NOTES ON THE STATUS AND BREEDING OF THE IMPERIAL CORMORANT PHALACROCORAX ATRICEPS AT HEARD ISLAND

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INTRODUCTION

The Imperial Cormorant *Phalacrocorax atriceps* is a sedentary species which occupies a range of between 38° and 65°S, including the coasts of southern South America, sub-Antarctic islands and the Antarctic Peninsula (Watson 1975, Harrison 1983). The taxonomy of the group is confused but eight subspecies are generally listed with *P.a. nivalis* being endemic to Heard Island (Watson 1975, Harrison 1983).

Sub-Antarctic Heard Island (53 05S, 73 50E) lies in the Southern Ocean, 450 km southeast from Iles de Kerguelen on the Kerguelen-Heard submarine plateau. The Island is 42 km long, 16 km wide, predominantly ice-covered and with an elevation of 2 750 m above sea-level. Very little has been published on the Imperial Cormorant at Heard Island, the most detailed records being made by Downes *et al.* (1959), during the only extended occupation by biologists on the island. Since that time visits to the island and records of the cormorants have been infrequent and restricted to brief notes in Johnstone (1982), Vining (1983) and more extensive records in Burton & Williams (unpubl.). We visited Heard Island between 14 November 1986 and 21 January 1987 and made observations on the population numbers, breeding and roost sites of the cormorants. In this paper we collate the available information and comment on the status and breeding of the Imperial Cormorant at Heard Island.

METHODS

At Heard Island we counted all cormorants, classifying them as juveniles or adults on plumage characteristics (Williams & Burger 1979, Harrison 1983). We visited breeding colonies on several occasions counting birds, nests, eggs and chicks. Chicks were aged from descriptions in Williams & Burger (1979). Our arrival on Heard Island was after eggs had been laid, so extrapolating from chick growth data (Williams & Burther 1979), and the assumption that an incubation period of between 29 (Williams & Burger 1979) and 33 days (Brothers 1985) was applicable, the breeding season was estimated. Searches, both on foot and by helicopter, were undertaken to locate breeding colonies and roost sites. Roosts are defined as areas with accumulated guano deposits that are usually associated with the presence of regurgitated pellets.

RESULTS AND DISCUSSION

Breeding Colonies, Nests and Eggs

Two breeding colonies were found (Fig. 1), both on the northwest of the island, at Sydney Cove and Saddle Point in the tussock grassland community (Hughes in press). The Sydney Cove colony was situated on mainland cliffs opposite a 30-m high vegetated rock stack, approximately 50 m offshore, the same location as recorded for the 1985/86 breeding season (Burton & Williams unpubl.). Both Downes *et al.* (1959) and Johnstone (1982) report the Sydney Cove colony to have been on the offshore rock stack.

The colony at Saddle Point was at the edge of weathered lava cliffs. This site also is locally transient. In 1985/86 the colony comprised two distinct nesting aggregations, 15 m apart (Burton & Williams unpubl.). In 1986/87 there were four sites along the cliff edge which showed signs of recent cormorant occupation, but only one of these was in use.

One nest containing a single chick was found at Stephenson's Lagoon in 1983 (Vining 1983). There was no sign of breeding at this site either in 1985/86 (Burton & Williams unpubl.) or in 1986/87. Apart from restricted local movements therefore, it appears that the cormorants are faithful to their breeding areas, only two of which have been consistently recorded on the island. Johnstone (1982) stated that there were no cormorants on the nearby McDonald Islands (40 km west of Heard Island) and none was recorded at Shag Island (12 km north) in the summer of 1983 (Vining 1983).

Nests were composed of the most readily available material, principally the tussock grass *Poa cookii*. The nests were compacted with both mud and guano and tended to degenerate as chicks grew. In 1985/86, 11 clutches were observed (Burton & Williams unpubl.) and these contained a mean of 2,5 $\pm$ 0,5 eggs per nest. This is similar to the average clutch size of 2,7 for Imperial Cormorants on Macquarie Island (Brothers 1985). Downes *et al.* (1959) reported that two to four eggs are laid per clutch, four eggs being the usual clutch. On Macquarie Island the maximum clutch size recorded was three eggs (Brothers 1985).

Breeding Season and Success

In 1986/87 egg laying began in early October and continued through to early November, with most being laid in mid to late October. This timing is consistent with Burton & Williams (unpubl.), who recorded the first egg on 23 October and the first chicks on 19 November. In 1948 laying commenced in mid-October but slightly earlier in 1949, when, extrapolating from observations of pipping eggs, laying would have commenced in early October (Downes *et al.* 1959). These data suggest that cormorants on Heard Island generally start laying in early October with the majority of eggs being laid in the last half of October. This is consistent with the Macquarie

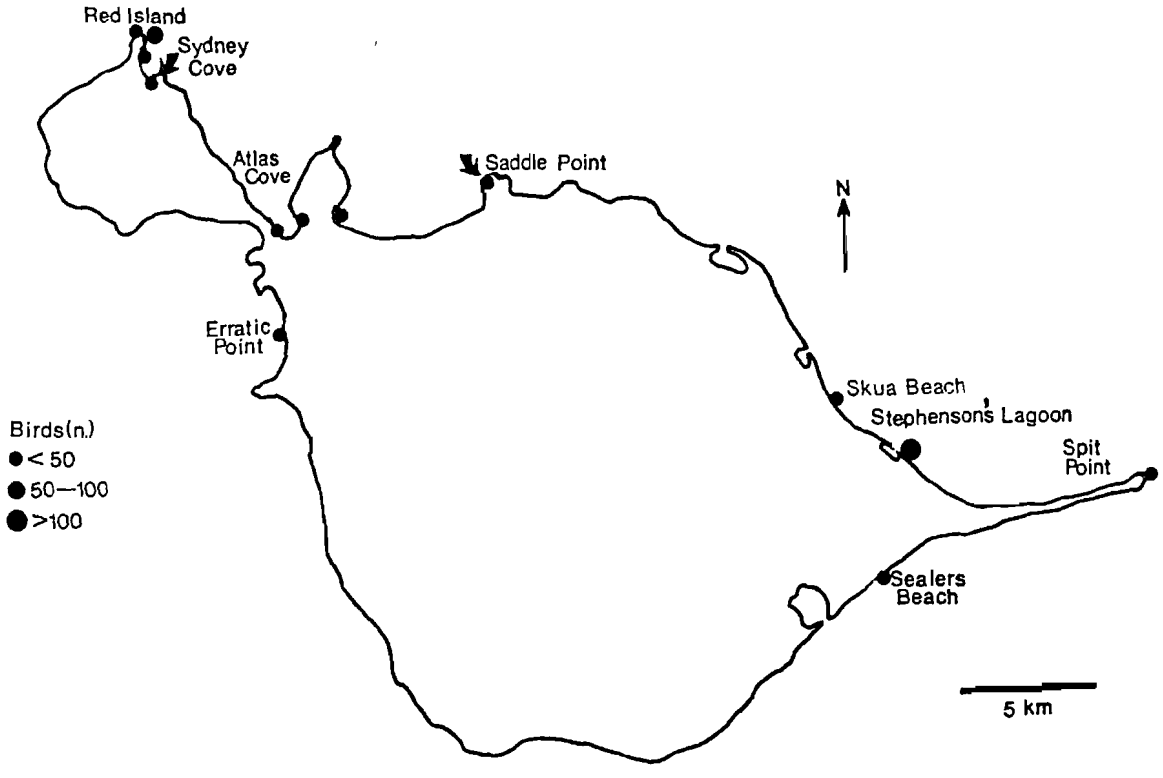

Figure 1

Heard Island showing location of breeding sites and location and size of roost sites of Imperial Cormorants. Breeding sites denoted by arrows, roost sites by circles (small circle: <50 birds, medium circle: 50-100 birds, large circle >100 birds).

Island and Marion Island subspecies *P.a. melanogenis* although the species may initiate breeding earlier or later at the other localities (Table 1).

Downes *et al.* (1959) stated that *c.* 20 pairs nested annually at Sydney Cove and six to eight pairs at Saddle Point, giving a total breeding population of about 25-30 pairs. From a maximum of 90 nests observed in 1985/86, taking nest failures into account and combining the number of eggs and chicks seen, a maximum of 43 chicks could potentially have fledged in that season (Burton & Williams unpubl.). In 1986/87 however, we did not see any cormorants with juvenile plumage, indicating that either the fledging success of the previous season was low or that the juveniles did not survive their first year. This assumes that the juvenile cormorants on Heard Island are similar in appearance to those on Macquarie Island where the species is sedentary and juveniles do not attain adult plumage until their second year (Brothers 1985). In the 1986/87 season, a maximum of 27 nests being attended by adults was counted, seven nests containing a total of nine chicks. After two chicks disappeared, a maximum of only seven could have fledged.

Roost Sites

Thirteen roost sites have been identified (Fig. 1). These sites show a temporal stability in their occupation (Downes *et al.* 1959, Burton & Williams unpubl., G.W. Johnstone pers. comm.). Unlike the breeding sites, both of which are restricted to cliff edges on the northwest of the island, the roost sites are more widely distributed (Fig. 1). Roost sites range from cliff tops similar to the breeding areas (e.g. Red Island), offshore rock stacks (e.g. Skua Beach), boulder beaches (e.g. Atlas Cove) to black volcanic sand (e.g. south Spit headland).

Although numbers of birds present at these sites varied both through the day and between days, roosts can be classed according to size of occupancy (Fig. 1). Most roosts contained between 10 to 20 birds. The Red Island roost was larger, with Stephenson's Lagoon being the major roost site. Largest congregations were counted at dawn and dusk with the highest totals being recorded at Stephenson's Lagoon: 215 individuals in 1983 (Vining 1983), 548 in 1985/86 (Burton & Williams unpubl.) and 340 in 1986/87.

Population Size and Status of the Imperial Cormorant at Heard Island

Without concurrent counts of cormorants around the island, or knowledge of the local movements, an accurate assessment of the population size is impossible. Downes *et al.* (1959) surmised that the total population is small. Based on counts at roost sites and the total number of roost and breeding sites it is likely that the population is in excess of 600, but probably less than 1 000 individuals.

TABLE 1

TIMING OF INITIATION OF BREEDING BY IMPERIAL CORMORANTS *PHALACROCORAX ATRICEPS*

Subspecies	Locality	Earliest laying date	Source
P.a. atriceps	Mocha Island 38S, 74E	mid-Nov	Murphy (1936)
P.a. melanogenis	Iles Crozet 46 25S, 51 45E	late Oct	Derenne *et al.* (1976)
P.a. melanogenis	Prince Edward Island 46 38S, 38 00E	mid-Jun	Ryan & Hunter (1985)
P.a. melanogenis	Marion Island 46 52S, 37 51E	12 Oct Jul-Aug	Williams & Burger (1979) S. Hunter *(in litt.)*
P.a. nivalis	Heard Island 53 05S, 73 50E	early Oct	This study
P.a. purpurascens	Macquarie Island 54 30S, 58 57E	30 Sep	Brothers (1985)

Low food availability and adverse weather conditions have been suggested as the causes of poor breeding success and adult mortality in cormorant populations along the Namibian coast (Crawford *et al.* 1980), on Marion Island (Williams & Burger 1979), and Macquarie Island (Brothers 1985). N.P. Brothers (pers. comm.) has observed up to 90 % mortality of cormorant chicks after a single storm on Macquarie Island. The weather conditions during the breeding season (October - March) on Heard Island are more severe than on Macquarie Island (Allison & Keage 1986, G. Copson pers. comm.). The impact of adverse weather conditions on breeding success could be even greater at Heard Island. The effects of adverse weather on breeding success may be manifested by not only the physical destruction of nests but also by restricting access to the food sources of breeding adults.

Imperial Cormorant chicks are susceptible to starvation during brief periods of food shortages since there is only limited accumulation of fat reserves in the first eight weeks of growth (Williams & Burger 1979). These cormorants do not employ resource storage, postulated by O'Connor (1978) as an appropriate strategy when food levels fluctuate during the chick-rearing period. Given the range in clutch sizes observed on Heard Island, and that Downes *et al.* (1959) observed many four-egg clutches, it could be that the cormorants are capable of clutch size adjustment, an alternative strategy suggested by O'Connor (1978). The cormorants may then be capable of extremely high productivity in some years which would offset the effects of the seemingly more frequent years of low breeding success.

More data are required to establish the factors controlling the size of the Imperial Cormorant population on Heard Island, but the results presented here indicate that there may be strong limiting factors in operation. Therefore, the introduction of activities such as commercial fishing in the area could be deleterious for the survival of the species on Heard Island. In addition, the low population size makes the Imperial Cormorant susceptible to inbreeding depression and low genetic variation. Franklin (1980) suggested that a minimum population of 50 would prevent the former and 500 the latter. Frankel (1982), however, pointed out that these estimates would have to be increased by as much as an order of magnitude because effective population size (the number of breeding adults) is usually much smaller than the observed population size.

We consider the Imperial Cormorant population of Heard Island to be vulnerable as defined by Ride & Wilson (1982). The population fits their definition, being localized in its distribution, having a small population and the introduction of a process such as commercial fishing could endanger its survival.

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