WINTER DIET OF THE SUBANTARCTIC SKUA *CATHARACTA ANTARCTICA* AT MACQUARIE ISLAND

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Received 4 November 2003, accepted 25 May 2004

The Subantarctic Skua *Catharacta antarctica* has a wide circumpolar breeding distribution that includes most of the Southern Ocean islands from the Antarctic Continent northwards to the Chatham Islands (Higgins & Davies 1996). The sub-Antarctic islands provide the species with a variety of potential prey captured using a range of feeding techniques including predation, scavenging and kleptoparasitism (Higgins & Davies 1996, Reinhardt *et al.* 2000). The species is usually migratory, spending the summer on the islands, and then in the winter months dispersing at sea northwards. In some localities where prey is available year-round, particularly in temperate-zone islands such as the Chatham Islands, the Subantarctic Skua may be resident (Hemmings 1990). Little information is available on the diet of the species in the non-breeding season (Furness 1987, Reinhardt *et al.* 2000) apart from at the Chatham Islands (Hemmings 1990).

Macquarie Island (54°40'S, 158°49'E), situated in the Southern Ocean, supports an estimated population of approximately 550 breeding pairs of Subantarctic Skuas during the summer months (Rounsevell & Brothers 1984). There have been no recent total-island breeding counts of that species on the island. The population is typically migratory, with most individuals leaving in March and April. Stragglers persist on the island until the first week of June (Falla 1937, Jones & Skira 1979). The first arrivals occur in late August, and during September numbers rapidly increase. In previous years no skuas have remained on Macquarie Island over winter (Jones & Skira 1979, Tasmanian Parks and Wildlife Service unpub. records, G. Copson pers. comm.), but since 1999 small numbers of skuas have remained on the island during the winter months (S. Robinson & M. Schulz unpubl. data). Because of the size (120 km^2) and ruggedness of terrain on the island, an accurate count of wintering skuas was not possible during the present study. However, the minimum total population was estimated at fewer than 20 individuals of mixed age classes in mid-winter, with maximum monthly winter congregations ranging from three birds in July to seven in August 2003. Here we report on the winter diet of the Subantarctic Skua between 1 June and 31 August 2003.

To investigate prey taken, dietary studies of the Subantarctic Skua during the breeding season have predominantly examined remains and regurgitation pellets deposited adjacent to nests within breeding territories (Reinhardt *et al.* 2000). Unlike the situation in temperate localities such as the Chatham and Snares Islands (Horning & Horning 1974, Hemmings 1990), no breeding territories on Macquarie Island appeared to be occupied during the winter months, with little territorial behaviour as described by Burton (1968) observed. Diet was therefore not investigated using pellets and prey remains because

- the lack of such defended territories and regular resting/loafing sites makes the collection of remains and pellets difficult.
- difficulty arises in reliably ageing pellets encountered at irregularly used resting or feeding sites.
- regurgitation pellets underestimate soft prey items, such as fish and carrion flesh (Young 1990, Reinhardt *et al.* 2000), and those prey may be an important component of the diet in overwintering skuas.

Instead, all dietary records were obtained by direct foraging observations around the island. All skuas encountered were checked for feeding behaviour. Non-foraging individuals on the ground were observed for 10-minute+ periods to maximize the number of feeding observations. Flying individuals detected were observed using 10×42 binoculars until they flew out of view, landed and commenced bathing or resting behaviour, or engaged in prey capture or feeding behaviour. When foraging was observed, the date, locality, habitat (divided into plateau, escarpment slope, coastal terrace and shoreline), identity of the prey item, foraging technique [classified as predation, scavenging or kleptoparasitism (after Reinhardt *et al.* 2000)] and the capture technique deployed where predation was involved were recorded.

Daily one-hour sea watches (except on days of continuous rain or snow, or sea fog) were conducted with a 25× field telescope to record foraging observations over inshore waters. Dusk and early evening watches were conducted at winter-breeding Grey Petrel *Procellaria cinerea* colonies or Blue Petrel *Halobaena caerulea* and Fairy/Fulmar Prion *Pachyptila* spp. colonies when non-breeding individuals were present. All detected marine mammal (Killer Whale *Orcinus orca* and New Zealand Fur Seal *Arctocephalus forsteri*) foraging episodes that attracted mixed-species flocks of scavenging seabirds were scanned for skuas. Spotlighting at night with a hand-held 50-W spotlight was conducted in all habitat types across the island to record nocturnal foraging.

We recorded 143 foraging observations in approximately 415 diurnal field observation hours during the three-month period (Table 1). Most food items had previously been recorded in the diet of this species, with the exception of the scavenging observations on beach-cast New Zealand Fur Seal, Spectacled Porpoise *Australophocaena dioptrica* and King Crab *Lithodes murrayi* (Reinhardt *et al.* 2000).

The predominant observed prey item was the introduced European Rabbit *Oryctolagus cuniculus,* with most of those observations constituting skuas scavenging on rabbits that had been dead for some time (n = 48). It is unknown how many of those rabbits had been killed by skuas before the sightings. Predation on live rabbits consisted primarily of targeting kittens or juveniles (n = 11) and myxoma-infected individuals (n = 6). The rabbits were captured either by "crash diving" and knocking the rabbit off its feet, followed by pinning it to the ground; or crash-diving followed by one or more lunges as the skua pursued the evading rabbit over the ground on foot. Additionally, three unsuccessful crash diving attempts aimed at live adult rabbits ended in the rabbit escaping down a burrow or into grass tussocks *Poa foliosa*. Rabbits were the only prey item observed taken on the plateau area of the island.

The King Penguin *Aptenodytes patagonicus* was the second most commonly observed prey item (n = 46). All foraging on this species occurred by scavenging on carcasses that were the result of Giant Petrel *Macronectes* spp. predation, seal predation (as evidenced by inverted carcasses on the tideline) or death through unknown causes. Skuas frequently scavenged on the edge of Giant Petrel groups feeding and squabbling over a carcass.

Scavenging on beach-cast or stranded individuals of various species (excluding King Penguins) accounted for 23 foraging observations. The most common species was the Southern Elephant Seal *Mirounga leonina,* including three observations of feeding on recently aborted foetuses in July. Individual skuas were observed pecking at clusters of Goose Barnacles *Lepas* spp. attached to beach-cast foamed plastic, driftwood and a fishing buoy. *Lepas* was an important dietary item for skuas overwintering on the Chatham Islands (Hemmings 1990).

TABLE 1
Frequency of prey items taken by wintering Subantarctic Skuas *Catharacta antarctica* on Macquarie Island

Prey species	Foraging method	Occurrence (n=143)
Mammals		
European Rabbit *Oryctolagus cuniculus*[a]	S	48
European Rabbit *O. cuniculus*[a]	P	20
Southern Elephant Seal *Mirounga leonina*	S[b]	8
Black Rat *Rattus rattus*[a]	P	3
House Mouse *Mus musculus*[a]	P	3
New Zealand Fur Seal *Arctocephalus forsteri*	S[b]	2
Spectacled Porpoise *Australophocaena dioptrica*	S[b]	1
Birds		
King Penguin *Aptenodytes patagonicus* (chick)	S	26
King Penguin *A. patagonicus* (adult)	S	20
Gentoo Penguin *Pygoscelis papua*	S[b]	3
Fairy/Fulmar Prion *Pachyptila* sp.	S[b]	1
White-headed Petrel *Pterodroma lessonii*	S	1
Invertebrates		
Goose Barnacle *Lepas* sp.	S[b]	5
King Crab *Lithodes murrayi*	S[b]	1
Chiton *Plaxiphora aurata*	S[b]	1

[a] Introduced species.
[b] Foraging on stranded or beach-cast individuals.
S = scavenging; P = predation.

No skuas were observed scavenging on food scraps about the base during the winter. The absence of this behaviour may be attributed to a policy of base personnel being discouraged to feed this species. Additionally, food scraps were not deposited about the base, but, in an effort to avoid an increase in introduced rodent populations, were instead incinerated or packaged for return to Australia.

Three Black Rats *Rattus rattus* and one House Mouse *Mus musculus* were captured by skuas crash diving on the edge of *P. foliosa* tussocks on rock stacks or the edge of the shoreline. Two House Mice were located and consumed by individuals probing the base of *P. foliosa* pedicels on coastal slopes heavily grazed by rabbits. The only feeding attempt on the two introduced passerine bird species resident on the island was an unsuccessful crash dive at a flock of foraging European Starlings *Sturnus vulgaris.*

No incidences of confirmed kleptoparasitism were observed. However, on three occasions individual skuas were observed pursuing immature Kelp Gulls *Larus dominicus* for brief periods although without apparent effect.

Direct observations of skuas encountered at night have provided an indication of nocturnal foraging in the species at other localities (e.g. Young 1978). We recorded 46 skuas in 141 spotlight hours with no foraging observations recorded. All individuals were either standing (n = 30) or resting on the ground (n = 16) with no fresh prey item remains in the vicinity. No flying individuals were observed while spotlighting. Similarly, no foraging observations were recorded at dusk around known colonies of the Grey Petrel (nine observation hours), Blue Petrel (six observation hours) or Fairy/Fulmar Prion (four observation hours). Although the Grey Petrel is the only winter-breeding petrel on Macquarie Island, the species not being targeted by the Subantarctic Skua is unsurprising because of its rarity, with breeding confirmed only since 2000, coinciding with the extermination of the Domestic Cat *Felis catus* (S. Robinson & M. Schulz unpubl. data).

Nine single Subantarctic Skuas were observed offshore in 87 sea-watch hours, with no foraging behaviour observed. Most birds (n = 7) were located within 200 m of the shore flying parallel to the coastline rather than returning inshore from distant feeding grounds. No skuas were observed in mixed-species flocks attracted to feeding Killer Whales (four observations) or New Zealand Fur Seals (nine observations).

The reasons for small numbers of skuas overwintering on Macquarie Island since 1999 are unclear. Rabbit numbers have increased since the eradication of the Domestic Cat, but have not risen to pre-myxoma population numbers as recorded in the 1970s, during which time no overwintering skuas were reported (Jones & Skira 1979, Copson *et al.* 1981, G. Copson pers. comm., Tasmanian Parks and Wildlife Service unpubl. data). Those observations suggest that factors other than rabbit numbers may be responsible for the recent presence of a small overwintering population. Those factors may be related to unknown changes in the marine environment (although no commercial fishing activities operate in the waters around the island during the winter months to support

scavenging skuas). Overwintering may be a result of learned behaviour exploiting new or expanding food resources. King Penguin chicks and attendant adults are present throughout the winter months, with the total number of breeding pairs estimated at 500 000 birds (Robinson & Scott 1999). Breeding numbers have increased annually by 9.7% on the island (Rounsevell & Copson 1982). Although no current population estimates are available, breeding numbers may now be of sufficient size to contribute to supporting a number of overwintering skuas. Increased food availability because of a suspected expansion of rodent and petrel populations following the eradication of the Domestic Cat may also provide an expanding prey resource for overwintering skuas on Macquarie Island.

ACKNOWLEDGEMENTS

We thank John Lynn, the Ranger-in-Charge on Macquarie Island, for willingly providing the opportunity to undertake this study, Geoff Copson for providing comments on an earlier draft, Andie Smithies for compiling and sending references down to Macquarie Island, Peter Cusick for his support that provided MS the opportunity to overwinter on Macquarie Island and Stephan Hahn and Alan Hemmings for providing useful comments on an earlier draft.

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