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NEST SITE SELECTION OF WILSON'S STORM PETREL (*OCEANITES OCEANICUS*) AT CIERVA POINT, ANTARCTICA

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Selección del sitio de nidificación del Petrel de las tormentas (*Oceanites oceanicus*) en Punta Cierva, Antártida.

Key words: Wilson's Storm Petrel, *Oceanites oceanicus*, Nesting, Antarctica.

Wilson's Storm Petrels (*Oceanites oceanicus)* is one of the few species in Antarctica nesting beneath rocks and the only one that nests in burrows digged in mosses. In some Antarctic regions, it only nests in moss, as on the Argentine Islands, Antarctic Peninsula (Roberts 1940). In other zones, their colonies are located under rock debris (Warham 1990) and mosses, as at Cierva Point, Antarctic peninsula (Novatti 1978, Orgeira 1997), whereas, in other areas, there are colonies only under rock debris, rocky cliffs or postglacial moraines, as at Potter Peninsula, King George Island (Quillfeldt *et al.* 2006), or at the Nunatak Bertrab, Filchner Iceshelf (Orgeira 2000), which indicates that Wilson's Storm Petrels take advantage of the various environments distributed along an extensive latitudinal gradient, whenever these provide optimal or suitable habitats for nest building. Cierva Point (64º09'S, 60º57'W, Gerlache Strait, west of Antarctic peninsula), constitutes an interesting case as it is one of the fewest Antarctic regions where great extensions of mosses and rocky debris alternate and Storm Petrels use both types of substrates for nesting. Nevertheless, studies on population density carried out in this area demonstrated that the species prefers to build its nests under rocky substrate instead of mosses and that the rocky area is not completely occupied (Orgeira 1997a, 1997b). Several rocky cavities remained empty in successive seasons, even in areas of high population density, suggesting a pattern for nest site selection.

Nest site selection as an aspect of habitat selection is assumed to have adaptative value implying that nests are placed at sites that provide optimum conditions for survival and reproduction (Klopfer & Ganzhorn 1985). The aim of this work is to determine the most indicating substrate variables for nest site selection of Wilson's Storm Petrels at Cierva Point, Antarctica.

Cierva Point is characterised by two contrasting habitats: rocky walls and hillside,

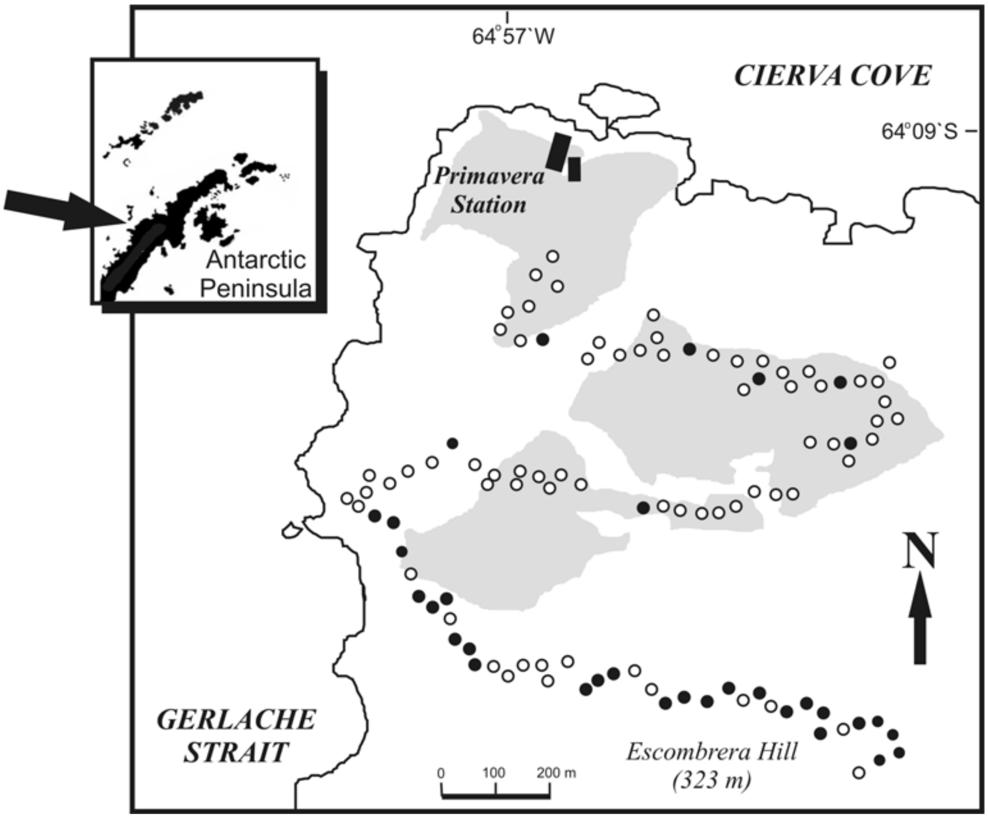

FIG. 1. Cierva Point showing tentative location of samples. White points: occupied nests, black points: empty nests. Grey zones indicates exposed hillsides (adapted from Agraz et al. 1994).

which comprise about 40% of the total area (Fig. 1), most of this covered with mosses, grasses and lichens (Agraz *et al.* 1994). Wildlife is very abundant and many species of birds nests at Cierva Point, probably due to the microhabitats and climate conditions that allow a high diversity of birdlife in a relatively small area (c. 3 km^2) (Quintana *et al.* 2000). Wilson's Storm Petrel colonies occupy almost all rocky walls and hillsides from the coastline to the top of Escombrera Hill (323 m). In order to cover this spatial heterogeneity, a random linear transect sampling was carried out from coastline to the hill top between December 1996 and January 1997, using an infrared device, a method for finding Wilson's Storm Petrel, tested at Primavera Station during the 1995/96 breeding season (Orgeira 1997b). This method insured us that all nests, even those at less accessible sites, were recorded. The infrared device was used by inserting the infrared lens into cavities to detect an increase in temperature due to the presence of birds. Data sampling along the transect was done every 10 m in an area of 5 m^2, resulting in 103 sample units. The number of occupied nests was counted for each 5 m^2 sample. Non-active nests were distinguished from natural cavities by the evidence from previous breeding seasons: presence of feath-

TABLE 1. Variables and categories recorded for each sample unit (5 m^2). Marked variables (*) were selected by discriminant analysis.

	Variables	Categories
1*	Distance to sea	1 (0–20 m), 2 (21–50 m), 3 (51–100 m), 4 (> 100 m)
2	Solar exposition	1 (135–225°), 2 (226–314°), 3 (315–45°)
3*	Rock size	1 (5–20 cm), 2 (21–50 cm), 3 (> 50 cm)
4*	Substrate consolidation	1 (unstable), 2 (stable), 3 (very stable)
5	Vegetation	% of moss *Polytrichum alpestre* and gramineous *Deschampsia antarctica.*
6*	Slope	(Degrees)
7	Height (Elevation a.s.l.)	(m)
8	Presence of snow or ice	(m2)

ers, mummified bodies, broken eggs and incubation chamber, sometimes easily visible and conspicuous. To determine species activity off the nests, surveys were conducted every hour from 18:00 to 06:00 h, on 15, 18 and 23 December 1996. All Wilson's Storm Petrels observed flying over the colony were recorded. Activity peaked between 22:00 and 01:00 h; data sampling was carried out after this period of time when most birds were assumed to have returned to their breeding sites (Orgeira 1997b).

The following variables were recorded for each sample: distance to the sea, slope (inclination), solar exposition, height (a.s.l.), presence of snow or ice, vegetal cover (mosses or gramineous), rock size, and type of substrate. Each variable was divided into categories (Table 1). Distance to the sea and height were measured with an optical distanciometer, slope with clinometer, solar exposition with compass and rock size with a tape measure. The substrate consolidation and vegetal cover was estimated. As some of the involved variables were separated according to categorical, a general discriminant function analysis (DFA) was applied (StatSoft 2001). The aim of this method was to examine the separation between groups with different characteristics related to the studied variables (Digby & Kempton 1991).

Out of the 103 sample units, 70 had nests and 33 did not, resulting in two well defined groups. Wilk´s Lambda statistic used in the DFA confirmed that the difference between groups was statistically significant (W = 0.4325, $P < 0.0001$). Four variables were selected as best predictors: substrate consolidation (stable), rock size (21 to 50 cm), slope (between 19º and 30º), and distance to the sea (21–50 m). These features characterized the habitat preferences of the the Wilson's Storm Petrels nesting at Cierva Point corresponding to hillsides, because 45 of 51 nests (88%) found on hillsides were occupied.

Our results support the findings of other studies. Wasilewski (1986) found a high correlation between the size of Wilson's Storm Petrel colonies and the extension of rocky debris in colonies of King George Island, South Shetland Islands. According to this author, the rocky debris areas were not evenly occupied by petrels. This was related to the thickness of the debris layer: the birds preferring areas with relatively fixed rock debris, especially of considerable thickness (= consolidation or stability), indicating that the characteristics of the rocky surfaces selected for nesting are quite similar, completely independent of the geographic latitude, such as on South Orkney Islands (Beck & Brown 1972), King George Island, South Shetland Islands (Aguirre 1995), Cierva Point, or even at Nunatak Bertrab (Filchner iceshelf) (Velez 1995, Orgeira 2000) and Peter I Island (68º40'S, 90º40'W, Tomo 1973). Thus it can be expected that the variables that describe the habitat preferences of Wilson's Storm Petrels at Cierva Point are recurrent elsewhere.

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