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CHARACTERISTICS OF NEST SITES OF SKUAS AND KELP GULL IN THE ANTARCTIC PENINSULA

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Abstract.—We investigated nest-site selection of sympatrically breeding skuas (*Catharacta* spp.) and Kelp Gulls (*Larus dominicanus*) in the Antarctic Peninsula. We evaluated habitat preferences of nesting skuas and gulls in a patchy landscape by counting the numbers of nests in each of ten habitat types. Additionally, we evaluated the importance of 11 habitat variables (known to be influential to the reproductive success of marine birds) on nest-site selection by skuas and gulls. Both skuas and Kelp Gulls did not used habitat types in proportion to their availability. Skuas tended to nest in highlands with a north-northwest aspect, and in depressed areas with stable substrata. Kelp Gulls nested exclusively on coastal cliffs and pebble beaches, with no difference in tendency to use either habitat. Skua and gull nest sites were differentiated by elevation, percent of vegetation cover, slope, and microtopography. Grasses (for Kelp Gull), mosses (for skuas), and rockiness were the main variables predicting differential use of the available environment. Factors such as type of nest materials, proximity to foraging areas, social interactions, and presence of other species, among others, probably also affect nest-site selection for both skuas and gulls at Cierva Point, Antarctic Peninsula.

CARACTERÍSTICAS DE LOS SITIOS DE NIDIFICACIÓN DE SKUAS Y GAVIOTAS COCINERAS EN LA PENÍNSULA ANTÁRCTICA

Sinopsis.—Estudiamos los recursos de nidificación de colonias nidificantes de skuas (*Catharacta* spp.) y gaviotas cocineras (*Larus dominicanus*) en condición de simpatría en la Península Antártica. Evaluamos las preferencias de hábitat de anidamiento de estas aves en un paisaje compuesto por parches de diez diferentes tipos de hábitats. Este análisis se realizó comparando el número de nidos observados y esperados en cada uno de estos tipos de hábitat. Por otra parte, evaluamos la importancia de 11 variables ambientales (de importancia para el éxito reproductivo de aves marinas) sobre la selección de sitios de anidamiento por skuas y gaviotas. Tanto skuas como gaviotas no utilizaron los distintos tipos de hábitats de acuerdo a su disponibilidad. Los skuas mostraron una tendencia significativa a anidar en las áreas de mayor altitud con una exposición nor-noroeste y en áreas deprimidas con sustrato estable. Las gaviotas anidaron exclusivamente en acantilados costeros y en playas de rodados, sin observarse tendencia alguna en el uso de estos hábitats. Los nidos de skuas y gaviotas se diferenciaron en la altitud, porcentaje de cobertura de vegetación, pendiente y microtopografía. Las gramíneas (para las gaviotas), los musgos (para los skuas) y el tamaño de rocas presentes fueron las variables principales que predijeron el uso diferencial de los hábitats disponibles. Diferentes factores tales como el tipo de material de construcción de nidos, proximidad a las áreas de forrajeo, interacciones sociales y presencia de otras especies, entre otros, podrían afectar la selección de los sitios de anidamiento tanto para los skuas como para las gaviotas en Punta Cierva, Península Antártica.

Skuas (Family Stercorariidae) and gulls (Family Laridae) are close relatives (Furness 1987) that sometimes nest sympatrically. Skuas (*Catharacta*

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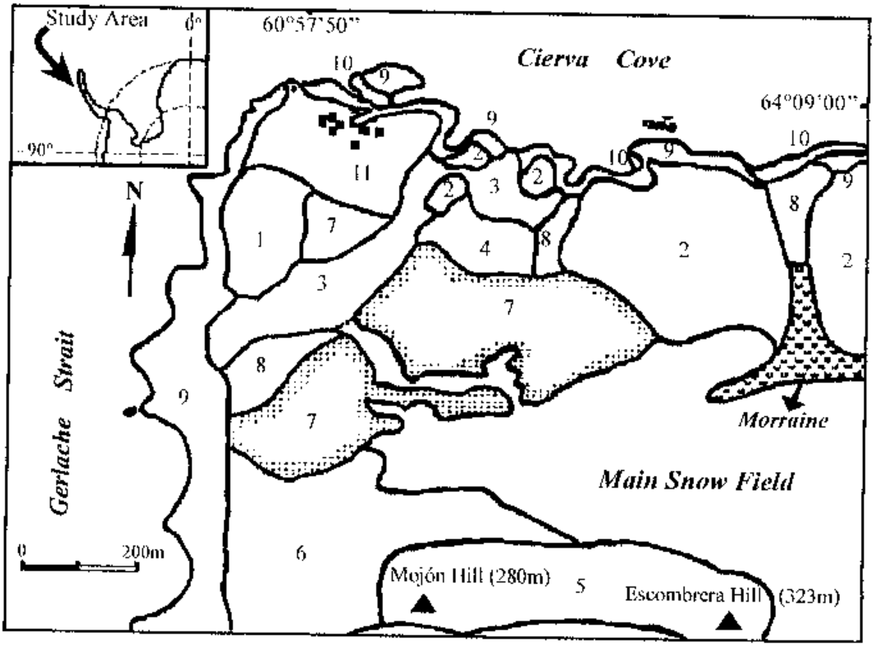

FIGURE 1. Map of the study site at Cierva Point, showing habitat types.

spp.) are mainly found in the Southern Oceans and the Antarctic continent (Furness 1987). The most common Antarctic skua species are the South Polar Skua (*Catharacta maccormicki*) and the Brown Skua (*C. lonnbergi*) (Furness 1987). Most of their breeding areas are allopatric, but they nest sympatrically along the Antarctic Peninsula, between 61° and 65°S (Pietz 1987). There, skua classification is complicated by morphological similarity, presence of mixed pairs, and hybridization. Kelp Gulls (*Larus dominicanus*) nest in South Africa, South America, New Zealand, Australia, the Antarctic and Subantarctic Islands, and Madagascar (Moynihan 1959, Fordham 1964, Watson 1975, Brooke and Cooper 1979, Harrison 1985). Although these species nest sympatrically in the Antarctic Peninsula, little is known about their specific nest site preferences. This hampers future management efforts oriented to the preservation of Antarctic birds and their environment. Our objective is to evaluate quantitatively long-term nesting resource selection and requirements of sympatric skua and Kelp Gull populations in the Antarctic Peninsula.

METHODS

We studied skuas and Kelp Gulls during the 1992–1993 breeding season at Cierva Point, on the west side of the Antarctic Peninsula (64°09′S, 60°57′W; Fig. 1). Vegetation in this area is well–developed, with a continuous ground cover of mosses, grasses, and associated lichens (Agraz et al.

1994). Many species of seabirds nest at Cierva Point (e.g., Gentoo and Chinstrap Penguins, *Pygoscelis papua* and *P. antarctica*; Wilson's Storm-Petrel, *Oceanites oceanicus*; Blue-eyed Shag, *Phalacrocorax atriceps*; Pintado Petrel, *Daption capense*); skuas and Kelp Gulls are the most important avian nest predators (Quintana et al. 1995).

Weather at Cierva Point is moderate, considering the latitude and compared to more northerly locations on the Antarctic continent. During the study period, monthly mean temperature ranged between 1.8 and 2.2 C (range − 1–6.3 C). Relative humidity averaged 79%; it was cloudy and rainy almost every day, and snowy days were frequent. Mean wind speed was 7.9 km/h (range 0.0–40.6 km/h). Human activity was infrequent and limited to summertime (late November to mid-March). Tourism is forbidden by the Antarctic Treaty, which has designated this area as a Site of Special Scientific Interest (SSSI Number 15) due to its high animal and plant diversity (Quintana et al. 1995).

The study area was classified, based on major differences in vegetation cover and environmental variables, into 10 habitat types following Agraz et al. (1994; Fig. 1 and Appendix). Data on habitat availability and use were recorded at the population level (Manly et al. 1993). We counted numbers of skua and gull nests by direct observation in all 10 habitat types between 15 Dec. 1992 and 15 Jan. 1993. As it was almost impossible to clearly identify skua pairs to species, their data were pooled before comparing to those of the gulls. Provided that these skuas have similar breeding biology, we considered pertinent to analyze the nest site characteristics of both species together, focusing the analysis on the differences between skuas and gulls.

We evaluated if skuas and Kelp Gulls used habitat types in proportion to their availability. To assess this we compared number of observed and expected nests in each habitat type using χ^2 tests. Numbers of expected nests were calculated by assigning total nests to habitat types proportionally to their area (see Appendix). Therefore, we partitioned the χ^2 table to detect the habitat types responsible for the global differences (Siegel and Castellan 1988). Significant differences were set at $P < 0.05$.

We also performed a one-factor MANOVA (Morrison 1976) on habitat characteristics at nests to assess whether habitat use differed between skuas and Kelp Gulls in the study area as a whole. For this purpose, we quantified 11 habitat variables (Table 1) that had proved to be influential on reproductive success in other studies of marine birds (Burger and Gochfeld 1981). These variables were estimated for 5 × 5-m squares centered on each nest and on random points. Random points were selected within random distances on line transects within the corresponding habitat type. In all subsequent parametric tests square root, logarithmic, and angular transformations were used for those variables with non-normal distributions (Zar 1996). Finally, we identified the most important habitat variables for both species using stepwise discriminant analysis (Lee 1971, Williams 1981). The percentage of correctly assigned sites was validated using jacknife classification (Dixon 1992).

TABLE 1. Habitat variables used for stepwise discriminant analysis of skua and Kelp Gull nests at Ciera Point, Antarctic Peninsula.

Abbreviation	Variable	Category	Value
ALT	Altitude over sea level (m)		
SLP	Slope (°)		
ASP	Aspect (°)	315°–45°	4
		225°–315°	2
		135°–225°	1
		45°–135°	2
TP	Topographic position	Flat	0
		Hill top	1
		Steep slope	2
		Smooth slope	3
		Terrace	4
		Beach	5
		Depression	6
		Slope promontory	7
M	Microtopography	Flat	1
		Convex	2
		Concave	3
		Grooved	4
		Cracked	5
		Pitted	6
		With knobs	7
		Crinkled	8
		Wavy	9
		Hummocky	10
BR	Bed rock (%)		
R > 60	Rockiness >60 cm (%)		
R25–60	Rockiness 25–60 cm (%)		
R < 5	Rockiness <5 cm (%)		
MC	Moss cover (%)		
GC	Grass cover (%)		

We used a one-factor MANOVA on the same 11 habitat variables described above to test whether habitat at nest sites differed from random points. This analysis was carried out for skuas and Kelp Gulls in each habitat type with sample sizes sufficient to perform the analysis (see similar analyses in Montevecchi 1978, Burger and Shisler 1978, Burger and Gochfeld 1981, Donazar et al. 1993). In those habitat types for which the MANOVA showed significant differences between nest sites and random points, we identified the most important habitat variables in nest-site selection using stepwise discriminant analysis (Lee 1971, Williams 1981).

RESULTS

We counted a total of 149 skua and 52 Kelp Gull nests. We quantified habitat variables on all these nests and at 119 random points. Both skuas and Kelp Gulls did not use habitat types in proportion to their availability ($\chi^2 = 193.76$, df = 9, $P < 0.001$, $\chi^2 = 73.75$, df = 1, $P < 0.001$, respectively). Kelp Gulls nested exclusively in coastal cliffs and pebble beaches, showing no preference between the two ($\chi^2 = 0.22$, df = 1, $P = 0.64$). Skuas nested in every habitat type except pebble beaches. Skuas used habitat types 2 and 4 (see Appendix) more than expected by chance ($\chi^2 = 14.47$, and $\chi^2 = 15.69$, respectively; df = 1, $P < 0.001$ in both cases), habitat types 1, 6, 7, and 8 in the same proportion as availability ($\chi^2 = 3.0$, $\chi^2 = 3.21$, $\chi^2 = 0.6$, and $\chi^2 = 0.11$, respectively; df = 1, $P > 0.05$ in all cases) and used habitat types 3, 5, and 9 less than predicted ($\chi^2 = 7.6$, $\chi^2 = 16.31$, and $\chi^2 = 15.68$, respectively; df = 1, $P < 0.01$ in all cases).

Skua and Kelp Gull populations differed significantly in their use of available habitat (MANOVA, $F = 98.66$; $P < 0.05$). Skua nest sites were located at higher altitude and on areas with higher moss cover and gentler slope than were those of Kelp Gulls. Predominant microtopography also differed between both nest groups (Table 2). Elevation above sea level was the main variable differentiated both skua and Kelp Gull nest sites, followed, in descending order of importance, by moss cover, type of microtopography, and slope. Overall percent of correct assignments after Jacknife validation was 95.0% (93.3% for skuas and 100.0% for Kelp Gull).

We did not perform MANOVA test on habitat types 3, 5, 8 and 9 for skuas because of small sample size (Table 2; habitat type 5 does not appear in this table because only one nest was found there). No habitat differences were observed between nest sites and random points on habitat types 1 and 2 (Table 2) due to their homogeneity (Agraz et al. 1994). Nest sites and random points differed in habitats 4, 6, and 7 for skuas and in habitats 9 and 10 for gulls (MANOVA; Tables 2 and 3).

Stepwise discriminant analyses showed that in habitat type 4 (significantly selected) skua nest sites were more rocky (rocky 25–60 cm) than were random points. Similarly, in habitat type 6 (used in proportion to availability), skua nest sites had more bed rock than random points, and in habitat type 7 (used in proportion to availability), skua nest sites were located at higher elevation and in sites that were less rocky (rocks < 5 cm) than random points. The more frequent type of microtopography was also different between nest sites and random points. Percentage of rocks < 5 cm was the most important variable in the differentiation of both skua nest sites and random points, followed by altitude over sea level. Type of microtopography was the less important among the three.

Higher percentages of bed rock and grasses, and greater slope, differentiated gull nest sites from random points in HT9. Slope was the main variable in this discrimination, followed, in descending order of importance, by grass cover, percentage of bed rock, and moss cover, respectively. In habitat type 10, gull nest sites were more rocky (rocks 25–60 cm) than were random points. Overall percent of correct assignments after jacknife validation was 65.7% for HT4 (64.0% for skua nest sites and 70.0% for random points); 75.0% for HT6 (71.4% for skua nest sites and 77.8% for random points); 67.7% for HT7 (68.8% for skua nest sites and 66.7% for random points); 88.5% for HT9 (91.3% for Kelp Gull nest sites and 80.0%

for random points) and 81.8% for HT10 (100.0% for Kelp Gull nest sites and 60.0% for random points).

DISCUSSION

Colonial birds have rather specific nest-site requirements and, in mixed colonies, there are often distinct species-specific preferences (Burger and Shisler 1978, McCrimmon 1978, Burger and Gochfeld 1981, Cody 1985). We observed a difference in habitat use between skuas and gulls at Cierva Point, Antarctica. Skuas used nine out of ten available habitat types whereas gulls only nested in two, with coastal cliffs the only habitat used by all species. Both skuas and gulls selected those areas that were snow-free in the early summer.

Peter et al. (1990) reported that skuas selected snow-free nest sites, such as small hills, rocks, moraines, and cliff edges. Osborne (1985) reported similar results at Bird Island, South Georgia, where Brown Skuas bred from open scree to deep tussock grass (*Poa flabellata*). In this study, skua nests were also located on mounded microtopography in the moss-turf areas. The skua nests were located at higher elevations and with higher moss cover than were gull nests.

Furness (1987) has pointed out that Great Skuas (*Catharacta skua*) nest preferentially in areas with developed short grass or moss carpets. Peter et al. (1990) found that Brown Skuas nested on dry as well as moist areas, whereas South Polar Skuas nested only on dry places, next to small lakes and ponds. In our study, skua nests were most abundant in those habitat types with a continuous cover of the drier *Polytrichum alpestre* moss. In all cases, they tended to avoid wet moss carpets. Nevertheless, selection for habitat types 2 and 4 against 1 and 6 (all on *P. alpestre* turf) could be related to differential exposure between both groups: north-northeast aspect for habitats 2 and 4 versus north-northwest aspect for habitats 1 and 6. These differences could be important in nest-site selection due to the influence of local environmental conditions.

A nesting group of skuas was located within habitat type 7 in spite of the small and discrete distribution of *Polytrichum* patches. This could be attributed to the presence of a Gentoo Penguin colony in the area, which represents an attractive food item for this species. In this case, skuas would defend not only a breeding territory, but also a feeding one (Trillmich 1978, Neilson 1983, Osborne 1985, Furness 1987, Pietz 1987), actively excluding Kelp Gulls as well as other skuas from it (Pietz 1987).

Kelp Gulls have been observed nesting in different habitat types (Burger and Gochfeld 1981; Fordham 1964). In our study, Kelp Gulls nested only in coastal habitat types, on small and discontinuous rocky terraces covered by short grasses (*D. antarctica*). Gull nest sites were characterized by a lower elevation and a greater slope than skua ones. Burger and Gochfeld (1981) have commented that Kelp Gulls select their nest sites on the basis of slope and cover. Selection for coastal habitat types by gulls could be related to favorable environmental conditions (abundant rock crevices for cover and shelter), good food supply (abundance of the At-

TABLE 2. Sample means (and standard deviation) of the 11 habitat variables between skua (SK) and Kelp Gull (GU) nests and between nest sites (NS) and random points (R) among the different habitat-types (HT) for skuas and Kelp Gulls.

	SK vs. GU		GULLS				SKUAS			
			HT9		HT10		HT1		HT2	
Habitat Variable	SK (n = 149)	GU (n = 52)	NS (n = 46)	R (n = 15)	NS (n = 6)	R (n = 5)	NS (n = 12)	R (n = 9)	NS (n = 62)	R (n = 25)
ALT[a]	77.28	8.63	9.33	9.00	3.33	5.60	52.50	46.44	67.16	57.36
	(53.39)	(5.07)	(4.98)	(4.71)	(0.82)	(1.34)	(6.22)	(12.60)	(34.24)	(40.28)
SLP	7.55	10.51	10.87	2.00	8.00	2.00	2.12	1.89	5.11	2.84
	(8.46)	(9.59)	(9.67)	(3.68)	(9.36)	(2.74)	(3.82)	(2.89)	(7.59)	(4.93)
ASP[b]	4	4	1	4	4	4	2	1	4	4
EP[b]	4	4	1	1	5	5	4	1	4	4
M[b]	10	1	1	1	7	1	10	10	10	10
BR	19.95	36.73	40.65	52.33	6.67	0.00	27.00	23.33	17.69	15.28
	(21.24)	(29.87)	(29.32)	(25.49)	(11.69)	(0.00)	(25.10)	(27.61)	(20.69)	(15.50)
R > 60	2.23	9.04	7.61	4.33	20.00	2.00	0.00	3.89	3.15	4.00
	(6.27)	(16.98)	(15.84)	(5.63)	(22.80)	(4.47)	(0.00)	(6.97)	(8.02)	(8.66)
R25–60	6.23	15.77	14.67	3.33	24.17	6.00	2.50	1.67	2.48	2.60
	(9.44)	(19.76)	(20.67)	(4.50)	(6.65)	(8.94)	(4.52)	(3.54)	(6.30)	(4.97)
R < 5	1.24	2.27	0.83	0.33	13.33	50.00	0.42	0.00	0.32	1.32
	(3.67)	(6.21)	(2.12)	(1.29)	(13.66)	(15.81)	(1.44)	(0.00)	(1.24)	(3.63)
MC	58.19	11.25	11.74	20.67	7.50	3.00	57.83	71.11	70.63	62.00
	(32.22)	(18.78)	(19.50)	(15.10)	(12.55)	(4.47)	(34.69)	(26.31)	(26.51)	(32.88)
GC	5.98	29.62	30.87	15.00	20.00	2.00	11.25	0.00	4.68	9.80
	(15.29)	(24.61)	(25.41)	(16.15)	(15.49)	(2.74)	(28.77)	(0.00)	(11.90)	(14.25)

[a] See Table 1 for abbreviations.
[b] mode.

TABLE 2. Continued, Extended.

Habitat Variable	SKUAS HT3 NS (n = 3)	HT3 R (n = 7)	HT4 NS (n = 25)	HT4 R (n = 11)	HT6 NS (n = 7)	HT6 R (n = 10)	HT7 NS (n = 32)	HT7 R (n = 30)	HT8 NS (n = 3)	HT8 R (n = 7)	HT9 NS (n = 3)	HT9 R (n = 15)
ALT[a]	16.67	28.14	36.20	38.82	225.71	202.80	110.03	79.47	60.00	45.71	60.00	9.00
	(16.07)	(13.79)	(6.00)	(6.87)	(46.50)	(35.10)	(33.25)	(27.44)	(8.66)	(25.40)	(0.00)	(4.71)
SLP	14.33	4.86	15.32	16.91	9.57	8.40	7.53	8.43	9.67	31.14	2.00	2.00
	(12.90)	(3.98)	(7.65)	(4.30)	(5.74)	(4.35)	(8.53)	(6.67)	(9.50)	(12.06)	(3.46)	(3.68)
ASP[b]	4	4	4	4	4	2	4	4	4	4	2	4
TP[b]	—	3	2	2	7	7	4	1	—	2	1	4
M[b]	—	1	10	10	7	7	7	2	7	7	10	1
BR	1.67	13.57	0.00	1.64	27.14	9.00	35.59	23.60	10.00	2.14	25.00	52.33
	(2.89)	(20.56)	(0.00)	(3.23)	(11.85)	(11.01)	(29.88)	(26.01)	(5.00)	(3.93)	(18.03)	(25.49)
R > 60	8.33	1.43	0.52	0.18	1.43	4.00	2.34	4.10	5.00	17.43	0.00	4.33
	(2.89)	(3.78)	(1.48)	(0.60)	(3.78)	(3.94)	(6.60)	(6.77)	(5.00)	(15.43)	(0.00)	(5.63)
R25–60	3.33	2.86	10.08	0.09	10.71	1.50	10.38	12.15	18.33	26.43	6.67	3.33
	(5.77)	(3.93)	(9.46)	(0.30)	(14.56)	(3.37)	(10.92)	(13.51)	(17.56)	(22.12)	(7.64)	(4.50)
R < 5	11.67	30.71	1.00	0.00	0.00	0.50	2.19	20.57	6.67	9.29	3.33	0.33
	(12.58)	(20.09)	(2.50)	(0.00)	(0.00)	(1.58)	(5.06)	(23.95)	(2.89)	(15.92)	(5.77)	(1.29)
MC	41.67	13.57	78.56	77.27	48.57	76.50	29.25	11.87	15.00	20.86	38.33	20.67
	(37.53)	(13.45)	(19.21)	(31.23)	(16.51)	(20.42)	(27.08)	(17.62)	(18.03)	(31.36)	(35.17)	(15.10)
GC	13.33	7.14	4.80	20.45	1.43	5.00	4.72	3.17	11.67	0.00	26.67	15.00
	(23.09)	(6.36)	(9.95)	(34.31)	(3.78)	(7.45)	(13.24)	(7.90)	(20.21)	(0.00)	(46.19)	(16.15)

TABLE 3. Values of the approximate F-statistic for the discriminant analysis between nest sites and random points in the different habitat types. SK = skuas; GU = Gulls; HT = Habitat type.

Comparison	F	df	P
SK-HT4	12.86	2, 32	<0.05
SK-HT6	9.51	1, 14	<0.05
SK-HT7	14.55	3, 58	<0.05
GU-HT9	9.30	4, 56	<0.05
GU-HT10	13.54	1, 9	<0.05
SK vs GU	98.66	4, 196	<0.05

lantic Limpet, *Nacella concinna*), and the avoidance of skua attacks. Inland *D. antarctica* patches located within skuas territories were probably not used to avoid attacks. Pietz (1987) observed that South Polar Skuas raided Kelp Gull nests built within a skua territory. We observed only a few skua nests near the breeding areas of gulls, but always far from gull colony patches.

Heterogeneity within habitat types was an important factor in nest-site selection for both skuas and Kelp Gulls. Skuas selected high elevation sites within unit 7 (which were close to the Gentoo Penguin colony) but on mounded patches of *P. alpestre*. The smaller abundance of pebbles (<5 cm) around these sites than around random points were related to the nest habitat partition because these types of pebbles are the main nesting resource for this penguin species in the Antarctic Peninsula (Bost and Jouventin 1990).

Use of nest sites with higher percentages of bed rock and large stones (25–60 cm and >60 cm) by both skuas and gulls could be to obtain better protection, shelter, and drainage at nests. Peter et al. (1990) found that skuas nests were sheltered on one to four side by stones according to the mean wind directions. The type and abundance of plant cover were other key variables in the selection of nest site within a habitat type. Grasses for kelp Gulls and mosses for skuas were the main nest resources responsible for the differential use of the environment. This conclusion agrees with Burger and Gochfeld (1981) who found that vegetation features such as species and percentage of cover could affect nest-site selection. A more covered nest would be protected from temperature fluctuations (Walsberg 1985). In an Antarctic environment, protection from strong winds and frequent snows during the breeding season could be important for nesting success.

As previously observed by Fordham (1964), Kelp Gulls selected grasses against moss-covered patches and exposed pebble beaches. Similarly, other researchers have found that Kelp Gull nest sites in areas of low cover generally had more cover than random points (South Africa, Burger and Gochfeld 1981; Punta León, southern Argentina, Yorio et al. 1995). These last authors support the idea that gull use of these sites was to gain protection against radiation.

The overall conclusion from this study is that several factors, such as type of nest materials, prevalent environmental conditions, proximity to foraging areas, social interactions and presence of other species, affect nest site selection at the considered scales for both skuas and gulls in Cierva Point, Antarctic Peninsula.

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APPENDIX. Habitat types constituting the study area at Cierva Point, Antarctic Peninsula (following Agraz et al., 1994).

Habitat type	Description	Main features	Surface (ha)
1	Highlands with north-northwest aspect	Convex to slightly convex relief with mean slope <10° toward the sea. Big rock blocks exposed and plant cover dominated by moss-turf sociation of *Polytrichum alpestre*. No snow cover during summer time.	2.65
2	Highlands with north-northeast aspect	Generally convex with mean slope between 10 and 15°. No snow cover during summer time. These discontinuities produced by faulting. Depressed areas cut by small channels alternated with exposed terraces and smooth areas protected from the wind. Plant cover dominated by moss-turf sociation of *Polytrichum alpestre* and patches of *Dechampsia antarctica*.	11.85
3	Depressed area with unstable substratum	Generally concave with snow during summer time. Hard rock outcrops and different grain sized accumulation. Death vegetation and numerous run-off channels originated from melting of snow patches. There is a pond within this land unit. Moss carpets of *Calliergidium sarmentosum* and *Sanionia uncinata* are the main cover vegetation.	7.15
4	Depressed areas with stable substratum	Moderate slope (15–20°) toward the northeast with outcrops of bed rock and high drainage. No snow cover during summer time and cut by several run-off channels. Dominant vegetation is composed by an extended moss-turf sociation of *P. alpestre*, interspersed with patches of *D. antarctica*.	2.05
5	Mountain top	Convex relief with numerous ice-wedging. No snow cover during summer time in the highest places. Vegetal cover is very scarce, dominated by lichens.	9.10

APPENDIX. Continued.

Habitat type	Description	Main features	Surface (ha)
6	Steep hillside	Generally moderate slope with flat to convex terraces and rocky cliffs. General aspect toward the north-northwest. No snow cover during summer time and cut by several run-off channels. Most terraces cover by *P. alpestre* while lichens dominate rocky substrata.	11.60
7	Highly weathered exposed hillside	Gentle to moderate slope with several run-off channels and several snow tongues. Irregular topography with alternate concave areas with permanent snow and convex gentle to moderate slope with several run-off channels and several snow tongues. Irregular topography with alternate concave areas with permanent snow and convex areas with summer snow free terraces. These terraces are used by a nesting colony of a Gentoo Penguin. Patchy vegetation covering no more than 30% of the flat and convex areas. There are patches of *D. antarctica* associated with *S. uncinata* and patches of *P. alpestre*.	18.16
8	Debris deposition hillside	Mean steep slope (35°), made of different grain sized deposits originated by slumps. Flat to concave general aspect with outcrops. Good drainage and no snow cover areas during summer time where a gentle plant cover of early successional stages is settled. The dominant community is composed by fruticose lichens and small moss tufts of *Polytrichum piliferum* and *Andreaea regularis*.	2.15

APPENDIX. Continued.

Habitat type	Description	Main features	Surface (ha)
9	Coastal cliff	Steep to moderate slope, irregular relief, outcrops and different grain sized deposits related to physical weathering. Crevaces facing to the south have more persistent snow during summertime than the others. A high specific plant diversity and gentle plant cover is observed. There are lichen communities dominated by *Usnea antarctica* on cliffs, small moss tufts and small terraces covered by *D. antarctica*.	11.75
10	Pebble beach	Spatially restricted and developed in zones protected from heavy storms. No snow cover during summertime, however, often cover by ice remains brought by the tides. Moderate slope, outcrops interspersed with different grain sized deposits originated by slumps form cliffs. Patches of *D. antarctica* and lichens restricted to the beach portion away of tiding influence.	1.15