Nest success of White-fronted Plover *Charadrius marginatus* and Kittlitz's Plover *Charadrius pecuarius* in a South African dune field

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Nest success of White-fronted and Kittlitz's Plovers was recorded in an area close to the Swartkops Estuary in South Africa in September-October 1997. In total, 12 White-fronted Plover nests and 16 Kittlitz's Plover nests were found, equivalent to densities of 36 pairs/km^2 and 56 pairs/km^2 respectively. Nest success was 43% for White-fronted Plover and 42% for Kittlitz's Plover. The main cause of nest loss was flooding on the equinoxial spring tide. Although chicks were not ringed and the fates of individuals could not be determined, chick survival was presumably very low since no chicks older than a few days of age were seen.

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INTRODUCTION

The members of the genus Charadrius that are most numerous as breeding birds along the coasts of southern Africa are White-fronted Plover *Charadrius marginatus* (later referred to as WFP) and Kittlitz's Plover *Charadrius pecuarius* (KP). Both species have a long breeding season along the south coast of South Africa lasting from August to February (Winterbottom 1963, 1968). Peaks in breeding numbers occur in December. Data on hatching and breeding success are scarce but can provide a useful tool in estimating the development of populations in addititiion to monitoring adult birds. In September and October 1997, nest records were kept of these two species in a South African dune field to estimate nest success.

METHODS

Data were collected at a dunefield *c.* 6 km east of Port Elizabeth (33° 52'S; 25° 38'E) in South Africa. The study area comprised a 2 km long beach and the adjacent dune field (Figure 1). On the landward side, the area was cut off from the Swartkops estuary by a highway. Only the 0.25 km wide area south of the road (dotted in Figure 1) was searched for nests and chicks, resulting in a total study area of 0.5 km^2. The beach was covered with stones and partially overgrown with vegetation. The vegetation on the dunes consisted of *Salicornia* sp., and grasses. Several sand/dirt roads traversed the dunefield. The dunes were intensively used by joggers at the weekend and the beach was frequently used by anglers who drove their off-road vehicles towards the Swartkops river mouth. Two tidal inlets are used for oyster farming. The oyster farm was permanently guarded by a group of dogs. Tidal range was 1-2 metres, but due to a steeply descending shore the intertidal zone was very limited. Avian predators were not common. Kelp Gulls *Larus dominicanus* were present but not in large numbers (several tens at the most), and were never observed roaming along the coast. They mainly roosted at the river mouth and fed in the estuary on mudprawns *Upogebia africana*. No tracks of ground predators such as mongoose, known predators of plover eggs at Langebaan Lagoon (Summers & Hockey 1980), were found.

Visits were carried out between 0700 and 1800 hours between 3 September and 20 October 1997. Nests were located by means of observing adult birds leaving their nests and by backtracking footprints in the sand. Eggs were measured and floated to estimate incubation stage. A short description of the nest surroundings was made. If possible, the distance to the nest at which the adult bird alarmed or left the nest was noted by counting the number of paces to the nest and later converting this to metres. Each nest was visited on average twice a week and the fate of the clutch was recorded. Nests were visited on the expected hatching date to ensure that they had hatched. If the nest disappeared prematurely, the possible cause of nest loss was determined. Nest survival and confidence intervals were calculated using the Mayfield method (Mayfield 1975, Johnson 1979). A record was kept of the number of alarming pairs with chicks present in the area. With some practice, a distinction could be made between alarm calls used during incubation and those used in the chick phase.

RESULTS

In total, 12 White-fronted Plover nests and 16 Kittlitz's Plover nests were found. At the peak of nest presence, at least 25 pairs (9 WFP and 14 KP) bred concurrently in the study area, equivalent to a breeding density of 36 pairs/km^2 and 56 pairs/km^2 respectively. These figures are based on nesting habitat only; the actual territories are likely to be larger and extend into the intertidal zone. The shortest distance between two nests (a WFP and a KP) was 9 m. The WFP clutches consisted

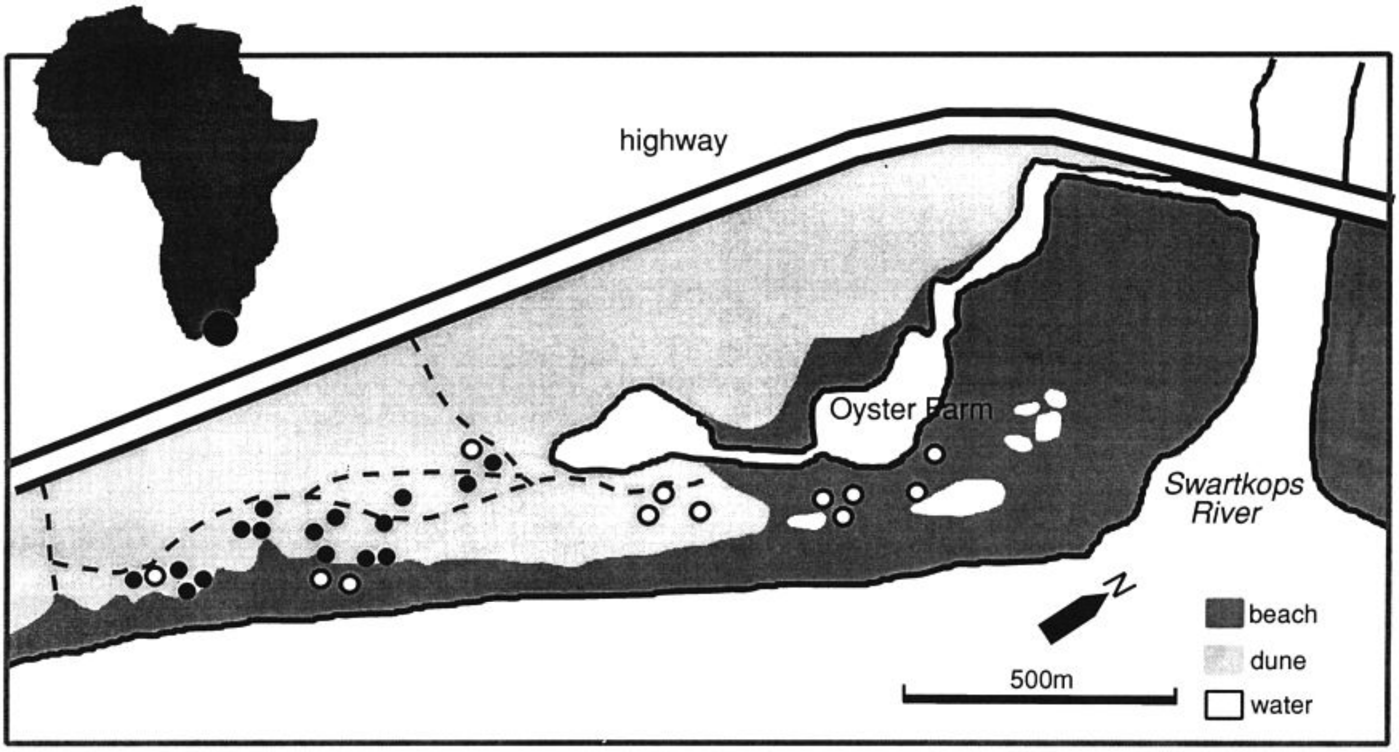

Figure 1. Study site at the Swartkops river mouth with nest locations. Nests of White-fronted Plovers are indicated with an open dot, nest of Kittlitz's Plovers with a closed dot. Only the area south of the road (dotted line) was intensively searched for nest/chicks. The edge of the beach represents the mean high water.

of one (1 nest), two (7) or three eggs (4, mean clutch size: 2.25); all KP nests contained two eggs. The incubation of the first nests found probably started on August 21 (WFP) and August 27 (KP), while the last observed nests were started on 5 and 6 October respectively (Figure 2). The first eggs hatched on 16 (WFP) and 22 September (KP); the last had still not hatched by the end of the study.

The majority of the WFP nests were found on the beach on sandy substrate with some shingle (Figure 1). Nests were lined with shells or vegetable matter. Apart from two nests that were in a clump of grass, all nests were exposed on all sides. KP nests were mainly found in the more vegetated parts of the dunes and along the sandy tracks. Three of these nests were built on top of a small (1 m high) dune. The nests were lined with small leaves.

On most nest visits, KP covered up their eggs with sand and plant material before leaving the nest. Only when they were taken by surprise and the nest was left in a hurry, was egg-covering skipped. In WFP, egg covering was never observed (contrary to Liversidge 1965 and Summers & Hockey 1981). The mean distance between observer and nest at which the incubating parent left the nest was larger in KP (27m, range=12-75 m, n=31) than in WFP (22m, range=10-50 m, n=39). On several occasions KP were not even seen leaving the nest, suggesting that the mean distance that causes the bird to leave the nest is even larger.

Since nest checks were not carried out daily, the exact incubation period (the time between laying and hatching of the last laid egg) could only be established for one WFP nest. Excluding the egg laying period, the incubation period for this nest lasted 26 days.

Total daily survival of the nests was 97% and 99% for WFP and KP respectively (Table 1). Since a nest can be lost in the egg-laying stage, this period needs to be included in calculations of nest survival. Using 26 days as the length of the incubation period, 2-4 days for the egg-laying interval (Summers & Hockey 1980) and mean clutch size of two eggs, the complete nesting period including egg-laying for WFP adds up to 28-30 days. For KP the incubation period could not be derived from the data but 23-26 days and a laying interval of 1-2 days are given in Cramp & Simmons (1983), resulting in a nesting period of *c*. 24-28 days for a two egg clutch. The probability of surviving a complete nesting period was 43% and 42% for WFP and KP respectively.

The main cause of nest loss was flooding by high tides. On 18 September, when the spring tide reached an even higher level than normal because of the equinox, a large proportion of the study area was inundated and nine nests were flooded (3 WFP, 6 KP). Apart from these losses, one WFP nest was predated, one deserted and one was driven over by an off-road vehicle.

Unfortunately the chicks could not be ringed, so no details on chick growth and survival were collected. However, during an attempt to catch adult and young plovers with torchlights and handnets on the night of 20 October, a group of four people covered the complete study area and a total of only four chicks was found. Three were KP chicks, of which two were only a few days old. The other chick was approximately a week old and the WFP chick about four days. During visits in daytime,

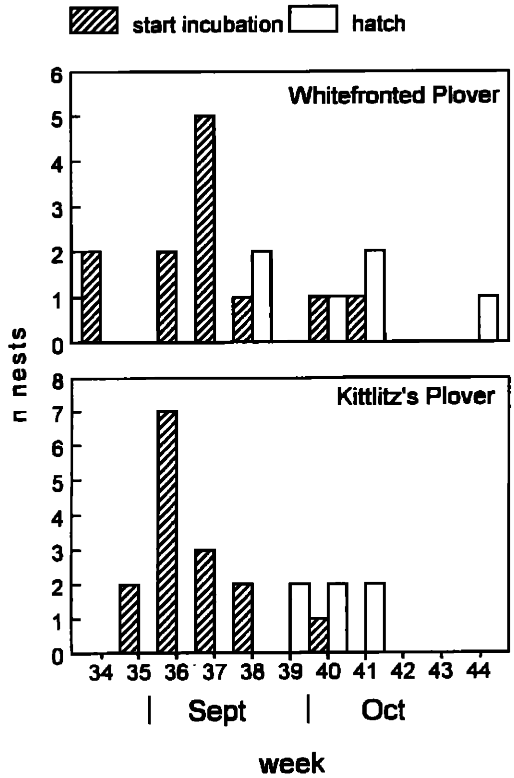

Figure 2. The timing of start of incubation and timing of hatching, as observed or as derived from incubation stage.

no chicks older than a few days were seen. By October 20, 12 nests had hatched and approximately 24 chicks ranging in age from 2 to 34 days should have been present in the study area. WFP chicks fledge at 35-38 days; KP at 26-32 days (Urban *et al.* 1986), which means that if any hatched chicks had still been alive at this stage, the oldest ones would have just reached fledging age. Given the observations noted above, I assume that a very large proportion of the chicks did not reach fledging age. Apart from predation, food shortage or disturbance might have caused the death of chicks.

DISCUSSION

Data on hatching success of these two plover species are very scarce. For White-fronted Plover only one study (Summers & Hockey 1980) mentions a daily survival probability of 0.9545 resulting in a probability of surviving a 32 day incubation period of 24.7%. At Langebaan Lagoon, where this study was undertaken, predation by mongooses caused most of the nest losses. Breeding success was 0.08 and 0.14 young per pair per season in two successive years. Records of Kittlitz's Plovers' hatching success range from 19 to 77% (del Hoyo *et al.* 1996). Breeding success ranges between 0.5 and less than two young per pair. Nest failures are reported to be mainly caused by flooding, vehicles and predators. The nest success recorded in this study falls well within the reported range. The main cause of nest loss in this study was flooding of nests on a single occasion: the equinoxial spring tide on 18 September. The nests were checked a few hours before high tide on this day. On no other spring tide did the water level get high enough that the study area flooded. If the equinoxal spring tide is a very regular event, with little variation in timing, it might act

Table 1. Nest success of White-fronted and Kittlitz's Plover. The survival probability is given on a daily basis and for the complete incubation period of 30 (White-fronted) and 28 days (Kittlitz‹s). 95% confidence intervals are given in brackets

	White-fronted Plover	Kittlitz's Plover
no. nest-days	210	192
no. nests hatched	6	10
no. nests flooded	3	6
no. nests predated	1	0
no. nests destroyed	1	0
no. nests deserted	1	0
daily survival probability	0.972 (0.949-0.995)	0.970 (0.945-0.995)
survival probability for laying and incubation period	0.430 (0.210-0.866)	0.423 (0.203-0.864)

Table 2. Timing of the equinoxal spring tide in the years 1979-1999. The date of the equinoxal spring tide shifts forward between years by 2-5 days for 2-3 years in a row and then jumps back 10-11 days in the next year.

year	date (September)	year	date (September)
1979	22	1989	16
1980	25	1990	20
1981	29	1991	25
1982	18	1992	27
1983	23	1993	17
1984	26	1994	21
1985	30	1995	26
1986	19	1996	28
1987	24	1997	18
1988	26	1998	21

as a selective pressure on laying date. Plovers might adapt so that either their eggs have already hatched before the equinoxal spring tide, or they start nesting only after this event. The predicted equinoxal spring tide over the past 20 years fell anytime between 16 and 30 September (a 14 day period is self-evident, since spring tides occur at new and full moon; Table 2). The difference in timing was as much as 11 days between consecutive years. Therefore, the variation in the date on which an area like this will flood may be too large to select for birds that time their nesting activities relatively early or late. The nests that were on small dune tops and at more inland sites might reflect an alternative form of adaptation to the dynamic environment. Furthermore the plovers' breeding season is very long (June-January, Summers & Hockey 1980) and all sorts of factors other than flooding of the nests may affect breeding success.

Although no thorough study of the chicks' fate was carried out, very few chicks more than a couple of days old were observed. Also, the number of territorial pairs decreased in the period after most clutches had hatched. If parents still have chicks their alarm is unmistakable. Unless the parents (with chicks) moved inland away from the study area and remained unnoticed, chick survival was very low.

Possible reasons for the assumed low chick survival at Swartkops are predation, starvation, disturbance or a combination of these factors. Although it cannot be excluded, no direct clues pointing to high levels of predation of the chicks were found. Apart from Kelp Gulls, no other avian predators were common. During all visits only one bird of prey, a Marsh Owl *Asio capensis*, was observed; these are known to feed mainly on rodents (Harrison *et al.* 1997). Families with young chicks were mostly found in the transition zone between the beach and the dunes (WFP) and amongst the dune vegetation (KP), where disturbance by people regularly occurred. Disturbance may reduce feeding time and can hamper access to favourable feeding areas.

Mean annual survival rate for adult White-fronted Plovers is 87.6% (Summers & Hockey 1980). Data on survival rates of young birds (until the second year) are not available, but if we assume this to be in the range of the survival rates of the northern hemisphere plovers that closely resemble White-fronted Plovers, Kentish Plover *Charadrius alexandrinus* (64%, Page *et al.*, 1983), each pair has to raise 0.4 young per year to maintain a stable population.

Information on the status of both species in South Africa is limited but for White-fronted Plovers there is thought to have been an overall decline in population and breeding success due to increasing use of beaches by off-road vehicles and holiday makers (Harrison *et al.* 1997). For another beach-breeding wader, the African Black Oystercatcher *Haematopus moquini*, it has been suggested that, in mainland situations, breeding success has declined due to increasing recreational use of beaches, while it has remained constant on islands (Hockey 1997).

In addition to data on status, information on the different factors affecting reproductive success is essential to estimate their impact on population dynamics. This is especially true of species which might be affected by human use of their breeding areas, in order to be able to identify problems in time.

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