed 40 g.

Feeding terns fish in small bays, lagoons, and in the surf zone along the open coast. At the salt works north of Swakopmund sea water is pumped into a large pan where it undergoes initial concentration prior to being used for salt production. This pan is a favoured fishing

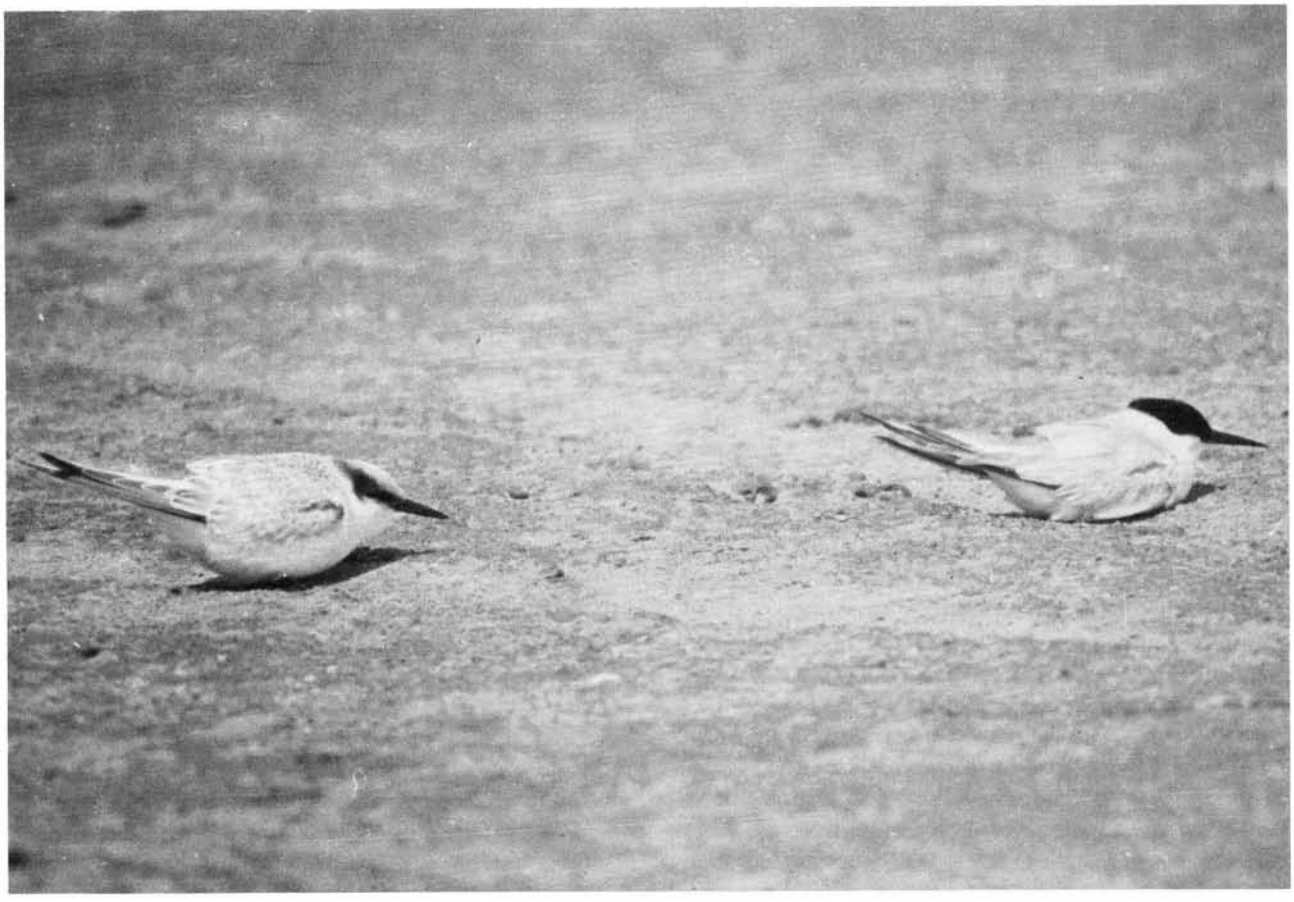

PLATE 4: Adult and newly fledged Damara Tern chick. Photo W. R. Tarboton.

locality for terns from a nearby breeding area. Attempts to correlate breeding areas with physical features on the coast which may influence food availability proved meaningless. Systematic sampling of food organisms in the surf zone may show that breeding sites are determined by the availability of food nearby.

5 DISCUSSION

5.1 Significance of one egg clutch

Frost and Shaughnessy (1976) commented at length on the single egg clutch of the Damara tern, which they regard as anomalous in the temperate zone inshore feeding terns. They suggest that clutch size in this species is a result of selection for maximum growth rate of young in consequence of the exposed nest site and high risk of predation. This applies acceptance of Lack's (1968) hypothesis that growth rates of birds have direct influence on reproductive success. Ricklefs (1968, 1969) regards growth rate as being determined within narrow limits by adult body size and precocity of development. In a later paper Ricklefs (1973) suggests that "nestling mortality is such a strong selective force that growth rate is driven to a physiological maximum rather than adjusted to some ecological optimum". In a number of cases however, including that of the Damara tern, it would be expected that the physiological maximum and the ecological optimum are synonymous.

Unfortunately Ricklefs (1973) presents no growth data for any of the group of terns to which the Damara tern belongs (see Schnell 1970). He does suggest that sea birds laying only one egg have slower growth rates than those having larger clutches. Growth rates given by Ricklefs (1973) for *S. fuscata* and *Anous stolidus* to support this hypothesis are in part explicable by the fact that they nest on tropical oceanic islands where predation pressures are low and food supplies may be sparse. Using formulae given by Ricklefs (1973) to calculate growth rate for the Damara tern gives a Kg = 0,273, a somewhat higher value than for the three temperate zone terns for which he calculated growth rates. All of these three species lay more than one egg per clutch.

Safriel (1975) proposed a model which relates brood size, and therefore clutch size, in nidifugous birds to protection which the parents can afford the young and to food availability. He derived his model from natural and artificially increased broods of *Calidris pusilla*, the young of which are precocial. Young Damara terns are only semi-precocial, requiring to be fed by their parents throughout their fledging period and for some time after. Safriel's (1975) model requires little modification to fit the conditions pertaining to Damara terns. Young Damara terns require protection from extremes of weather and from predators. Daily climatic variation may be extreme, depending on the extent and duration of fogs, and the present study has shown predation pressure to be high. Frost and Shaughnessy (1976) citing Pearson (1968) stress the need for small tern species to supply food to their chicks at a rapid rate. Any increase in the brood size of the Damara tern would limit both the rate of feeding and the amount of protection individual young would obtain.

The Least *S. albifrons*, Fairy *S. nereis*, and Yellow-billed *S. superciliaris*, terns, which are ecologically similar to the Damara all lay clutches of two to three eggs. All three of these species breed in sites different from those used by Damara terns; on beaches, small islands and sandbanks (Frost and Shaughnessy 1976 and references therein). Besides these sites being closer to food supplies those on islands and sandbanks would provide protection from terrestrial predators.

The ecologically equivalent Peruvian Tern *S. lorata* breeds in sites similar to those used by the Damara tern yet lays two eggs (Johnson 1967). The Peruvian tern is however more aggressive towards intruders and nests more colonially than the Damara. Both factors which would reduce the amount of protection an individual pair would need to provide their young.

5.2 Conservation

The coast of South West Africa can conveniently be divided into four regions of differing importance in the distribution and breeding of Damara terns.

5.2.1 The area from the Orange River to Walvis Bay

Most of this is diamond area and as such is not open to the public. Terns breeding in this area are protected largely by virtue of their isolation, but only two breeding sites are known. The flat, rocky area around Meob Bay, where the birds breed, is at present being prospected for uranium deposits. Mining developments within this area are therefore a possibility and would pose a threat to the existence of one breeding colony.

5.2.2 The area from Walvis Bay to the mouth of the Ugab River

This is the National West Coast Tourist Recreation area and suffers most disturbance from development and tourism. There are eight known breeding sites of Damara terns in this area, and it supports a high percentage of the estimated total population. Disturbance throughout the year but particularly during the breeding season is extremely high. During the three-month period November 1975 to January 1976 some 15 000 people made use of accommodation in rest camps and caravan parks controlled by the Division of Nature Conservation and Tourism along this stretch of coast (unpublished departmental report). An unknown number of tourists camped privately in the northern part of this area and others lodged in hotels at Walvis Bay, Swakopmund and Henties Bay. Angling

is the main attraction to holiday makers and tern breeding sites suffer considerable disturbance from vehicles turning off the main road to reach favoured angling spots.

At two major breeding sites within this area Roads Department has sited borrow pits where gravel is removed for maintenance of the main coastal road. A new road is planned and has in part been surveyed. Road construction will involve further removal of gravel and in some areas the proposed road traverses tern breeding areas.

5.2.3 The area between the Ugab River and Möwe Bay

This is the Skeleton Coast Park and as such is protected. There are six known Damara tern breeding sites in the area. Disturbance is limited within this area as it is largely closed to the public and no major developments have yet taken place here. Camping, at Torra Bay only, is permitted during the summer season but tourism at present causes no disturbance at any of the known breeding sites. There are two defunct diamond mines in the area, one of which is being developed as a tourist camp.

The Skeleton Coast Park does not enjoy National Park status and payable mineral deposits could result in mining within this area.

5.2.4 The area from Möwe Bay to the Cunene Mouth

This area is protected by virtue of its isolation but nothing is known of the number of Damara terns breeding there.

The Damara tern poses a serious conservation problem which requires urgent action. As a result of the present study proposals for the protection of breeding sites within the National West Coast Tourist Recreation area have been made. These have been accepted in principal by the Executive Committee for South West Africa and appropriate steps will hopefully be taken to protect certain sites.

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