Colony and nest site selection by roseate and common terms in the Azores archipelago - a multivariate analysis

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COLONY AND NEST SITE SELECTION BY ROSEATE AND COMMON TERNS IN THE AZORES ARCHIPELAGO- A MULTIVARIATE ANALYSIS

BY

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ABSTRACT

Multivariate techniques were used to examine overall characteristics of colonies, and detailed characteristics of nest sites within colonies, of Roseate and Common terns in the Azores archipelago. The characteristics of the nest sites were compared (1) with the available habitat and (2) between colonies, species and early and late nesting birds (Roseate terns only). Larger colonies occured far from the mainland, human setlements and other tern colonies, which reveals the importance of islets situated relatively far from sources of disturbance, predation and potencial competition for feeding resources.

Both species showed markedly different nest site preferences: Roseate terns nested at areas with high relief and/or tall vegetation and Common terns selected open areas. Roseate terns nested within higher densities and their nests were less visible from above than those of the Commons. Differences between the characteristics of early and late Roseate tern nests were attributed to seasonal changes in the vegetation structure of the habitat. Discriminant analysis indicated that the characteristics of Roseate tern nests differed more from the available habitat than those of Common terns, suggesting a more specialised nesting preference by Roseates. It is suggested that these nesting differences are primarily a result of preferences developed during allopatric speciation .

Evidence of competition for nest sites between Roseate and Common terns was not found with this observational approach. It is speculated that Common terns might prevent younger Roseates from nesting in the open areas of mixed colonies. This idea is formulated in a model. The need to maintain optimal areas for nesting Roseate terns is stressed.

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1 INTRODUCTION

Habitat selection is important when investigating avian habitat relationships and, consequently, in elucidating patterns of ecosystem structure. Habitat selection during the breeding season is likely to have repercussions on survival and reproductive fitness because, while breeding, birds are confined to the habitat in which they place their nests. Habitat preferences exist as a consequence of variation in quality of available habitat and have been demonstrated in a number of species (Partridge, 1978).

Avian habitat relationships can be adressed by several different approaches (see Rice *et al*, 1983). Two approaches are used in this study: (1) Discrimination between used and available habitat characteristics. (2) Between-species discriminant analysis of the habitat characteristics of two species at once. Although this later approach assumes that interspecific competition is a prerequisite to investigate resource partitioning (Rice *et al*, 1983) its use is justified since such situation can occur in mixed colonies of Roseate terns (*Sterna dougallii*) and Common terns (*Sterna hirundo*), the main subjects of this study. Common terns are slightly larger and more agressive than Roseate terns (Cramp. 1984; Burger & Gochfeld, 1988b), and prefer relatively open areas whilst Roseate terns prefer sheltered areas (Langham, 1974). When nesting in the open ground Roseate terns compete with Common Terns for available nest sites (Spendelow, 1982). Such examination of habitat preferences of closely related presumptive competitors has been given much attention (e.g., Bertin, 1977; Cody, 1979; Burger & Gochfeld, 1988a) because it can make readily and substantial contributions toward understanding habitat partitioning.

Avian ecologists have taken 4 different approaches to analyse colony and nest site selection of terns: (1) Descriptive, in terms of substrate and vegetation (e.g.Blokpoll *et al*, 1978; Burger & Lesser, 1978; Gochfeld & Burger, 1977). (2) Experimental, providing birds with a choice of substrate types (Richard & Morris, 1984) or habitat features (Spendelow, 1982). (3) Analysing environmental factors responsible for nest site selection by comparison of nest sites with available habitat and/or examining temporal differences in nest-site choices (Burger & Gochfeld, 1988a and 1988c). (4) Multivariate analysis to compare characteristcs of occupied colony sites to abandoned and/or adjacent unused areas (Kotliar & Burger, 1986). Approaches (1) and (3) have been used to study nest site selection in mixed species colonies of Roseate and Common terns (Burger & Gochfeld, 1988a; Gochfeld & Burger, 1988) in USA and monospecific tropical subcolonies of Roseate terns (Burger & Gochfeld, 1988c). Roseate terns, at all colonies studied, selected taller vegetation than that present at randomly selected points. They also nested closer to nearest vegetation. In temperate areas both species nest in a wide variety of habitats but Roseate terns have concealed nests while Common terns nest in more open sites. Such concealment proved to be advantageous for Roseate tern breeding output in USA colonies: Nisbet & Drury, (1972) reported more young raised per pair by Roseate terns than Common terns and Spendelow (1982) found higher hatching sucess for Roseate terns nesting in highly protected sites- in burrows and under boards- as opposed to those nesting by rocks and inside tyres. Burger & Gochfeld (1988c) argued that predation is a major factor in explaining nest concealment in Roseate terns in the USA.

These studies have characterized Roseate and Common tern habitat relationships and habitat partitioning. However, they all have used univariate data analysis methods, which fail to recognize correlations among variables and do not identify the hierarchy of importance of habitat characteristics with respect to tern nesting habitat selection and separation between species. Being a multidimensional concept, with physical and social attributes, habitat selection is better explored with multivariate analysis (Edge *et al*, 1987). The aim of my work was to elucidate the colony and nest site preferences of Roseates and Common terns in the Azorean archipelago using multivariate techniques (Ordination, Linear and Multiple Discrimination). Multiple discrimination was used to determine which habitat attributes differed significantly between colonies. Linear discrimination differentiates between nest sites and available habitat both within and between species. Empirical differences were interpreted as preferences or avoidances of the habitat attributes, as cues to nesting habitat selection preferences and niche differenciation of the terns.

The Roseate tern has a patchily cosmopolitan breeding distribution. The atlantic race, *Sterna dougallii dougallii*, has declined dramatically on both sides of the Atlantic and is now considered threatened or endangered (Gochfeld, 1983). In Europe, the species breeds in Northwest Europe and in the

Azores and is thought to be a closed population (Cramp, 1984). Azorean terns are now considered to be of international importance (del Nevo *et al*, 1990) and, therefore, a knowledge of nest-site requirements there, for a comparison with nest sites elsewhere and as a basis of future conservation measures, is important.

2 STUDY AREA

The work was carried out on the Azorean archipelago (36°55'N-39°43'N, 25-31°30'W). The climate of the Azores is oceanic temperate with precipitation, windspeed and west winds increasing from E to W (Medeiros, 1987).

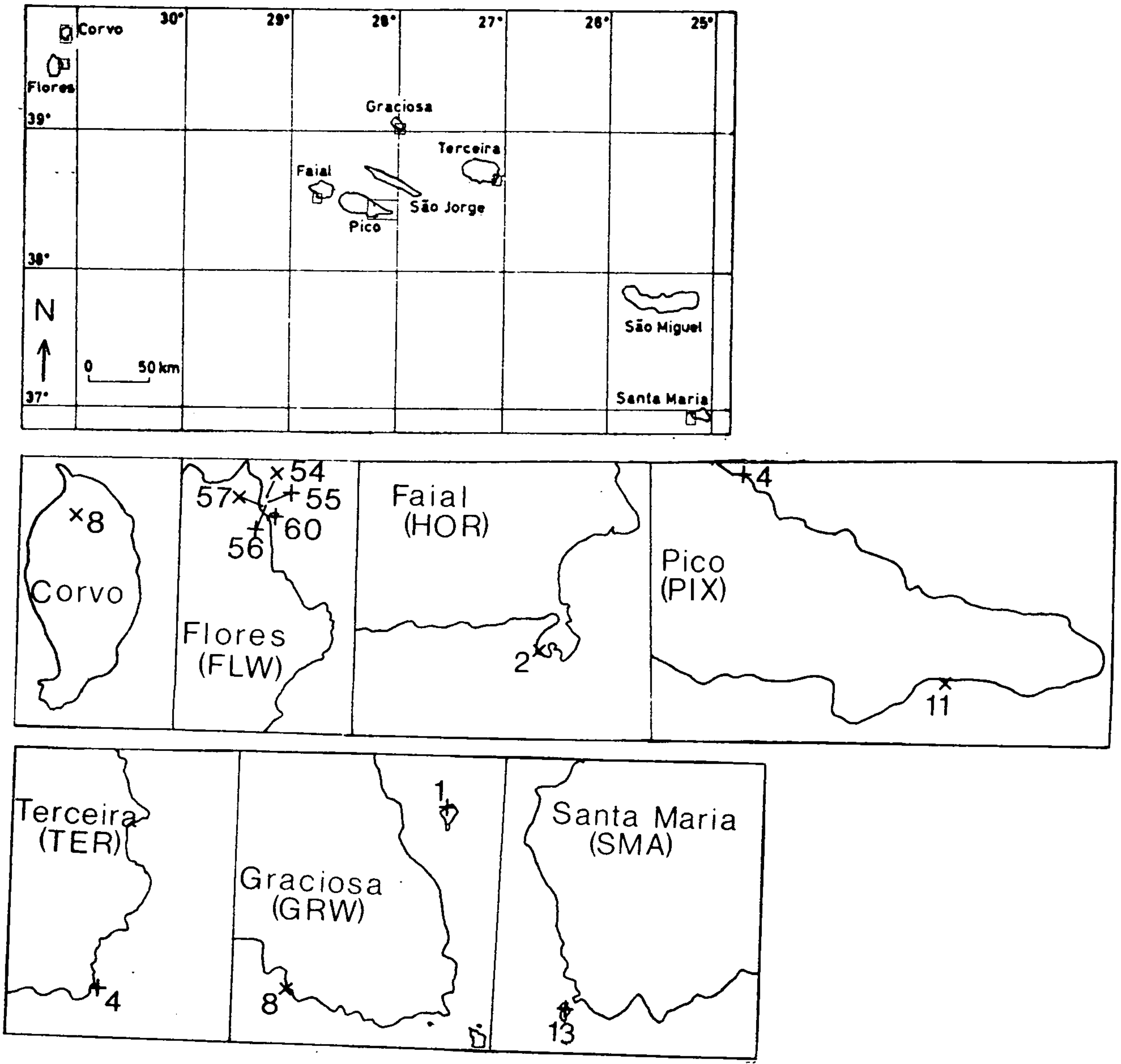

Fig 1. Locations of mixed tern colonies (+) and Common tern (unmixed) colonies (x) where site characteristics were recorded. Numbers follow the RSPB survey (del Nevo *et al*, 1990).

Data were collected on all islands except S.Jorge (characteristics of nest sites and colonies) and S. Miguel (characteristics of nest sites). Detailed nest site characteristics were measured in the following colonies: (1) 100% bare rock islets (TER4), (2) moderately vegetated rocky islets (FLW55, FLW60, PIX4, PIX11, GRW5), (3) heavily vegetated rocky islets with soil (FLW54, FLW56, FLW57), (4) Loose lava with some gravel and soil (GRW1) and (5) mainland boulder beaches (GRW8) and bare rock slope areas (HOR1) (Fig 1). Terns nested also in steep sided sea stacks, mainland cliffs and crater lakes (only Common terns). Rock pigeons, Starlings as well as other seabirds, mainly Cory's Shearwater, (*Calonectis diomedea*) nested in the tern colonies. Small lizards were present in some of the colonies. In 1990 colonies held between 2 to 216 Roseate and 2 to 326 Common breeding pairs. The status of colonies is given by del Nevo *et al* (1990).

3 METHODS

Fieldwork was conducted from 15 May until 15 July 1990, in conjunction with a long-term study by the Royal Society for the Protection of Birds and the University of the Azores.

At each colony studied, the total number of breeding pairs, and the seasonal status of individual nesting sites was accurately recorded following methods described by Birkhead & Nettleship (1980), Evans (1984) and del Nevo *et al* (1990). The following information was recorded for each colony: (a) AREA(m^2); (b) LOCATION : islet or mainland site; (c) ASPECT; (d) DEGREE OF SURFACE :0,1,2,3- to measure the existence of high relief-cracks, crevices and so on; (e) SLOPE: 1=0-30°, 2=31-60°, 3=61-89°, 4=cliff; (f) SUBSTRATE: percent substrate of bare rock, soil, boulders, mixed with vegetation (visual estimation), (g) COVER: percentage vegetation cover (visual estimation); (h) VEGETATION HEIGHT: mean vegetation height 1=0-5cm, 2=6-10cm, 3=11-15cm, 4=16-20cm, 5=>20 cm; (i) DISTANCE TO MAINLAND (if an island site); (j) NDHHABITATION: nearest distance to human habitation and (l) NDTCOLONY: distance to nearest tern colony. These data were collected from 32 colonies (12 mixed and 20 unmixed).

At or a few days after the peak of egglaying, a sample of nest sites were selected in each colony for detailed measurements. For small colonies (less than 10-20 pairs) data were obtained from all sites found. Larger colonies were sampled using a stratified random procedure: colonies were divided in 2 to 4 areas according to their size. A transect was made along the two greatest lengths of each area; 20 to 35 points were distributed along each transect at regular intervals-240 or 120 cm-depending on the size of the colony. Site characteristics were recorded for these points (random points) and the nearest tern nest (Fig 2). Data were collected from 182 Roseate tern nests and 145 Common tern nests in mixed colonies, 123 Common tern nests in unmixed colonies and 181 random points. In colony SMA13 data was also collected on 15 late Roseate tern nests.

For each nest site and random point the following parameters were recorded: (1) NEST PLACE: 1=narrow, 2=broad, or 3=platform; (2) WALLS: number of walls around the nest; (3) OVERHANG: 0=none, 0.5=partial, 1=complete; (4) DRAINAGE:

0=poor, 0.5=fair, 1=good; (5) SUBSTRATE: bare rock, soil, vegetation, boulders, gravel, mixed; (6) VEGETATION TYPE: 1=grass, 0=not grass; (7) DNEAVEG: distance to nearest vegetation (cm); (8) HNEAVEG: height of nearest vegetation (cm); (9) COVER 0.5m and COVER 3m: percentage of vegetation cover within 0.5 m and 3m of nest (visual estimation); (10) VISIBILITY: percentage of nest visible from above; (11) DNN: distance (cm) and species of nearest neighbour; (12) NN2m: number of neighbours within 2 metres; (13) SLOPE AT NEST AND OVERALL SLOPE: maximum slope at nest and within 2m section around the nest (1=<5°,2=6-20°, 3=21-60°, 4=61-89°, 5=cliff) and (14) NEST POSITION: the position of the nest in the colony (edge, middle, center). Colony edge was defined as a line connecting all peripheral nests. The presence or absence of a nest cup and bed linen was also recorded.

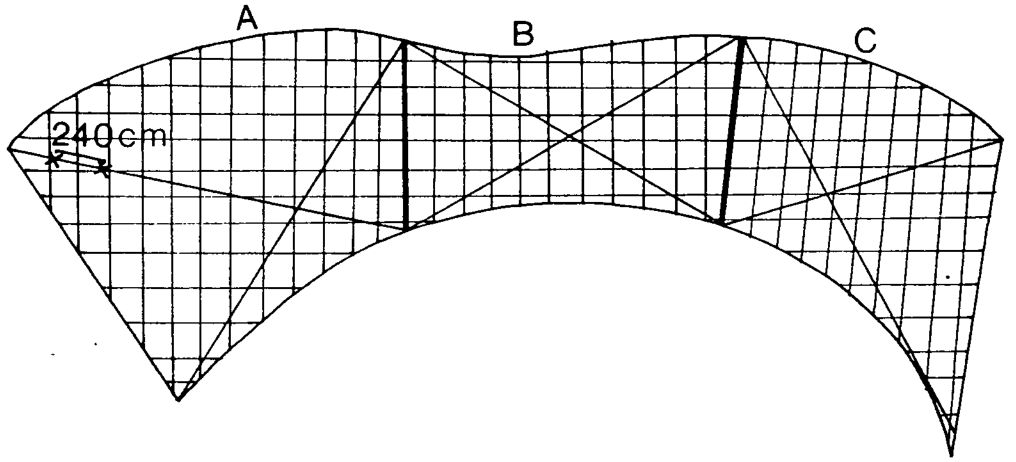

Fig 2. Diagram showing the sampling technique in colony GRW1. The colony was percieved as a grid and divided into 3 strata (a,b,c). In each stratum two transects were made along the two major axes and points located at every 240 cm (the "random points"). These and the nearest nest were examined and their characteristics measured.

The samples of nests were followed till hatching. Colony hatching sucess was also obtained (hatching success was used as a measure of nesting sucess as chicks move out from nest sites within a few days and are difficult to follow to fledging). Overhanging rock, holes and burrows provide cover and may entail higher hatching sucess (Burger & Gochfeld, 1988; Spendelow, 1982). To investigate such patterns every nest site with a partial and total overhang was recorded and, on Santa Maria, nest sites were divided into 4 categories: closer to rocks, closer to vegetation, with partial overhangs and with total overhangs.

3.1 Statistical analysis

The analysis is on two levels:

1-COLONIES. Examination of overall characteristics of colonies

2-NEST SITES. Examination of detailed characteristics of nest sites within colonies.

COLONIES. Colony structure was investigated using Principal Component Analysis (PCA), a classic ordination technique, and Detrended Correspondence Analysis (DCA), an improved ordination technique (Hill & Gauch, 1980). Fortran programs for these procedures were selected in the program CANOCO (Ter Braak, 1986). These techniques extract axes of maximum variation that help to summarize colony patterns (Gauch, 1982). Thirteen variables were entered in this analysis. Each type of colony SUBSTRACTE entered as a separate variable. ASPECT was removed from all colony analysis because two other attributes affected by it, average rainfall and windspeed, were not measured.

Multiple Discriminant (=Canonical variate) Analysis (MDA) was used to identify those nest site characteristics that were important in separating colonies. Overall characteristics of mixed and unmixed colonies were subjected to Linear Discriminant Analysis (LDA). The Fortran programs DISCRIM and CANVAR (courtesy of Dr. B. Huntley) were used for these two procedures. From the 11 overall characteristics of colonies 8 were selected to enter in LDA. SUBSTRATE was entered as % of bare rock, NDHHABITATION and NDTCOLONY were eliminated because they were correlated (r >0.75) with several other variables and irrelevant to group separation. These two techniques analysed the between-colony variation of (1) the overall colony characteristicsb (LDA) and (2) the nest site characteristics (MDA) compared with the within-colony variation and establish optimal separation of colonies based on linear transformation of the independent variables.

NEST SITES. The following group pairs were subjected to LDA: characteristics of Roseate tern (or Common tern) nest sites versus those of Random points nearby, characteristics of Roseate tern nest sites versus those of Common tern nest sites, characteristics of early Roseate tern nests versus characteristics of late Roseate tern nests in colony SMA13 and characteristics of Common tern nest sites in mixed colonies versus those of Common terns in unmixed colonies. Thirteen site variables were used. NEST PLACE was removed because of strong correlation with many variables (r>0.65, p>0.001) and close resemblance to WALLS. SUBSTRATE was entered as a dichotomous variable: hard (bare rock)=1 and soft (soil, vegetation or mixed)=0. The number of nests within boulders and on gravel were few. DRAINAGE was difficult to assess in the field and SLOPE AT NEST was invariant, therefore these variables were not used. Position was entered as 1 (centre) or 0 (edge, middle).

Variables entered in the analysis of colonies and nest sites were chosen after several steps of data editing and refinement of the multivariate techniques. Analysis was performed on raw data and transformed data. Arcsine transformation was used on percentage variables, logarithmic transformation on other continuous variables and square root on counts (NN2m) (Sokal & Rolhf, 1969). Since suitable attributes to characterize colonies and nest site selection were to be identified, some relatively weak discriminators (variables with a negative relative % to explain multivariate distance between group mean scores; Ludwig & Reynolds, 1988) were maintained. If a more concise function was needed the less useful characters were dropped.

The magnitude of Wilk's Lambda standardised coefficients indicates the parameters which contribute most to the separation between *a priori* groups (Reyment et al, 1984). However, these coefficients are sensitive to inequalities in variance and magnitude of the variables (Norusis, 1988) and thus are not directly interpreted. Furthermore, two important statistical assumptions underline the use of discriminant analysis: (1) The universes (groups) are multivariate normal and (2) The variance-covariance matrices for all populations are homogeneous (=equal) (Green, 1971; Norusis, 1988). This assumption is very important because a pooled variance-covariance matrix is used in the transformation to canonical space , which supports the linearity of the discriminant function (Williams, 1983). To met assumption (1) continuous and discrete variables were transformed. The Box's M criterion (Norusis, 1988) showed that assumption (2) was met only for the LDA analysis of Common tern nest site characteristics versus Random points in FLW57. This assumption is rarely met for ecological data (Green, 1971; Williams, 1983).In fact, if terns do exhibit nesting habitat selection differences in dispersion matrices are expected. Nonetheless, MDA and LDA are reasonably robust to moderate deviations from homogeneity and are more sensitive to differences in mean verctors than differences in dispersion matrices (Reyment *et al*, 1984). However, Williams (1983) proved that loss of statistical information occurs when discriminant assumptions are violated. As a consequence, my analyses and interpretation of canonical variates are data-exploratory.

The percentage of scores classified correctly into their respective group is a powerful and useful biological tool (Clark *et al*, 1983; Rice *et al*, 1983) and was used to indicate the efectiveness of the LDA. Overall statistical significance between LDA paired groups was based on an ANOVA using the discriminant scores as the dependent variable and the two group variables as the independent variable (Norusis, 1988).

The main hyphotheses examined with LDA were:

(1) Can Roseate tern nesting preferences be assessed using geographically large scale parameters? LDA of mixed colony vs non-mixed colony characteristics covering the whole Azores

arquipelago tested whether or not mixed colonies had significantly different features from Common tern colonies.

(2) Do Roseate and Common tern exhibit nest site selection? The comparison of characteristics of (a) Roseate and (b) Common tern nest sites against the same properties of random points tested the null hypothesis that sites chosen for nesting did not differ from available randomly located potential "nest sites".

(3) Do Roseates differ from Commons in the features they select when choosing nest sites? A comparison of Roseate vs Common tern nest sites determines which variables separate maximally the habitat selection of the two tern species. By examining overlap of the samples (a) and (b) along the discriminant function of hypothesis (2) and the contribution of each important variable to that discriminant function I determined which species showed a higher degree of habitat selectivity.

(4) Do Common tern nest site characteristics in mixed colonies differ from those in unmixed colonies? LDA of Common tern nest site characteristics in non mixed versus mixed colonies tested the null hupothesis that Common tern nest sites in mixed and unmixed colonies are similar. This information is relevant to habitat partitioning.

Site characteristics discriminant analysis was performed on individual colony data and on pooled colony data in order to investigate overall habitat discriminability (for non-vegetated colonies the values 700cm and 5cm were given for the variables DNEAVEG and HNEAVEG, respectively). This procedure is justified since hatching sucess did not differ significantly between mixed colonies (X^2(C.Tern)=0.287 df=4; X^2(R.Tern)=1.363 df=6; see results).

4. RESULTS

4.1 COLONIES

4.1.1 Colony ordination

The efficieny of ordination was slightly improved using transformed data. The % of the total variance explained by the first principle component was 78.9% and 72.0% using transformed and untransformed data, respectively. Transformed data only produced minor changes within the loadings of the variables. Two major patterns in the tern colonies (Fig. 3) were revealed. The first DCA axis (eigenvalue=0.286) has high positive loadings for % of MIXED SUBSTRATRE, SOIL, COVER and VEGETATION HEIGHT and negative loadings for % of BARE ROCK, SLOPE, NDTCOLONY, NDHHABITATION, LOCATION and AREA. In ecological terms this axis represents a continuous variation from immature (negative scores) to mature substrate (positive scores), with a tendency for colonies within relatively mature substrate to be gently-sloping and larger islets farther from human settlements and other tern colonies. This shows that a wide range of nesting habitats is used by both tern species (both Mixed and Common tern colonies are distributed along the first axis) and that larger colonies tend to occur far from constant human presence and other tern colonies.

The second DCA axis (eigenvalue=0.076) has a high positive loading for % of SOIL , a high negative loading for SUBSTRATE MIXED, low positive loadings for NDMAINLAND, NDTCOLONY and AREA and low negative loadings for VEGETATION HEIGHT, COVER and LOCATION. This axis contrasts larger soil colonies farther from the mainland (positive scores) and smaller vegetated colonies situated primarily close to the shore or in mainland sites (negative scores). The small eigenvalue for this axis, when compared to the eigenvalue for the first axis shows, however, that this axis is unlikely to be of much significance. The subsequent axes, with eigenvalues of 0.013 and 0.004, do not present interpretable patterns.

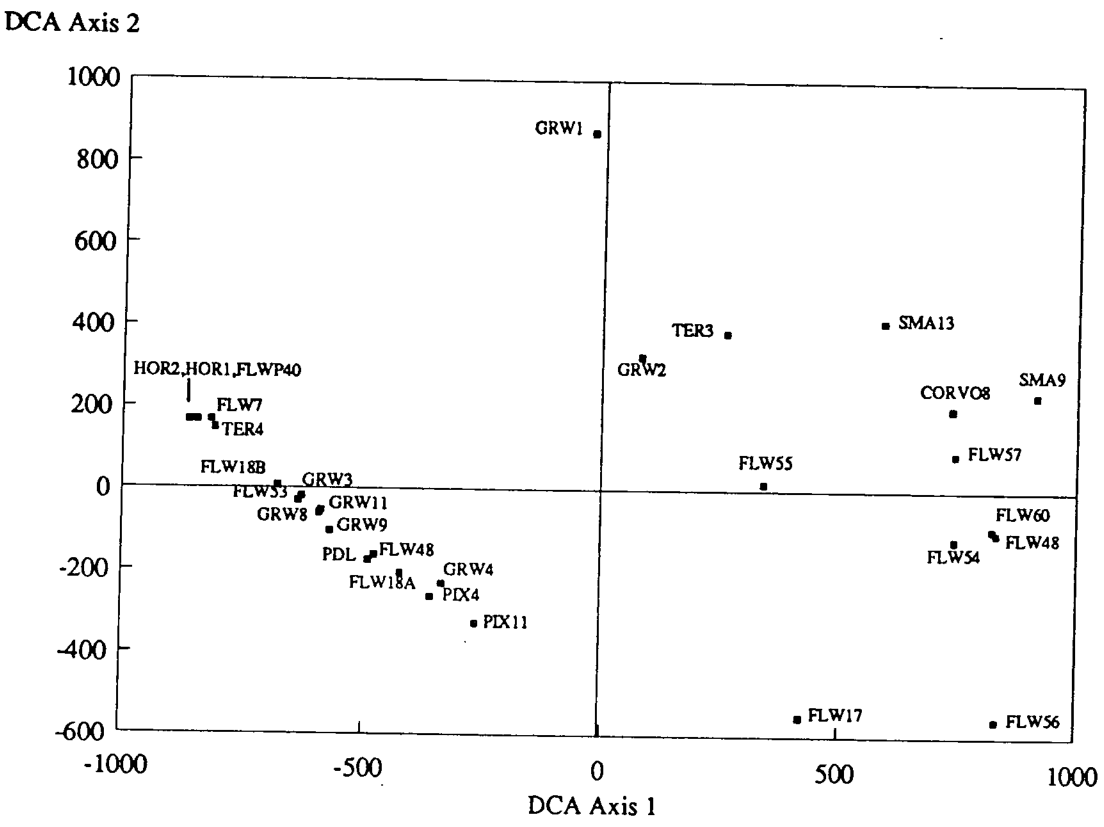

Fig 3. Detrended Correspondence Analysis of the Azorean tern colonies using transformed data. The DCA pattern was slightly clearer than the PCA pattern. The only two colonies with boulders (GRW10, GRW7) were percieved as outliers and were eliminated from the analysis.

4.1.2 Discrimination between overall characteristics of Mixed and Unmixed colonies

Overall the habitat characteristics of Mixed colonies were significantly different from Common tern colonies (ANOVA of LDA: $F=4.04$; $p<0.04$; $df= 3,23$) and only 2 out of 10 Mixed colonies fell within the range of characteristics of Common tern colonies (Fig 4). Such a difference was increasingly described by SLOPE, VEGETATION HEIGHT and DEGREE OF SURFACE (table 1). The use of highly pitted lava and ash, jagged rocks, fissures and higher vegetation for nest concealment by Roseate terns explains this discrimination. Avoidance of steep cliffs seems to be a reflection of their lack of heterogeneity. Cliff nesting Roseates were observed only in Flores (FLW18). The birds nested in crevices and hollows or among higher vegetation growing in flatter parts.

Table 1. Summary of LDA of colony characteristics among mixed and unmixed colonies.

Habitat variable	Standardised coeffi.	Percent added
DEGREE OF SURFACE	2.10	64.20
VEGETATION HEIGHT	2.66	43.15
SLOPE	-0.75	13.22
DISTANCE TO MAINLAND	0.27	2.47
AREA	0.15	0.43
LOCATION	-0.30	-4.30
SUBSTRATE	0.96	-6.21
COVER	-1.85	-12.98

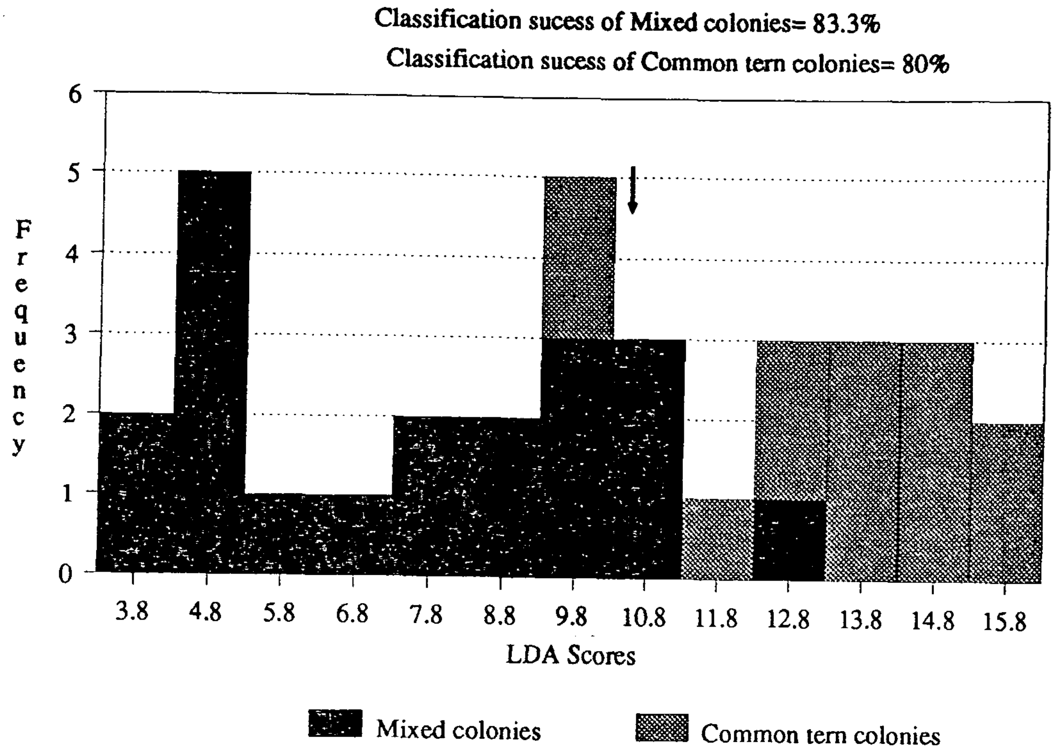

Fig 4. Frequency distribution of scores for the discriminant function from the analysis of mixed and Common tern colonies. The arrow indicates the midpoint between mean LDA scores of the two types of colonies.

4.1.2 Nest site differentiation between colonies

ROSEATE TERN. Plots of the six canonical variate Roseate sub-colonies means and the individual Roseate tern nest site canonical scores on the first two canonical variate axes show 3 groups of colonies: (1) FLW55 (A), FLW56 (B), FLW60 (C); (2) SMA13 (G), PIX4 (D); (3) TER4 (E), GRW1 (F) overlapping completely in terms of their nest site characteristics, but being fairly distinct among themselves (Fig.5). The variables most highly correlated (r values) with the first canonical variate axis (which accounted for 67.8% of the total variance) are : (I) Negative. COVER 0.5m (cover within 0.5m of nest) and COVER 3m (cover within 3m of nest) (-0.88) and (II) Positive. VISIBILITY (0.63), VEGETATION TYPE (0.56), DNEAVEG (distance to nearest vegetation) (0.57), NN2m (number of neighbours within 2m of nest) (0.46), POSITION (0.41) and WALLS (0.40). This axis thus distinguishes between nest site colonies that are vegetated (negative scores) and non-vegetated (positive scores). The latter possess nests more visible from above, with more walls and neighbours within 2 metres. The high correlation of the first canonical variate with VEGETATION TYPE is misleading and is due to the fact that the nearest vegetation (well outside of the colony) was grass.

The second canonical variate accounts for 21% of the total variation but does not present correlations higher than 0.37 with any one variable. The variables positively and negatively correlated with axis 1 change sign in the correlation in axis 2 suggesting that this axis is only stressing the patterns explained by the first one. The low importance of this axis is also indicated by the limited extent of the scale.

The results suggest that Roseate tern nest site selection is influenced by the type of habitat. In non-vegetated, more exposed areas, especially GRW1, the habitat permits denser nesting and social factors may assume greater importance.

COMMON TERN. Plots of the 12 canonical variate colony-means on the first two canonical variate axes (accounting for 81,6% of the total variance) are shown in Fig.6. Individual nest site canonical scores are not plotted due to extensive overlap. The first canonical variate axis has high positive correlations with COVER 0.5m (0.67) and COVER 3m of nest (0.77) and high negative correlations with VISIBILITY (-0.73), DNEAVEG (-0.55) and VEGETATION TYPE (-0.5). As with The Roseate terns this axis is primarily contrasting non-vegetated, exposed colonies (negative scores) with vegetated colonies (positive scores); but social factors do not assume here a significant importance. The second canonical variate axis has high negative correlations with SUBSTRATE (-0.56), HNEAVEG (height of nearest vegetation) (-0.62), VEGETATION TYPE (-0.5), DNEAVEG (-0.43), SLOPE (-0.46) and DNN (distance to nearest neighbour) (-0.42) but does not present any high positive correlations. The tendencies revealed by these variables are not well pronounced since there are no strong differences between the nest site characteristics of most colonies along this canonical variate axis.

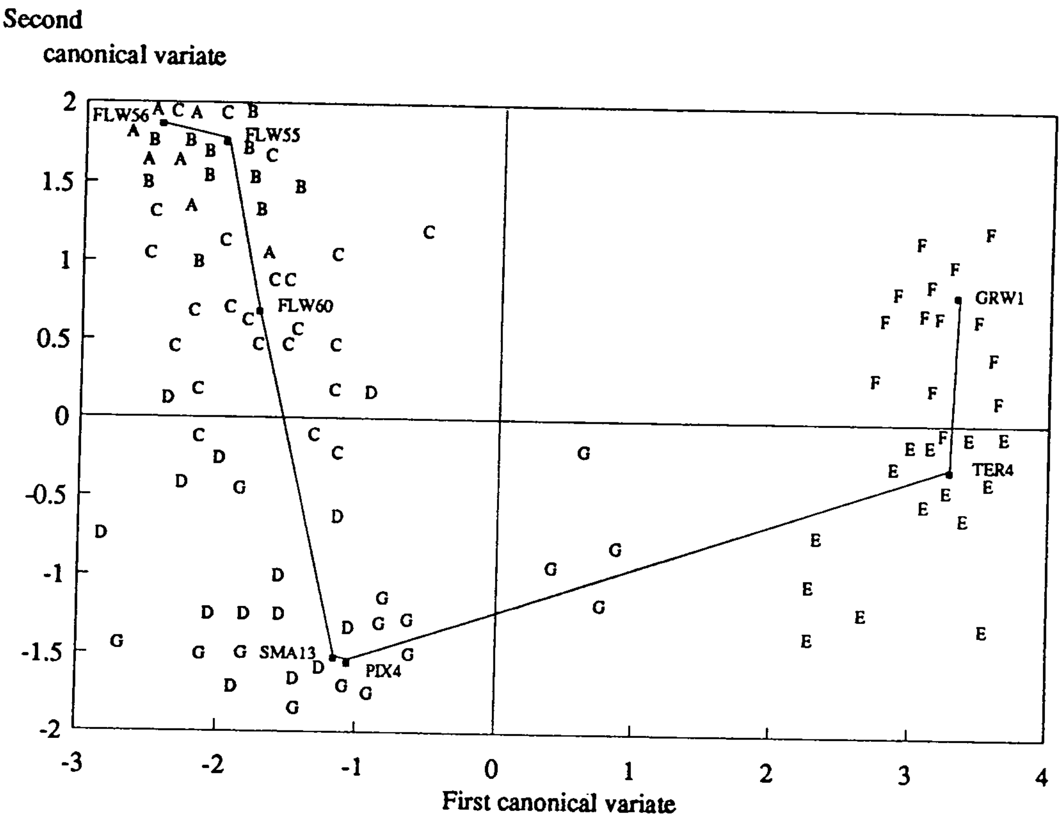

Fig 5. Plot of the 7 canonical variate Roseate colony means and the scores of the individual nest sites. Individual canonical scores of overlapping nest sites are not plotted. The Minimum Spanning Tree (Prim network) is also shown.

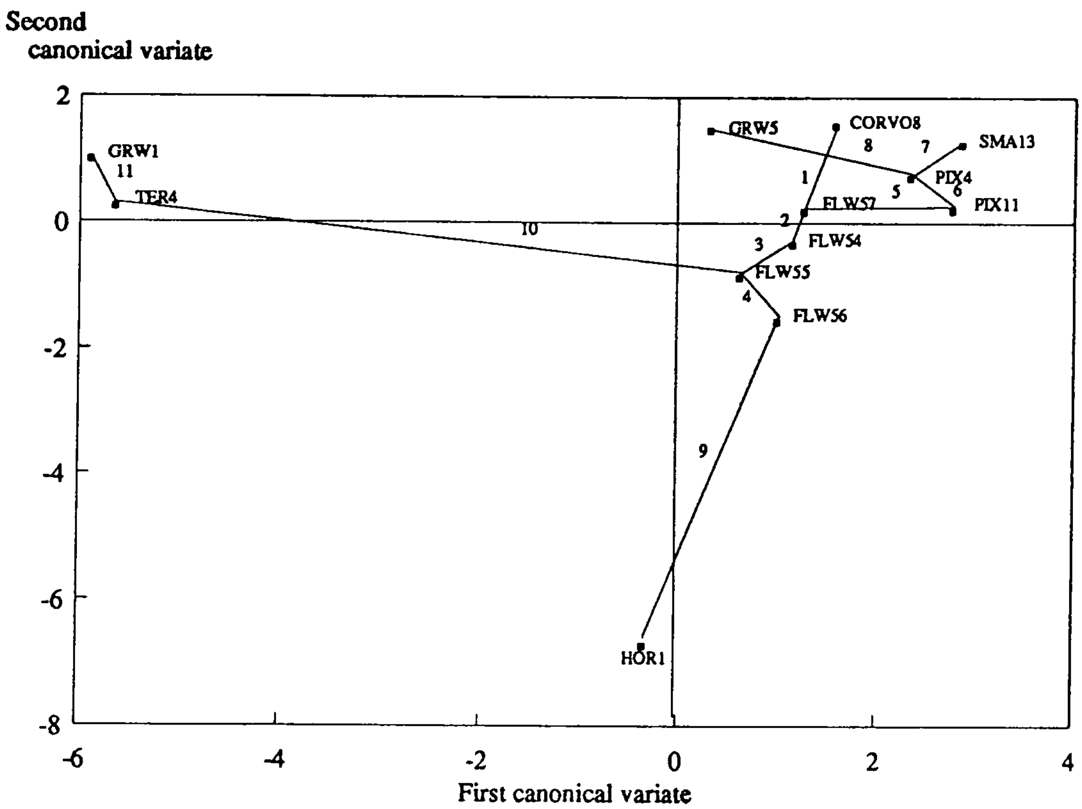

Fig 6. Plot of the 12 canonical variate Common tern colony means. The sequence of connections of the Prim's Minimum Spanning Tree are shown by the numbers 1-11.

The close similarity between vegetated colonies is clearly manifested in the Prim's Minimum Spanning Tree (graphical display to show the shortest connection between the most similar group means, Prim *in* Reyment *et al*, 1982), which does not present a clear pattern (Fig.6). This suggests that the variation within-colony is greater than the variation between colonies. Consequently, most of the colonies are not well separated on the first two canonical variate axes.

4.2 NEST SITES

At each mixed colony a discrete nesting area could be identified for each species. Roseates nested as a single group surrounded by Commons. Both species had the same species as nearest neighbour almost 100% of the time

Initiation of egg laying varied significantly among colonies (del Nevo, pers. comm.). On the island of Flotes, Roseate terns commenced laying in late April; on Santa Maria in late May. In mixed colonies, the peak of egglaying for Roseate terns was about two weeks earlier than the peak of egglaying for Commons (del Nevo, pers. comm.). Breeding Roseate terns significantly outnumbered Common terns in 77.7% of the colonies (X^2=202 $p<0.001$ df=8; table 2).

Continuous and discrete variables of the characteristics of the nest sites of Roseate and Common terns and of the Random points are summarised in table 3, which shows that various nest site characteristics of Roseate and Common tern seem to differ from each other and from the random points. These apparent differences are tested using the discriminant procedure. The results presented next are all based on transformed data because these matched better the assumptions of Linear Discriminant Analysis and/or produced better rates of classificaton sucess for the scores of the discriminant function.

Table 3. Mean ± S.E of continuous variables of Roseate (RT), late Roseate (LRT) and Common (CT) tern nest site characteristics and nearby random points (RA) in sampled tern colonies in the Azores.

		HABITAT VARIABLES							
COLONIES	n	WALLS (Nº)	DNEAVEG (cm)	HNEAVEG (cm)	COVER.5m (%)	COVER 3m (%)	VISIBILITY (%)	DNN (cm)	NN2m (Nº)
CORVO									
8 CT	21	0.9 ± 0.21	5.3 ± 1.30	9.8 ± 1.78	46.9 ± 5.42	57.9 ± 4.44	94.5 ± 3.93	106.5 ± 16.73	5.9 ± 1.13
FLW									
54 CT	22	0.6 ± 0.18	6.2 ± 0.91	15.2 ± 2.06	35.0 ± 3.68	43.0 ± 3.79	88.1 ± 5.29	140.4 ± 21.15	3.1 ± 0.47
55 RT	7	0.5 ± 0.30	1.2 ± 0.64	26.4 ± 2.19	90.0 ± 5.34	71.4 ± 6.70	83.6 ± 5.20	96.5 ± 10.12	4.9 ± 0.59
55 CT	16	0.1 ± 0.09	58.6 ± 15.62	19.6 ± 1.85	17.6 ± 6.70	23.7 ± 4.65	89.4 ± 6.40	136.1 ± 17.57	2.1 ± 0.37
55 RA	20	0.2 ± 0.11	223.9 ± 44.85	21.1 ± 1.43	14.6 ± 7.65	14.4 ± 5.55	94.0 ± 3.35	173.7 ± 37.59	2.1 ± 0.37
56 RT	24	0.2 ± 0.10	0.8 ± 0.38	23.7 ± 1.48	90.8 ± 3.41	85.6 ± 4.04	49.5 ± 6.02	80.2 ± 11.19	6.9 ± 0.65
56 CT	15	0.5 ± 0.24	68.5 ± 21.51	20.6 ± 1.89	14.3 ± 5.59	26.3 ± 5.19	98.3 ± 1.09	90.9 ± 12.59	3.4 ± 0.51
57 CT	29	0.6 ± 0.16	12.3 ± 4.47	12.5 ± 1.35	46.1 ± 5.79	41.9 ± 5.59	96.0 ± 1.43	113.2 ± 10.91	3.5 ± 0.38
57 RA	21	0.8 ± 0.22	30.3 ± 5.38	16.7 ± 2.17	21.6 ± 6.12	24.1 ± 5.79	95.4 ± 2.01	119.9 ± 15.08	2.1 ± 0.38
60 RT	21	1.5 ± 0.24	4.8 ± 0.79	17.7 ± 1.96	45.9 ± 6.40	43.8 ± 5.70	63.1 ± 7.16	84.0 ± 6.83	2.8 ± 0.40
60 RA	12	0.7 ± 0.33	26.5 ± 9.55	16.0 ± 2.80	22.6 ± 6.73	24.3 ± 5.59	97.5 ± 1.79	106.8 ± 18.54	3.5 ± 0.71
PIX									
4 RT	26	1.9 ± 0.22	15.7 ± 5.86	10.2 ± 1.74	15.9 ± 3.67	13.5 ± 2.87	73.4 ± 5.88	125.9 ± 11.36	2.5 ± 0.33
4 CT	19	1.1 ± 0.25	23.6 ± 11.72	8.7 ± 1.44	25.8 ± 5.62	25.0 ± 4.30	99.2 ± 0.79	113.5 ± 16.35	2.1 ± 0.37
4 RA	20	1.5 ± 0.27	33.5 ± 12.15	14.7 ± 2.36	14.5 ± 4.10	17.2 ± 3.98	94.5 ± 2.20	139.7 ± 19.10	1.6 ± 0.31
11 CT	23	0.8 ± 0.19	4.3 ± 0.68	12.8 ± 2.26	27.5 ± 4.80	35.8 ± 4.21	93.9 ± 3.49	129.8 ± 11.55	3.5 ± 0.56
HOR									
2 CT	15	0.6 ± 0.25	-	-	-	-	85.3 ± 8.39	328.0 ± 33.09	0.2 ± 0.12
GRW									
1 RT	30	1.9 ± 0.20	-	-	-	-	84.8 ± 4.97	79.5 ± 12.65	7.1 ± 0.86
1 CT	30	0.4 ± 0.12	-	-	-	-	99.8 ± 0.17	185.7 ± 12.41	1.4 ± 0.29
1 RA	30	1.0 ± 0.17	-	-	-	-	92.0 ± 2.84	178.5 ± 19.10	2.3 ± 0.61
8 CT	14	0.7 ± 0.22	250.0 ± 89.57	5.1 ± 0.34	25.1 ± 9.14	24.1 ± 8.50	100.0 ± 0.00	169.1 ± 25.10	2.2 ± 0.63
TER									
4 RT	23	2.8 ± 0.21	-	-	-	-	70.8 ± 8.37	109.5 ± 13.04	4.0 ± 0.43
4 CT	26	0.9 ± 0.18	-	-	-	-	100.0 ± 0.00	134.1 ± 13.63	3.5 ± 0.38
4 RA	24	0.5 ± 0.17	-	-	-	-	90.2 ± 5.14	148.3 ± 15.82	2.5 ± 0.46
SMA									
13 RT	32	2.3 ± 0.19	32.1 ± 11.68	11.1 ± 1.37	19.7 ± 3.31	17.9 ± 2.79	72.8 ± 6.04	87.7 ± 11.47	4.5 ± 0.46
13 CT	29	0.5 ± 0.14	5.4 ± 1.03	8.3 ± 0.89	40.6 ± 5.64	53.6 ± 4.82	100.0 ± 0.00	186.1 ± 17.61	0.9 ± 0.18
13 RA	35	0.7 ± 0.158	52.7 ± 15.02	11.1 ± 1.22	21.7 ± 4.59	33.6 ± 4.55	99.1 ± 0.63	408.5 ± 57.15	1.0 ± 0.29
13 LRT	15	2.1 ± 0.30	19.5 ± 10.69	18.6 ± 1.35	39.3 ± 6.42	29.0 ± 3.72	81.6 ± 6.18	153.6 ± 22.20	0.9 ± 0.19

- non-vegetated colonies

Table 2. Number of breeding pairs of Roseate and Common terns in mixed colonies

Colonies	Roseate terns	Common terns
FLW17	174	38
FLW55	8	38
FLW56	120	46
FLW60	54	2
PIX4	45	37
TER4	97	87
GRW13	139	90
SMA13	216	326

4.2.1 Comparison of the characteristics of Roseate tern nest sites with those of Random points nearby.

Nest site characteristics differed from those of random points within a colony in each individual colonies (Fig 10) and in pooled colony data (ANOVA of LDA: $F=21.1$ $p<0.0001$ $df=13,265$). 88.5% of the sites for which characteristics were measured were correctly classified as Roseate tern nests (Fig. 7). The discriminant function indicated that WALLS, VISIBILITY and NN2m best described differences between Roseate nests and random points (table 4). DNEAVEG (distance to nearest vegetation) and COVER 0.5m (cover within 0.5m of nest) also contibuted a little to the discrimination (table 4). Within the available habitat, Roseate terns selected more sites than expected by chance that were surrounded by walls, had more neighbours within 2 metres and were less visible from above. Although these variables were consistently of greater importance to discriminate between nest sites and random points within most of the individual colonies considerable variation exists among colonies (Fig. 10). By integrating the action of several variables (e.g. WALLS, COVER, OVERHANG) VISIBILITY appears to be of considerable importance to characterize Roseate tern nest site selection.

Table 4. Summary of LDA of nest site characteristics among Roseate terns and Random points (all colonies)

Habitat variable	Standardised coeffi.	Percent added
WALLS	1.29	35.6
VISIBILITY	-0.41	26.38
NN2m	-0.21	25.98
DNEAVEG	0.42	10.30
COVER 0.5m	-1.20	4.51
DNN	-0.35	2.72
OVERALL SLOPE	0.59	1.62
HNEAVEG	-0.79	1.61
SUBATRATE	-1.26	0.66
VEGETATION TYPE	-0.13	-0.49
POSITION	1.14	-1.46
COVER 3m	-0.30	-1.64
OVERHANG	-0.17	-5.48

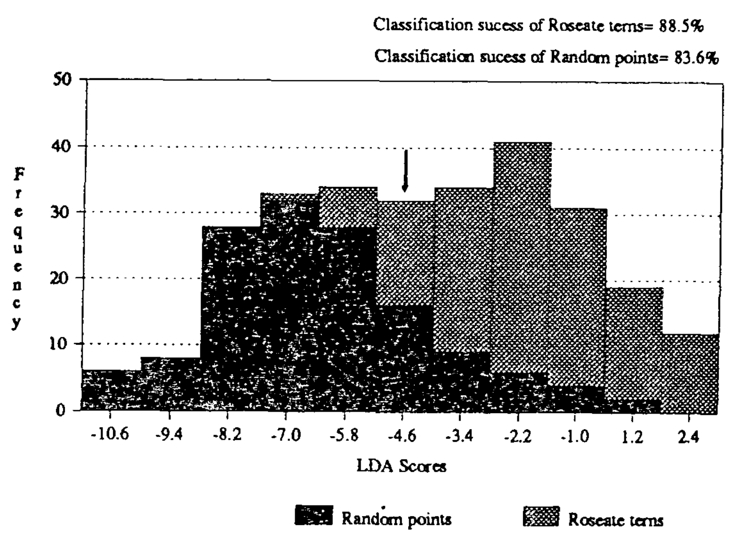

Fig 7. Frequency distribution of scores for the discriminant function from the analysis of characteristics of Roseate tern nest sites and nearby random points. The arrow indicates the midpoint between mean LDA scores of the two types of sites.

In colony FLW55 Roseates nested only in an area with tall dense vegetation. In this colony COVER 0.5m was highly correlated with DNEAVEG (r=-0.91,) COVER 3m (r=0.87) and VISIBILITY (r=-0.88) (all p<0.01) but was highlighted by the LDA as the best discriminator. In pooled colony data the discriminator COVER 0.5m was highly correlated with COVER 3m (r=0.91 p<0.001) indicating that the effect of cover on nesting Roseate terns can be assessed using only the variable COVER 0.5m. In colony FLW60 Roseates selected to nest in places where grass was the nearest vegetation. In that colony, it was taller than other plant types.

4.2.2 Comparison of the characteristics of Common tern nest sites in mixed colonies with those of Random points nearby.

Overall, the discriminant analysis differentiated significantly between Common tern nest sites and random points (ANOVA of LDA: F=4.31 p<0.00001 df=13,231) although discriminant scores overlapped quite extensively (Fig.8). At FLW57, a non-mixed colony, however, the overall habitat characteristics of nest sites and random points were not significantly different (Fig. 10; total number of correct classifications= 76%). This reflected higher habitat homogeneity in this colony.

The following eight variables: DNN (distance to nearest neighbour), DNEAVEG (distance to nearest vegetation), SUBSTRATE, COVER 3m, HNEAVEG (height of nearest vegetation), SLOPE, POSITION AND OVERHANG , listed in order of increasing importance, accounted for most of the variance between these site types (Table 5).

Table 5. Summary of LDA of nest site characteristics among Common terns and Random points (all colonies).

Habitat variable	Standardised coeffi.	Percent added
OVERHANG	-0.15	19.90
POSITION	-0.41	18.88
OVERALL SLOPE	-0.33	15.67
HNEAVEG	0.30	13.10
COVER 3m	-0.54	12.45
SUBSTRATE	-0.39	12.11
DNEAVEG	-0.50	10.69
DNN	0.52	8.96
WALLS	-0.04	2.87
NN2m	-0.45	1.31
VEGETATION TYPE	0.11	-1.76
VISIBILITY	-0.40	-1.69
COVER 0.5m	-0.52	-12.59

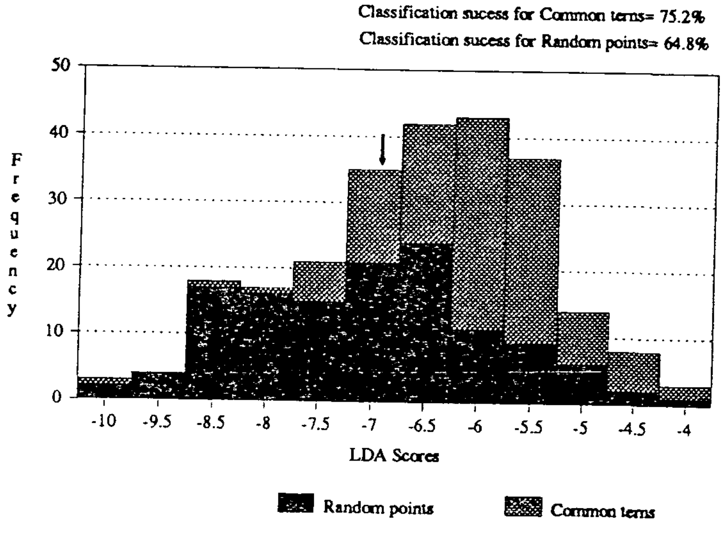

Fig 8. Frequency distribution of scores for the discriminant function from the analysis of characteristics of Common tern nest sites and nearby random points in mixed colonies. The arrow indicates the midpoint between mean LDA scores of the two types of sites

Common terns nested on soft substrates within open areas avoiding overhangs and tall vegetation. Their nests had more cover within 3m than 0.5m (table 3), were closer to vegetation and were situated in less steep slopes than random points (Nests had also greater cover within 0.5m but the LDA indicate that cover within 3m is a best discriminator, correlation between the two variables r=0.89, p<0.01). Less steep slopes usually had soil as the major substrate component. This allowed the construction of a nest cup, a regular feature of Common tern nests (75.3% of the sampled nests had a nest cup). In colony PIX11, on the island of Pico, some eggs rolled out of nests, presumably due to the steep slope of that islet. As with the Roseate terns, the most important discriminators differed among colonies (Fig. 10)

It can be argued that POSITION is not an appropriate variable to characterize Common and Roseate nest site selection in the Azores because, by nesting later, Commons surround the Roseates and, therefore, tend to nest on the edge of the colony. However, the importance of the variable POSITION as a discriminator between Common tern nest site characteristics and random points in mixed colonies reflects the existence of more open sections in the edge of the colonies. Positions's importance as a discriminator between Common tern, but not Roseate tern, nest site characteristics and random points reveals the low importance of physical characteristics in separating Common terns from the available habitat. This suggests that Common terns do not show a particular preference for any aspect of the available habitat, as measured in this study.

4.2.3 Comparison of the characterisctics of Roseate and Common tern nest sites

Site characteristics of Roseates differed significantly from those of Commons both on pooled colony data (Anova of

LDA: F=29.71 p<0.000001, df=13,260) and in individual colonies (Fig. 10). The Linear Discriminant Analysis indicated that WALLS, VISIBILITY, NN2m, COVER 0.5m and POSITION were the variables that distinguished optimally between the two tern species nest sites (Table 6; Fig. 11). The Discriminant Function scores for Roseate terns had little overlap with the scores for Common terns (Fig. 9), indicating that both species base their nest site selection on different habitat parameters.

Table 6. Summary of LDA of nest site characteristics among Roseate terns and Common terns (all colonies).

Habitat variable	Standardised coeffi.	Percent added
WALLS	1.73	31.17
NN2m	0.26	24.28
VISIBILITY	-0.47	21.95
COVER 0.5m	0.01	15.35
POSITION	-0.93	9.57
DNEAVEG	0.08	4.42
OVERHANG5m	2.59	3.88
OVERALL SLOPE	-2.88	0.38
HNEAVEG	-1.11	0.19
VEGETATION TYPE	0.42	-0.01
SUBSTRATE	1.36	-0.20
COVER 3m	0.20	-5.11
DNN	0.68	-5.90

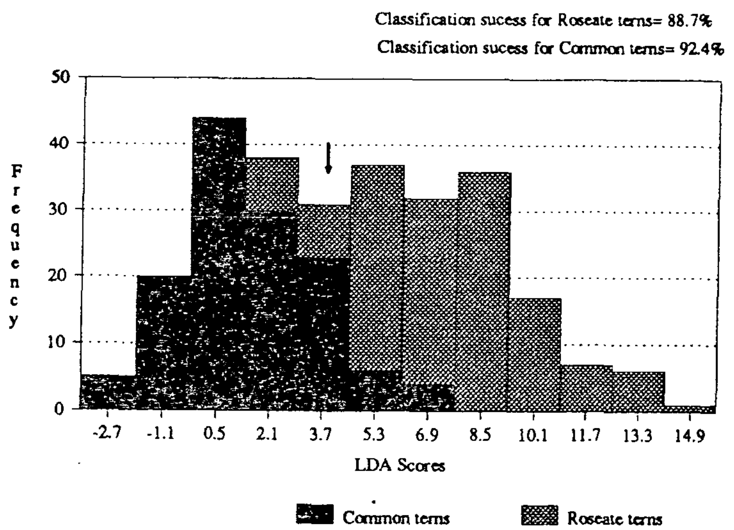

Fig 9. Frequency distribution of scores for the discriminant function from the analysis of the characteristics of Roseate and Common tern nest sites. The arrow indicates the midpoint betwen mean LDA scores of the two types of nests

Overall, Roseates had more walls around the nest and greater cover within 0.5 m of nest (which provided less visibility from above) (Tables 3 and 6). Roseates nested closer to other terns and had more neighbours within 2m (Table 3; correlation between the two variables r=-0.71, p<0.001), but the discriminant function showed that Number of Neighbours within 2m best describes this social density effect (Coulson & White, 1960; Veen, 1977). Therefore, although the maximum nest-density is related to the substrate structure of the colonies, Roseates seem to tolerate closer neighbours than Common terns. The relative variability in NN2m was higher for Common terns (CV=66.5) than for Roseate terns (CV=53.43) which shows that Roseates consistently nested at higher densities.

The differences in rates of correct classification of the pooled colony data between Roseate nest sites vs Random point on the one hand and Common nest site vs Random point on the other hand was highly significant (Fig 10; G=21.34 with Yate's correction p<0.001 df=1), which shows that areas where Roseate terns chose to nest differed more from the available habitat than areas where Common terns nested. To differentiate between the characteristics of Roseate nest sites and Random points, the discriminant function highlighted only 4 variables that explain more than 10 % of the discriminant analysis (table 4) whereas for Comnmon terns 7 variables were selected (Table 5). The total percentage explained by these variables is significantly higher for Roseates than for Commons (t=2.25 with arcsine transformation p<0.05 df=9). Among individual colonies, important discriminators consistently accounted for more of the variability for Roseates than Common terns (Fig. 10).

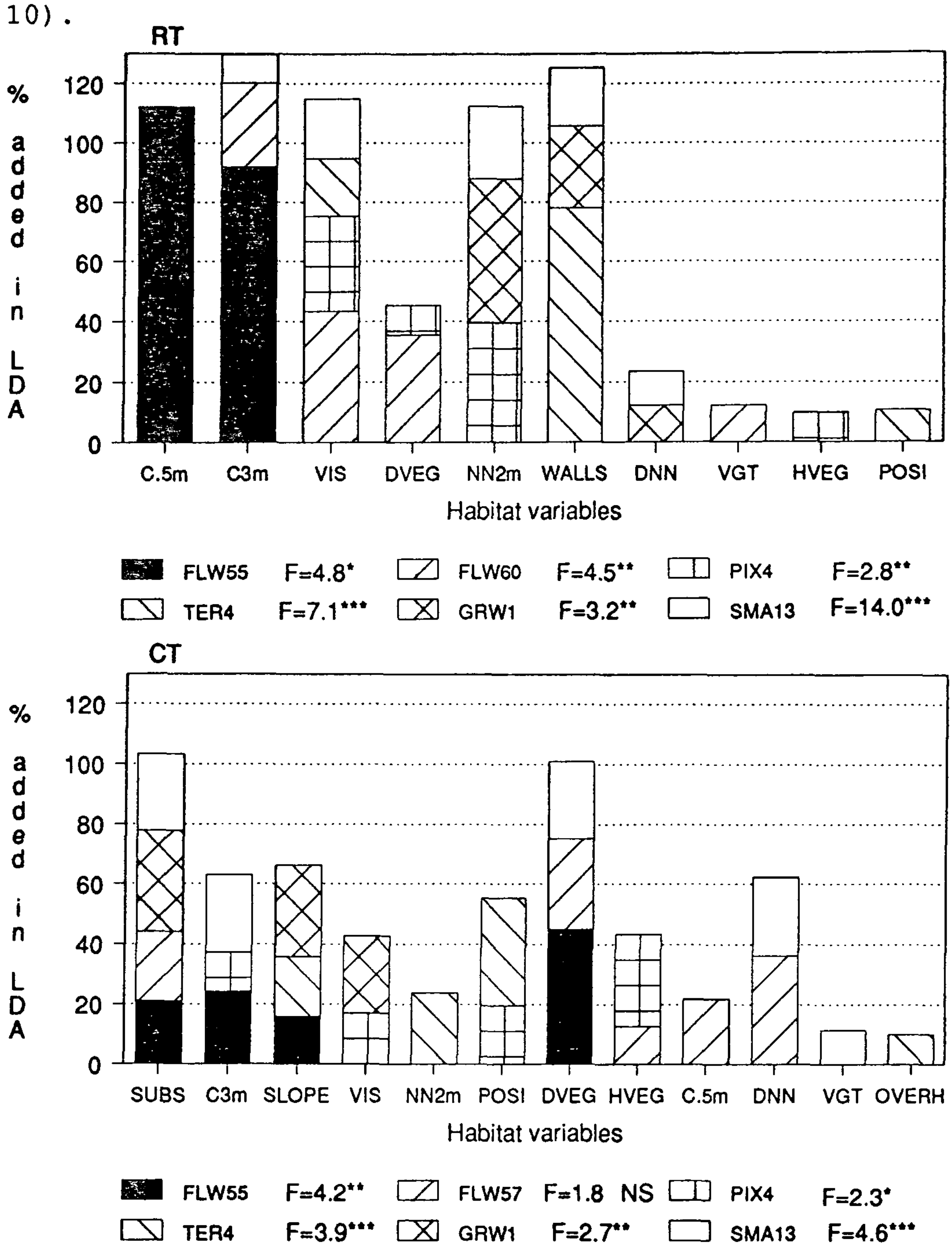

Fig 10. The importance of each habitat variable, expressed in terms of % added in the LDA, to distinguish between Roseate tern (RT) or Common tern (CT) nest sites and nearby Random points at different individual colonies (only variables that explained more than 10% of the LDA are shown. F-values of the comparison of the two types of nest sites using ANOVA on LDA scores are indicated; NS = non significant $*=p<0.05$, $**=p<0.01$, $***=p<0.001$.

Variables: C.5m-COVER 0.5m, C3m-COVER 3m, VIS-VISIBILITY, DVEG-DNEAVEG, HVEG-HNEAVEG, VGT-VEGETATION TYPE, POSI-POSITION, SUBS-SUBSTRATE, OVERH-OVERHANG.

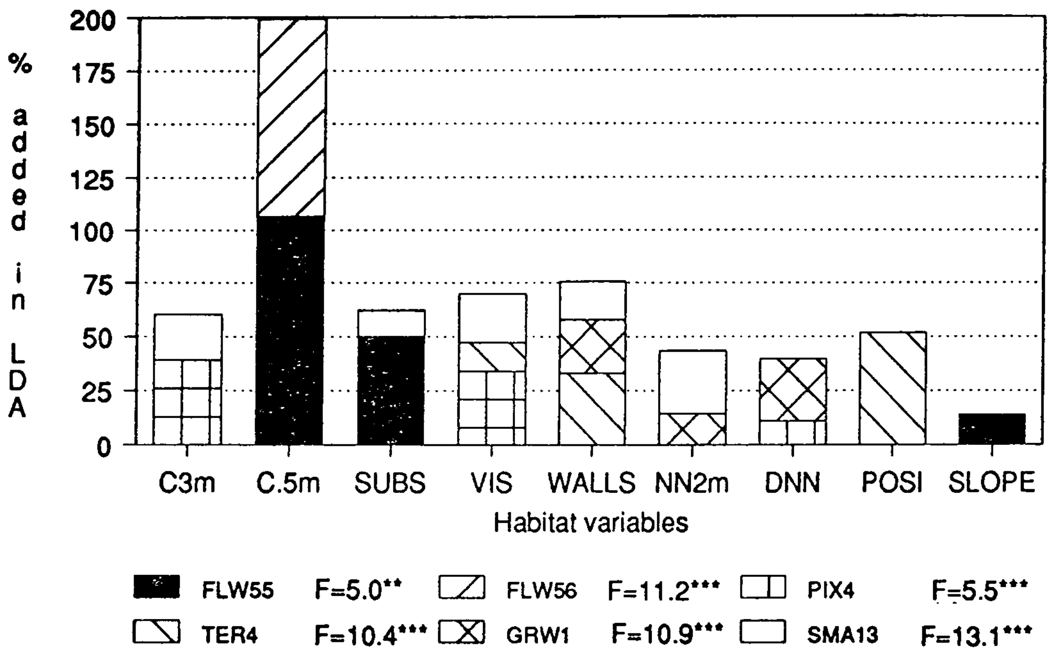

Fig 11. The importance of each habitat variable, expressed in terms of % added in the LDA, to distinguish between Roseate and Common tern nest sites at different individual colonies. For explanation see Figure 10.

These results suggest that two interacting mechanisms are involved in determining the degree and criteria of habitat selection by nesting Roseate and Common terns: Roseate tern nesting habitat is more distinctly from the available habitat and their precision of habitat selectivity is higher. On the other hand, Common tern nesting habitat is more similar to randomly located points and they are more disposed to use what is available.

4.2.4 Comparison between the characteristics of early and late Roseate tern nest sites on colony SMA13.

The characteristics of nest sites of late-nesting Roseate terns differed from those of early-nesting ones (ANOVA of LDA: $F=5.56$ $p<0.00004$ $df=13,33$) and the LDA scores of the two groups of nests overlapped very little (Fig.12). Late nests had fewer neighbours within 2m, more cover within 3m and 0.5m and were closer to higher vegetation (table 7). The important discriminators between early-nesting Roseates and available habitat are of minor importance in separating early from late Roseate tern nest sites. So, the differences between early and late Roseate tern nests are better explained by seasonal changes in the vegetation rather than a decrease in availability of optimal sites : new plants were growing and older plants were becoming broader and taller. Less neighbours within 2m reflects the scattered nesting of the late birds (Nisbet & Drury, 1972)- only nests with eggs entered in the variable NN2m.

Table 7. Summary of LDA of nest site characteristics among early and late nesting Roseate terns in SMA13.

Habitat variables	Standardised coeffi.	Percent added
NN2m	3.41	68.97
COVER 3m	-2.05	16.26
HNEAVEG	-1.03	13.56
COVER 0.5m	-1.25	11.34
VISIBILITY	-0.68	2.07
OVERHANG	0.32	1.45
VEGETATION TYPE	0.69	1.20
POSITION	-0.04	0.26
SUBSTRATE	-0.01	0.01
DNEAVEG	-2.59	-0.27
WALLS	-0.22	-0.58
OVERALL SLOPE	-0.72	-1.08
DNN	1.39	-13.24

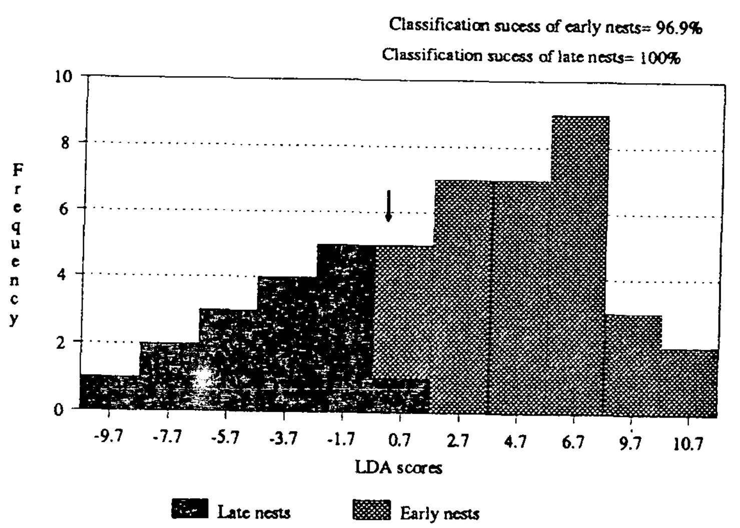

Fig 12. Frequency distribution of scores for the discriminant function from the analysis of early and late Roseate tern nest sites in colony SMA13. The arrow indicates the midpoint between mean LDA scores of the two types of nests.

4.2.5 Comparison between nest site characteristics of Common terns in Mixed and Non-mixed colonies

The overall degree of discrimination between nest sites of Common tern in Mixed and Non-mixed colonies showed a significant difference (ANOVA of LDA: $F=7.12$ $p<0.000001$ $df=13,139$), increasingly accounted for by the following variables: NN2m, VEGETATION TYPE, DNEAVEG and OVERALL SLOPE (Table 6). The LDA scores of the two groups overlapped moderately (Fig. 13). In mixed colonies, Common terns had more neighbours within 2 m of the nest and grass as the nearest vegetation type, nested farther from vegetation and on steeper slopes (Tables 3 and 8). Nest-site attributes of birds in Mixed and Non-mixed colonies are expected to differ if (1) the structure of the habitat differs between the two colony types and/or (2) if colony organization changes between colonies. The latter could arise if intraspecific and interspecific interactions assumed greater importance in Mixed colonies. Point (1) above is important because the mixed colonies that were entered in this discriminant analysis (FLW55, FLW56, PIX4 and SMA13) had more grass than the unmixed Common tern colonies (FLW54, FLW57 and PIX11). The grass in mixed colonies was taller and such areas were used for nesting by Roseate terns. Commons nested in more open areas, which had steeper slopes. Although Roseates started to nest earlier than Commons it seems unlikely that this explains the open ground nesting of Common terns. Commons avoid tall vegetation (Table 5) and thus, their nesting closer to vegetation in non-mixed colonies is partly due to the presence of shorter vegetation in those colonies. However, denser nesting in mixed colonies means that for Common terns in these situations intraspecific and interspecific interactions become increasingly important. In colony FLW55, nests initiated in early May were closer to vegetation ($\bar{x}$=58.6 cm, n=16) than nests initiated in early June ($\bar{x}$=409.2 cm, n=12). This difference is highly significant (t=5.1 after log transformation, p<0.001, df=26). Therefore, although Common terns avoid placing their nests within tall vegetation, there is no reason why they should not nest close to that vegetation, unless such sites are alreadly occupied, so that they are forced to use other areas. Social stimulation by early nesting Roseates might also be important; if so, it is predicted that Common terns in mixed colonies should begin to lay before Commons in non-mixed colonies and that a higher percentage of older, more experience Commons (Coulson & White 1958, 1960; Coulson, 1968; Veen 1977) should nest in the first colonies. Birds of three different status might be attracted to nest around the optimal nesting area for Roseates, namely: (1) older and (2) younger Common terns and (3) younger Roseates. However, these hypotheses cannot be tested with my data.

Table 8. Summary of LDA of nest site characteristics among Common terns in mixed and unmixed colonies.

Habitat variable	Standardised coeffi.	Percent added
NN2m	0.42	34.78
VEGETATION TYPE	-0.44	29.61
DNEAVEG	0.22	19.27
OVERALL SLOPE	1.16	17.72
POSITION	-0.85	5.24
VISIBILITY	-0.73	2.62
WALLS	-0.27	1.95
OVERHANG	-0.06	0.85
SUBSTRATE	-0.22	0.17
COVER 3m	1.20	-0.45
HNEAVEG	1.45	-1.20
COVER 0.5m	0.76	-4.38
DNN	0.41	-6.21

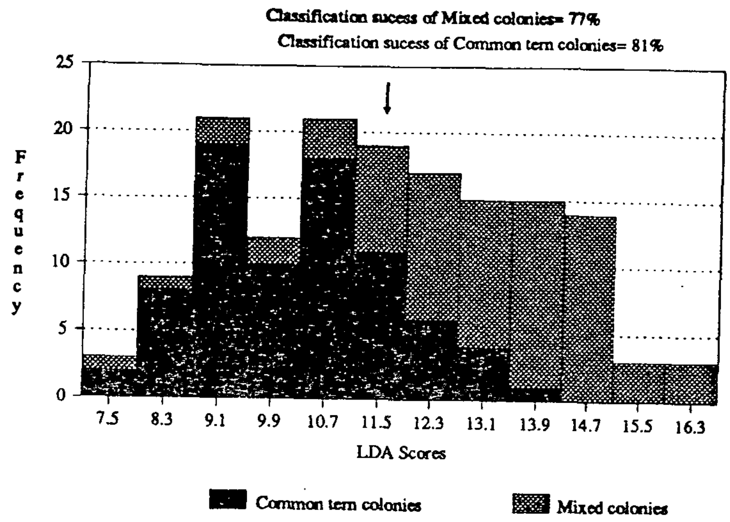

Fig 13. Frequency distribution of scores for the discriminant function from the analysis of the characteristics of Common tern nest sites in mixed and unmixed colonies. The arrow indicates the midpoint between mean LDA scores of the two types of sites.

4.2.6 Roseate tern hatching sucess in relation to habitat

Hatching sucess was measured in an attempt to understand Roseate tern nest site selection. Results were obtained in colaboration with Adrian del Nevo and Peter Akers and are based on every nest with a known outcome.

In mixed colonies hatching sucess for both Roseate and Common terns did not differ between colonies (tables 9 and 10). This was not true for Common tern colonies, such differences being explained by predation. In colony HOR1 (a mainland site with 15 nests) every nest was predated, presumably by a mammal, and in colony FLW57 a grey heron (*Ardea cinerea*) was observed preying on eggs and chicks (from 131 studied eggs 58% hatched; del Nevo, pers. comm.). It was suggested earlier that unmixed Common tern colonies probably contain a higher proportion of young, inexperienced breeding birds. This may be a contributory factor to these lower hatching levels.

The presence of overhanging rock, albeit being of some importance in non-vegetated colonies, did not have any significant effect on Roseate tern hatching sucess (table 11). Furthermore, in colony SMA13, no difference was found between the hatching sucess of the 4 habitat categories in to which nests there were divided (table 12). These observations are explained by the absence of predation. Although such pattern might have been different if, instead of hatching sucess, fledging had been used as the measure of breeding sucess, such differences would probably have arisen chiefly through the operation of social factors. Of the 17 eggs laid by late-nesting Roseate terns in colony SMA13, only 40% hatched. It is likely that the parents were mainly young, inexperienced birds, a fact which corroborates the importance of social factors in breeding sucess. These results suggest that predation is of minor importance in explaining nest site selection by Azorean Roseate terns.

Table 9. Roseate terns: hatching sucess in different colonies.

Colonies	N. of eggs	Eggs hatched (%)
FLW55	12	83
FLW56	49	94
FLW60	34	97
PIX4	46	85
TER4	39	85
GRW1	113	75
SMA13	121	79

χ^2 between colonies= 1.36

Table 10. Common terns: hatching sucess in mixed colonies.

Colonies	N. of eggs	Eggs hatched (%)
FLW55	43	70
FLW56	31	77
FLW60	5	80
PIX4	31	81
GRW1	56	70

X^2 between colonies= 0.28

Table 11. Roseate terns: hatching sucess from nest sites with a total, partial and no overhang.

	Total overhang		Partial overhang		No overhang		
	N.eggs	E.Ha(%)	N.eggs	E.Ha(%)	N.eggs	E.Ha(%)	X^2
PIX4	7	100	8	75	38	84	0.18
TER4	8	87.5	7	100	33	79	0.17
SMA13	21	79	26	69	99	82	0.24

Table 12. Roseate terns in SMA13: hatching sucess from nest sites within different habitat categories.

Habitat categories	N. eggs	Eggs hatched (%)
Total overhang	21	81
Partial overhang	26	69
Closer to rocks	28	89
Closer to vegetation	15	93

X^2 between habitat categories= 0.52

5. DISCUSSION

5.1 Colony site selection by Roseate and Common terns in the Azores Archipelago

Both tern species nested mainly on islets, despite the large availability of mainland sites. The ordination results showed that large colonies tend to occur far from: (1) human settlements (2) the mainland coastline and (3) other tern colonies. These patterns can be explained, respectively, in terms of avoidance of (1) disturbance, (2) invasion by mammalian predators and (3) competition with other tern colonies. The third feature is in accordance with Ashmole's theory of competition for food supplies during the breeding season (Ashmole, 1963). Colonies far from the mainland tend to be surrounded by a larger area of open water than colonies on or close to the mainland shore and, consequently, provide greater opportunities for feeding. Nesting in mainland sites can be hazardous as such sites may become unsuitable (Burger & Lesser, 1977) and, therefore, nesting sucess is relatively unpredictable.

Both Roseate and Common terns nested on a wide variety of substrates and considerable variation in nest site characteristics existed within and between colonies. Habitat preferences shown by Roseate terns caused the overall characteristics of mixed colonies to be different from those unmixed of Common terns alone. Roseates nested in patches with uneven surface (high relief areas with cracks, fissures, and so on) in non-vegetated or relatively tall vegetation in vegetated colonies, respectively. Although no systematic habitat descriptions were obtained from unused islets, these do not appear to present suitable nesting habitat, especially for Roseate terns. They are mainly higher islets covered with bushes and trees, with large populations of Herring Gulls or very steep sea stacks. The threat of Gulls to nesting terns are well documented (Thomas, 1972).

5.2 Nest site selection of Roseate and Common terns

Both tern species exhibited nest-site selection. Roseate terns selected sites surrounded by walls and/or within vegetation, that provide cover and are not easily visible from above, whereas Common terns avoided walls, overhangs and tall vegetation and selected open areas with soft substrates when available. In vegetated colonies, cover was important for both species, but each one sought different plant architectures: (a) Roseates prefered tall vegetation in the immediate vicinity of the nest (this provided a more heterogenous landscape but (b) Commons prefered short vegetation that provided a more uniform cover around the nest. Nest site characteristics for Common terns were less distinctly different from those for sites randomly available in the study areas than the differences between Roseate tern nest sites and random sites.

Differences between mean LDA vectors of Roseate and Common tern nest site selection and habitat availability, which I interpreted as nest site selection, may or may not represent nest site slection as far as a tern is concerned. However, discriminant analysis is a valuable technique because a large number of variables can be examined at the same time. This permits a much closer resemblance to Hutchinson's concept of the *niche* as a *n*-dimensional hypervolume. The results of my LDA analyses reaffirm much of what has been suggested for Roseate and Common tern nest site selection based upon univariate methods. However, my study indicates more clearly which variables contribute the most to Roseate and Common tern nest site selection. For instance, a relatively low number of Roseates nested under overhanging rock; this was reflected in the minor importance of this variable in discriminating between Roseate tern nest site characteristics and both Common tern nest site characteristics and random points. The reverse could have been concluded using univariate methods. Although studies in USA and Puerto Rico show that, in univariate comparisons, 10-12 variables differ with statistical significance from those in the available habitat, it is unlikely that all those variables are of major biological significance.

Important discriminators between the nest sites of both species and the available habitat presented great variation among Azorean colonies which suggests that scale factors affect habitat selection, as pointed out by Burger & Gochfeld (1988c). Roseate terns must respond to every important selection pressure in order to maximize their reproductive fitness. This demonstrates the need to consider different colonies independently in studies of habitat selection and in management considerations, especially for Roseate terns. Tern colonies that differ in physiognomy can be readily compared if more abstract variables (e.g. a variable representing concealment) are found to be applicable to all colonies, although it may provide less pratical information for management. VISIBILITY, although not representing all kinds of concealment, was consistently important in separating Roseate tern nest site characteristics from the available habitat in most of the Azorean colonies (this study) and at Cedar Beach (Burger & Gochfeld, 1988b). Consequently, this is potentially one of those variables.

5.3 Nest site differences between Roseate and Common terns in mixed colonies: Does interspecific competition have any role?

In my study, invoking interspecific competition between Roseate and Common terns is not necessary to account for the observed patterns of nest site selection. Both species showed markedly different nest site preferences. If Roseates had preferred less concealed sites they could have used them, especially in colony FLW60 where only two Common terns nested. Also, in colony SMA13, late nesting Roseates managed to find concealed sites. Common terns in unmixed colonies did not select concealed sites and, in mixed colonies, they could have nested in the remaining areas, with uneven surface, not used by Roseates. In North-eastern North America predation has been invoked as an important factor to explain concealment by Roseate terns (Burger & Gochfeld, 1988b, 1988c). In the Azores, at least in 1990, the role of predation was minor. As pointed out before, scale factors affect habitat choice; consequently, if predation is an important selection pressure Roseates should respond to it. As an alternative, I propose that the use of overall different nesting resources by both tern species in temperate habitats is primarily a result of specializations developed during allopatric speciation (Connell, 1980).

Although the discussion above suggests that there at present no competition, an observational approach, such as that used here and presented in the literature, is not designed to reveal the importance of competition. Therefore, these studies do not invalidate the hypothesis that competition, under some circumstances, may be relevant. An evaluation of this hypothesis provides some insight into the organization of Roseate and Common terns mixed colonies. I discuss this under three headings: (1) Comparison with breeding population studies in other seabird colonies. (2) Comparison of tern nest site selection between temperate mixed colonies and monospecific tropical colonies and (3) Nesting preferences and relative abundance of nesting resources in mixed colonies.

(1) Comparison with breeding population studies in other seabird colonies. Several studies indicate that the quality of habitat acquired by colonial seabirds is related to the age and experience of the individuals. This is reflected in their breeding performance (e.g. Coulson, 1968; Potts *et al*, 1980). This occurs through segregation of birds at the time of their recruitment: older birds arrive early in the breeding grounds, occupy the optimal areas, lay first and have higher productivity than younger birds (Hays, 1978; Wooler & Coulson, 1977; Potts *et al*, 1980).

In this study, the density of neighbours was one of the most important factors in explaining Roseate tern nest site selection. Temporal variation in the onset of laying and in productivity occured in colony SMA13 (and presumably in other colonies but data were not collected), where, at least 18 breeding pairs layed about 2 to 3 weeks after the first breeders. These were probably younger birds or failed breeders from another colony as similar temporal variations seem to occur in Roseate terns in Connecticut (Spendelow, 1982) and were demonstrated for Common terns (Hayes, 1978) and Artic terns (Cramp, 1984).

Generally speaking, it seems that Roseate tern sub-colonies present a social structure similar to that of other colonial seabirds. Thus, although good nesting areas are probably available outside the colony, younger Roseates are likely to nest in the less optimal areas on the edge of the sub-colony.

(2) Comparisons of tern nest site selection between temperate mixed colonies and monospecific tropical colonies. The nesting versatility of Roseate terns is well documented (Gochfeld & Burger, 1977, 1988c). Roseate tern populations in North America and Europe, which are in sympatry with Common terns, nest in cover and/or in virtual contact with an elevated object (Burger & Gochfeld, 1977; Langham, 1974). Overall, the nest sites selected by these populations are concealed (this study; Burger & Gochfeld, 1988a). Tropical populations in Puerto Rico, which are allopatric with Common terns, nest more in the open than do temperate populations, although a tendency to place nests close to tall vegetation, that provides cover over the nest, was found (Burger & Gochfeld, 1988c). The more open nesting habits of this population must be examined in relation to habitat availability in that area. Random points were significantly less visible than nest sites in only one of 4 sub-colonies studied (Burger & Gochfeld, 1988c). This reflects the more open habitat in Puerto Rico. Moroever, any comparison of disjunct populations presents limitations, in particular the potential existence of different selection pressures.

Although this comparison is consistent with the hypothesis that Roseate terns may nest in the open when exposed to fewer agressive competitors (Burger & Gochfeld, 1988a) its limitations prevent any firm conclusions being drawn.

(3) Nesting preferences and relative abundance of nesting resources in mixed colonies. The larger and more agressive Common terns have greater competitive ability (Schoener, 1974) and requirements that closely match available habitat and thus should have higher probabilities of resource acquisition. The more specialised nesting preferences of Roseate terns and their more restricted nesting locations suggest that they might face a shortage of optimal nest sites. On the other hand, Roseate terns have smaller clutch sizes and less synchronous breeding than Common terns, and thus seem to be responding to different selection pressures (Nisbet, 1975). Not only in nesting but also overall they seem to be more specialised birds than Common terns. This was shown in relation to their foraging locations in north-eastern north

America by Safina (1990) who concluded that this explains the usually lower population size of this species in America. As a result, in some locations, nesting resources may not be limiting for small populations and birds are not forced into open nesting areas.

However, the comparison of the status of Azorean and North America colonies suggests that interspecific competition may be relevant in some colonies. In the Azores, Roseate terns nested earlier, within higher densities and significantly outnumbered Common terns in most of the colonies ; the reverse is true for most colonies in North-eastern North America (Burger & Gochfeld, 1988b) and in Britain (Langham, 1974). In Cedar Beach, 50 % of Roseates had Commons as their nearest neighbours and they nested in 4 discrete groups whereas in the Azores they always had other Roseates for nearest neighbours and nested in one dense group. Differences in the spatial distribution of Roseate tern optimal nesting areas between the Azores and Cedar Beach might be the origin of these differences. As a result, Cedar beach Roseates seem to be exposed more often to the more agressive Common terns, which are more likely to win interspecific encounters (Schoener, 1974). Spendelow (1982) suggested that the most sheltered sites are the first ones to become occupied. These will be defended by older, more competitive Roseate terns forcing younger Roseates to more open areas where they might have to face aggressive Common terns. It seems that in Falkler island, Connecticut, when nesting on open ground, Roseate terns compete with Commons for available nest sites (Spendelow, 1982).

The above ideas lead me to propose a model of nesting resource partitioning in mixed colonies of Roseate and Common terns to be applied to any one colony site (Fig.14). Although this model is speculative, it can contribute to a more concise appreciation of the nesting relationship between Roseate and Common terns in any one mixed colony. Experiments to provide insight into this matter can be devised e.g. removing areas with highly uneven surface in mixed colonies where Roseate terns use to nest. Population dynamic studies of terns at various individual colonies are also important to evaluate this model. If the model is correct it indicates that the breeding population size of a Roseate tern colony is limited by the amount of optimal habitat for Roseate terns.

My study indicates that Roseate terns prefer nesting habitat characterized by areas with high relief- pitted ground with cracks, crevices and fissures- and/or tall vegetation. Therefore, managment actions should be taken to maintain these conditions, especially because nesting in open areas might be disrupted by competition with Common terns. Areas of high relief could indeeed be provided artificially (Spendelow, 1982).

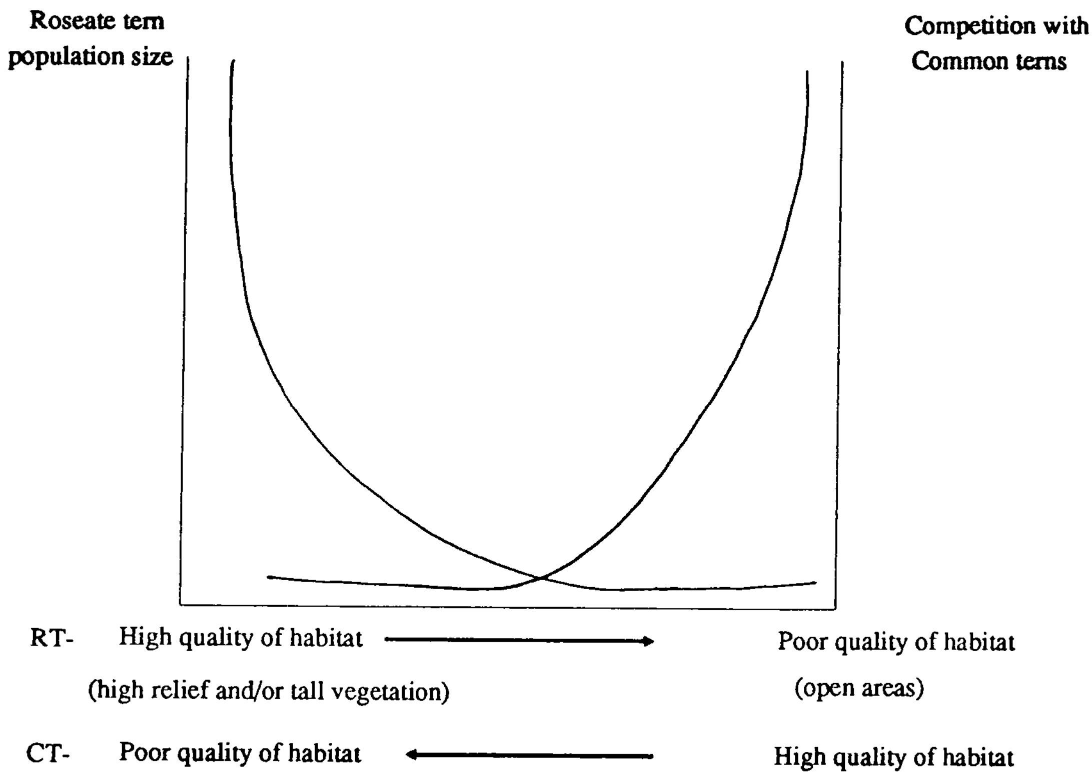

Fig 14. Model showing the breeding population size of a Roseate tern colony as a reflection of the existence of optimal habitat and competition with Common terns.

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Appendix 1- Overall characteristics of colonies

OVERALL CHARACTERISTICS OF COLONIES

COL.	VARIABLES															
1	1	650.0	2	3.0	3	1.0	4	1.0	5	100.0	6	0.0	7	0.0	8	0.0
1	9	4.0	10	1000.0	11	0.0	12	1.0	13	2800.0						
2	1	275.0	2	2.0	3	1.0	4	2.0	5	70.0	6	30.0	7	0.0	8	0.0
2	9	650.0	10	650.0	11	50.0	12	3.0	13	2800.0						
3	1	132.0	2	2.0	3	0.0	4	1.0	5	50.0	6	30.0	7	0.0	8	20.0
3	9	0.0	10	3000.0	11	75.0	12	4.0	13	400.0						
4	1	350.0	2	1.0	3	1.0	4	4.0	5	100.0	6	0.0	7	0.0	8	0.0
4	9	200.0	10	600.0	11	5.0	12	1.0	13	20.0						
5	1	459.0	2	2.0	3	1.0	4	3.0	5	50.0	6	10.0	7	0.0	8	40.0
5	9	200.0	10	600.0	11	65.0	12	4.0	13	20.0						
6	1	345.0	2	2.0	3	1.0	4	2.0	5	75.0	6	10.0	7	0.0	8	15.0
6	9	188.0	10	580.0	11	15.0	12	4.0	13	17.0						
7	1	345.0	2	2.0	3	1.0	4	1.0	5	40.0	6	0.0	7	0.0	8	60.0
7	9	115.0	10	570.0	11	75.0	12	5.0	13	17.0						
8	1	330.0	2	2.0	3	1.0	4	2.0	5	50.0	6	20.0	7	0.0	8	30.0
8	9	80.0	10	530.0	11	60.0	12	3.0	13	20.0						
9	1	1088.0	2	3.0	3	1.0	4	2.0	5	40.0	6	10.0	7	0.0	8	50.0
9	9	90.0	10	850.0	11	60.0	12	4.0	13	600.0						
10	1	1810.0	2	3.0	3	1.0	4	2.0	5	70.0	6	0.0	7	0.0	8	30.0
10	9	8.0	10	800.0	11	55.0	12	4.0	13	180.0						
11	1	494.0	2	3.0	3	1.0	4	4.0	5	100.0	6	0.0	7	0.0	8	0.0
11	9	30.0	10	940.0	11	25.0	12	4.0	13	180.0						
12	1	416.0	2	1.0	3	1.0	4	4.0	5	100.0	6	0.0	7	0.0	8	0.0
12	9	25.0	10	940.0	11	3.0	12	1.0	13	175.0						
13	1	54.0	2	2.0	3	1.0	4	3.0	5	100.0	6	0.0	7	0.0	8	0.0
13	9	30.0	10	40.0	11	0.0	12	0.0	13	900.0						
14	1	640.0	2	1.0	3	1.0	4	4.0	5	100.0	6	0.0	7	0.0	8	0.0
14	9	135.0	10	300.0	11	0.0	12	0.0	13	1200.0						
15	1	406.0	2	2.0	3	1.0	4	2.0	5	40.0	6	10.0	7	0.0	8	50.0
15	9	160.0	10	1400.0	11	65.0	12	4.0	13	880.0						
16	1	430.0	2	3.0	3	1.0	4	1.0	5	100.0	6	0.0	7	0.0	8	0.0
16	9	3.0	10	14.0	11	40.0	12	2.0	13	9000.0						
17	1	68.0	2	2.0	3	1.0	4	3.0	5	100.0	6	0.0	7	0.0	8	0.0
17	9	3.0	10	800.0	11	60.0	12	3.0	13	9000.0						
18	1	4900.0	2	1.0	3	0.0	4	2.0	5	100.0	6	0.0	7	0.0	8	0.0
18	9	0.0	10	700.0	11	0.0	12	0.0	13	180.0						
19	1	585.0	2	1.0	3	0.0	4	3.0	5	100.0	6	0.0	7	0.0	8	0.0
19	9	0.0	10	700.0	11	0.0	12	0.0	13	100.0						
20	1	60.0	2	1.0	3	1.0	4	3.0	5	100.0	6	0.0	7	0.0	8	0.0
20	9	3.0	10	200.0	11	10.0	12	3.0	13	9000.0						
21	1	475.0	2	2.0	3	1.0	4	2.0	5	100.0	6	0.0	7	0.0	8	0.0
21	9	8.0	10	180.0	11	20.0	12	2.0	13	9000.0						
22	1	2550.0	2	3.0	3	1.0	4	1.0	5	70.0	6	30.0	7	0.0	8	0.0
22	9	1700.0	10	1700.0	11	0.0	12	0.0	13	5000.0						
23	1	84.0	2	2.0	3	1.0	4	2.0	5	100.0	6	0.0	7	0.0	8	0.0
23	9	1000.0	10	1000.0	11	35.0	12	1.0	13	60.0						
24	1	960.0	2	3.0	3	1.0	4	1.0	5	0.0	6	0.0	7	100.0	8	0.0
24	9	1000.0	10	1000.0	11	10.0	12	2.0	13	60.0						
24	1	260.0	2	2.0	3	1.0	4	2.0	5	100.0	6	0.0	7	0.0	8	0.0
25	9	500.0	10	500.0	11	3.0	12	4.0	13	500.0						
26	1	180.0	2	1.0	3	0.0	4	4.0	5	80.0	6	20.0	7	0.0	8	0.0
26	9	0.0	10	800.0	11	30.0	12	2.0	13	800.0						
27	1	1000.0	2	1.0	3	0.0	4	2.0	5	40.0	6	20.0	7	40.0	8	0.0
27	9	0.0	10	3000.0	11	20.0	12	2.0	13	400.0						
28	1	56.0	2	1.0	3	1.0	4	3.0	5	100.0	6	0.0	7	0.0	8	0.0
28	9	250.0	10	3000.0	11	7.0	12	2.0	13	250.0						
29	1	300.0	2	1.0	3	0.0	4	4.0	5	100.0	6	0.0	7	0.0	8	0.0
29	9	10.0	10	3000.0	11	20.0	12	2.0	13	400.0						
30	1	21.0	2	2.0	3	1.0	4	3.0	5	100.0	6	0.0	7	0.0	8	0.0
30	9	250.0	10	3000.0	11	7.0	12	2.0	13	3000.0						
31	1	340.0	2	2.0	3	1.0	4	2.0	5	30.0	6	30.0	7	0.0	8	40.0
31	9	100.0	10	1000.0	11	70.0	12	4.0	13	1800.0						
32	1	9500.0	2	3.0	3	1.0	4	2.0	5	50.0	6	40.0	7	0.0	8	10.0
32	9	700.0	10	2000.0	11	50.0	12	3.0	13	9000.0						

VARIABLES

1-AREA 2-DEGREE OF SURFACE 3-LOCATION 4-SLOPE 5-% BARE ROCK 6-% SOIL 7=% BOULDERS 8-% SUBSTRATE MIXED 9-NDMAINLAND 10-NDHHABITATION 11-COVER 12-VEGETATION HEIGHT 13-NDTCOLONY

COLONIES (COL.)

1-TER4 2-TER3 3-CORVO8 4-FLW53 5-FLW54 6-FLW55 7-FLW56 8-FLW57 9-FLW60 10-FLW17 11-FLW18A 12-FLW18B 13-FLW7 14-FLWP40 15-FLW48 16-PIX4 17-PIX11 18-HOR1 19-HOR2 20-PDL 21-PDLCA 22-GRW1 23-GRW4 24-GRW4A 25-GRW3 26-GRW2 27-GRW7 28-GRW8 29-GRW9 30-GRW11 31-SMA13 32-SMA9

Apendix 2- Characteristics of nest sites and random points (for each colony the variables are presented as in colony CORVO8)

ISLAND-CORVO COLONY-8 STATUS-UNMIXED DATA-COMMON TERN

HABITAT VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13
3.0	0.0	0.0	0.0	0.0	4.0	90.0	80.0	100.0	320.0	0.0	1.0	0.0
1.0	0.0	0.0	0.0	4.0	6.0	60.0	75.0	100.0	205.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	205.0	0.0	1.0	0.0
2.0	0.0	1.0	1.0	22.0	18.0	40.0	40.0	100.0	90.0	2.0	1.0	0.0
0.0	0.0	0.0	0.0	3.0	6.0	70.0	80.0	75.0	90.0	3.0	1.0	0.0
2.0	0.0	1.0	0.0	3.0	25.0	80.0	65.0	100.0	70.0	3.0	1.0	0.0
2.0	0.0	0.0	0.0	3.0	6.0	70.0	85.0	100.0	230.0	0.0	1.0	0.0
1.0	0.0	1.0	1.0	2.0	3.0	65.0	60.0	100.0	60.0	9.0	1.0	1.0
0.0	0.0	1.0	1.0	2.0	2.0	20.0	30.0	100.0	43.0	10.0	1.0	1.0
0.0	1.0	1.0	1.0	5.0	3.0	40.0	40.0	20.0	53.0	14.0	1.0	1.0
0.0	0.0	0.0	1.0	2.0	30.0	75.0	65.0	100.0	33.0	13.0	1.0	1.0
1.0	0.0	1.0	1.0	21.0	6.0	30.0	60.0	100.0	67.0	15.0	1.0	1.0
0.0	0.0	0.0	1.0	7.0	11.0	30.0	60.0	90.0	65.0	12.0	1.0	1.0
2.0	0.0	1.0	1.0	5.0	14.0	60.0	60.0	100.0	60.0	12.0	1.0	1.0
2.0	0.0	1.0	1.0	4.0	2.0	15.0	40.0	100.0	40.0	10.0	1.0	1.0
1.0	0.0	1.0	0.0	11.0	16.0	50.0	60.0	100.0	110.0	5.0	1.0	0.0
2.0	0.0	0.0	1.0	4.0	6.0	60.0	75.0	100.0	70.0	5.0	1.0	0.0
0.0	0.0	1.0	0.0	6.0	19.0	35.0	45.0	100.0	46.0	4.0	1.0	0.0
0.0	0.0	0.0	1.0	0.0	4.0	60.0	80.0	100.0	150.0	2.0	1.0	0.0
1.0	1.0	1.0	1.0	3.0	10.0	20.0	50.0	100.0	70.0	3.0	1.0	0.0
0.0	0.0	1.0	1.0	5.0	16.0	15.0	65.0	100.0	160.0	1.0	1.0	0.0

1-WALLS, 2-OVERHANG, 3-SUBSTRATE, 4-VEGETATION TYPE, 5-DNEAVEG, 6-HNEAVEG
7-COVER 0.5m, 8-COVER 3m, 9-VISIBILITY, 10-DNN, 11-NN2m, 12-OVERALL SLOPE
13-POSITION

ISLAND-FLORES COLONY-54 STATUS-UNMIXED DATA-COMMON TERN

HABITAT VARIABLES

1.0	0.0	1.0	1.0	13.0	30.0	40.0	50.0	100.0	90.0	6.0	1.0	1.0
0.0	0.0	0.0	1.0	5.0	2.0	10.0	50.0	100.0	57.0	5.0	1.0	1.0
1.0	0.0	1.0	1.0	5.0	7.0	15.0	20.0	100.0	57.0	6.0	1.0	1.0
2.0	0.0	1.0	1.0	6.0	7.0	75.0	70.0	100.0	57.0	4.0	2.0	0.0
1.0	0.0	1.0	1.0	4.0	7.0	50.0	60.0	100.0	57.0	3.0	2.0	0.0
0.0	0.0	1.0	1.0	12.0	32.0	20.0	70.0	100.0	65.0	3.0	1.0	0.0
0.0	0.0	1.0	1.0	4.0	29.0	30.0	40.0	100.0	53.0	7.0	1.0	1.0
2.0	0.0	1.0	1.0	10.0	30.0	45.0	25.0	100.0	53.0	5.0	1.0	1.0
1.0	0.0	0.0	1.0	2.0	6.0	50.0	25.0	90.0	40.0	5.0	1.0	1.0
0.0	0.0	1.0	1.0	7.0	8.0	20.0	20.0	100.0	40.0	4.0	1.0	1.0
3.0	0.0	1.0	1.0	5.0	15.0	10.0	20.0	90.0	120.0	2.0	1.0	0.0
1.0	0.0	0.0	1.0	2.0	14.0	50.0	40.0	80.0	200.0	1.0	5.0	0.0
0.0	0.0	0.0	1.0	4.0	18.0	50.0	50.0	100.0	200.0	1.0	5.0	0.0
0.0	0.0	1.0	1.0	3.0	17.0	20.0	70.0	0.0	120.0	1.0	5.0	0.0
0.0	0.0	0.0	1.0	4.0	8.0	30.0	60.0	50.0	180.0	1.0	5.0	0.0
1.0	0.0	0.0	1.0	12.0	7.0	30.0	70.0	100.0	400.0	0.0	5.0	0.0
1.0	0.0	0.0	1.0	3.0	7.0	40.0	40.0	100.0	300.0	0.0	5.0	0.0
0.0	0.0	0.0	1.0	4.0	24.0	20.0	50.0	100.0	150.0	1.0	5.0	0.0
0.0	0.0	0.0	1.0	0.0	25.0	30.0	30.0	80.0	150.0	2.0	5.0	0.0
0.0	0.0	0.0	1.0	4.0	24.0	50.0	40.0	100.0	200.0	2.0	5.0	0.0
0.0	0.0	0.0	1.0	14.0	8.0	60.0	45.0	50.0	200.0	1.0	5.0	0.0
0.0	0.0	0.0	1.0	14.5	10.0	25.0	20.0	100.0	300.0	0.0	5.0	0.0

ISLAND-FLORES COLONY-55 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLES

0.0	0.0	0.0	1.0	0.0	26.0	100.0	90.0	65.0	60.0	5.0	5.0	0.0
2.0	0.0	0.0	1.0	0.0	24.0	100.0	100.0	80.0	78.0	4.0	4.0	0.0
0.0	0.0	0.0	1.0	0.0	17.0	100.0	70.0	90.0	98.0	6.0	4.0	0.0
0.0	0.0	0.0	1.0	0.0	33.0	100.0	70.0	70.0	140.0	3.0	4.0	0.0
0.0	0.0	0.0	1.0	3.0	27.0	70.0	60.0	100.0	97.0	7.0	4.0	0.0
1.0	0.0	0.0	1.0	2.0	24.0	90.0	50.0	80.0	120.0	6.0	3.0	1.0
1.0	0.0	0.0	1.0	4.0	34.0	70.0	60.0	100.0	83.0	3.0	3.0	1.0

ISLAND-FLORES COLONY-55 STATUS-MIXED DATA-COMMON TERN

HABITAT VARIABLES

0.0	1.0	1.0	1.0	85.0	24.0	0.0	12.0	0.0	130.0	3.0	3.0	1.0
0.0	0.0	0.0	1.0	0.0	34.0	90.0	70.0	100.0	73.0	5.0	3.0	0.0
0.0	0.0	1.0	1.0	34.0	24.0	5.0	15.0	100.0	150.0	2.0	1.0	0.0
1.0	0.0	1.0	1.0	4.0	28.0	30.0	40.0	100.0	70.0	3.0	3.0	0.0
0.0	0.5	1.0	1.0	120.0	18.0	0.0	15.0	70.0	120.0	4.0	3.0	0.0
0.0	0.0	1.0	1.0	150.0	28.0	0.0	10.0	100.0	120.0	3.0	3.0	1.0
1.0	0.0	1.0	1.0	2.0	23.0	50.0	30.0	75.0	70.0	3.0	3.0	1.0
0.0	0.0	1.0	1.0	90.0	6.0	0.0	20.0	100.0	100.0	1.0	3.0	1.0
0.0	0.0	1.0	1.0	39.0	17.0	4.0	2.0	100.0	70.0	1.0	3.0	0.0
0.0	0.0	1.0	1.0	45.0	20.0	3.0	40.0	100.0	80.0	2.0	2.0	1.0
0.0	0.0	1.0	1.0	50.0	20.0	0.0	20.0	100.0	220.0	0.0	1.0	0.0
0.0	0.0	1.0	1.0	220.0	18.0	0.0	5.0	100.0	310.0	0.0	1.0	0.0
0.0	0.0	1.0	0.0	75.0	7.0	0.0	15.0	100.0	180.0	1.0	2.0	0.0
0.0	0.0	1.0	1.0	5.0	16.0	50.0	30.0	95.0	85.0	3.0	1.0	0.0
0.0	0.0	1.0	1.0	10.0	17.0	40.0	50.0	90.0	170.0	2.0	1.0	0.0
0.0	0.0	1.0	1.0	10.0	13.0	10.0	5.0	100.0	230.0	0.0	2.0	0.0

ISLAND-FLORES COLONY-55 STATUS-MIXED DATA-RANDOM POINTS

HABITAT VARIABLES

0.0	0.0	1.0	1.0	580.0	19.0	0.0	0.0	100.0	630.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	540.0	19.0	0.0	0.0	100.0	616.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	532.0	19.0	0.0	0.0	100.0	300.0	0.0	3.0	0.0
0.0	0.0	1.0	1.0	501.0	19.0	0.0	0.0	100.0	180.0	1.0	3.0	0.0
1.0	0.0	1.0	1.0	400.0	19.0	0.0	0.0	100.0	170.0	2.0	1.0	0.0
0.0	0.0	1.0	1.0	394.0	18.0	0.0	0.0	100.0	190.0	2.0	3.0	0.0
1.0	0.5	1.0	1.0	350.0	18.0	0.0	0.0	90.0	210.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	200.0	19.0	0.0	2.0	100.0	100.0	2.0	2.0	1.0
0.0	0.0	0.0	1.0	180.0	14.0	0.0	10.0	100.0	120.0	3.0	2.0	1.0
0.0	0.0	1.0	1.0	140.0	23.0	2.0	2.0	100.0	90.0	1.0	2.0	1.0
0.0	0.0	0.0	1.0	85.0	21.0	0.0	20.0	100.0	60.0	4.0	3.0	1.0
0.0	0.0	1.0	1.0	30.0	34.0	10.0	25.0	100.0	30.0	4.0	4.0	1.0
0.0	0.0	0.0	1.0	0.0	36.0	80.0	50.0	80.0	150.0	3.0	4.0	0.0
2.0	0.5	0.0	1.0	0.0	24.0	100.0	85.0	40.0	90.0	4.0	4.0	1.0
0.0	0.0	0.0	1.0	0.0	26.0	100.0	70.0	70.0	35.0	6.0	4.0	0.0
0.0	0.0	1.0	1.0	120.0	14.0	0.0	5.0	100.0	40.0	1.0	3.0	0.0
0.0	0.0	1.0	1.0	150.0	13.0	0.0	5.0	100.0	190.0	1.0	4.0	0.0
0.0	0.0	0.0	1.0	150.0	24.0	0.0	3.0	100.0	80.0	3.0	4.0	1.0
0.0	0.0	1.0	1.0	67.0	13.0	0.0	4.0	100.0	120.0	3.0	4.0	1.0
0.0	0.0	0.0	1.0	60.0	29.0	0.0	8.0	100.0	74.0	2.0	3.0	1.0

ISLAND-FLORES COLONY-56 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLES

0.0	0.0	0.0	1.0	0.0	30.0	100.0	100.0	30.0	24.0	10.0	3.0	1.0
0.0	0.0	0.0	1.0	0.0	32.0	100.0	90.0	25.0	34.0	12.0	3.0	1.0
0.0	0.0	0.0	1.0	0.0	24.0	100.0	100.0	70.0	28.0	12.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	26.0	100.0	100.0	20.0	65.0	8.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	25.0	100.0	100.0	0.0	60.0	7.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	27.0	100.0	90.0	30.0	40.0	6.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	30.0	100.0	100.0	40.0	70.0	6.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	32.0	100.0	100.0	25.0	18.0	8.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	25.0	90.0	90.0	40.0	36.0	9.0	2.0	1.0
0.0	0.0	0.0	1.0	0.0	22.0	85.0	85.0	80.0	70.0	7.0	3.0	1.0
0.0	0.0	0.0	1.0	0.0	23.0	100.0	100.0	35.0	75.0	7.0	2.0	1.0
0.0	0.0	0.0	0.0	0.0	14.0	100.0	100.0	100.0	165.0	4.0	1.0	0.0
0.0	0.0	0.0	1.0	0.0	28.0	100.0	100.0	80.0	110.0	4.0	1.0	0.0
0.0	0.0	0.0	1.0	0.0	16.0	100.0	80.0	40.0	70.0	3.0	3.0	0.0
0.0	0.0	0.0	1.0	0.0	16.0	60.0	40.0	100.0	115.0	2.0	3.0	0.0
1.0	1.0	0.0	1.0	4.0	10.0	80.0	80.0	60.0	150.0	4.0	3.0	0.0
2.0	1.0	0.0	1.0	4.0	14.0	80.0	70.0	0.0	140.0	6.0	4.0	0.0
0.0	0.0	0.0	1.0	0.0	28.0	90.0	85.0	60.0	60.0	9.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	30.0	100.0	90.0	25.0	75.0	7.0	1.0	1.0
0.0	0.0	0.0	1.0	0.0	30.0	100.0	100.0	40.0	50.0	10.0	1.0	0.0
0.0	0.0	0.0	1.0	0.0	28.0	90.0	80.0	50.0	36.0	9.0	4.0	0.0
0.0	0.0	0.0	1.0	0.0	29.0	100.0	80.0	60.0	45.0	12.0	3.0	0.0
0.0	0.0	0.0	0.0	5.0	6.0	30.0	20.0	100.0	240.0	0.0	5.0	0.0
1.0	0.5	1.0	1.0	6.0	24.0	75.0	75.0	79.0	150.0	4.0	5.0	0.0

ISLAND-FLORES COLONY-56 STATUS-MICED DATA-COMMON TERN

HABITAT VARIABLES

0.0	0.0	0.0	1.0	4.0	17.0	60.0	70.0	92.0	86.0	4.0	3.0	0.0
0.0	0.0	1.0	0.0	13.0	13.0	10.0	30.0	100.0	64.0	3.0	1.0	0.0
2.0	0.0	1.0	1.0	140.0	23.0	0.0	15.0	100.0	70.0	2.0	3.0	0.0
1.0	0.0	1.0	1.0	170.0	23.0	0.0	10.0	100.0	180.0	2.0	3.0	0.0
0.0	0.0	1.0	1.0	68.0	28.0	0.0	8.0	100.0	75.0	4.0	3.0	0.0
0.0	0.0	1.0	1.0	80.0	16.0	0.0	28.0	100.0	68.0	5.0	2.0	0.0
1.0	0.0	1.0	0.0	2.0	4.0	5.0	10.0	100.0	40.0	3.0	3.0	0.0
0.0	0.0	0.0	1.0	10.0	26.0	10.0	33.0	98.0	55.0	7.0	1.0	1.0
0.0	0.0	1.0	1.0	40.0	26.0	13.0	25.0	100.0	40.0	7.0	3.0	0.0
0.0	0.0	1.0	1.0	14.0	34.0	14.0	30.0	100.0	90.0	2.0	4.0	0.0
0.0	0.0	0.0	0.0	13.5	26.0	16.0	25.0	100.0	85.0	4.0	4.0	0.0
1.0	0.0	1.0	1.0	24.0	16.0	17.0	17.0	100.0	74.0	3.0	3.0	0.0
0.0	0.0	1.0	1.0	180.0	17.0	0.0	20.0	100.0	210.0	0.0	4.0	0.0
3.0	0.0	1.0	1.0	270.0	17.0	0.0	3.0	100.0	140.0	1.0	4.0	0.0
0.0	0.0	0.0	1.0	0.0	23.0	70.0	71.0	85.0	87.0	4.0	1.0	1.0

ISLAND-FLORES COLONY-57 STATUS-UNMIXED DATA-COMMOM TERN

HABITAT VARIABLES

1.0	0.0	0.0	1.0	50.0	14.0	5.0	10.0	100.0	300.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	22.0	26.0	5.0	10.0	100.0	150.0	1.0	4.0	0.0
0.0	0.0	0.0	0.0	4.0	4.0	60.0	50.0	100.0	180.0	1.0	5.0	0.0
0.0	0.0	0.0	1.0	8.0	11.0	50.0	60.0	100.0	150.0	3.0	3.0	0.0
0.0	0.0	0.0	0.0	0.0	7.0	100.0	70.0	100.0	160.0	4.0	3.0	0.0
0.0	0.0	1.0	0.0	2.0	6.0	20.0	15.0	100.0	120.0	4.0	1.0	1.0
2.0	0.0	1.0	1.0	1.0	15.0	40.0	50.0	80.0	70.0	4.0	1.0	1.0
0.0	0.0	0.0	1.0	2.0	4.0	80.0	80.0	100.0	115.0	4.0	3.0	1.0
0.0	0.0	0.0	1.0	2.0	3.0	80.0	70.0	100.0	65.0	3.0	3.0	1.0
2.0	0.0	0.0	1.0	0.0	12.0	40.0	0.0	100.0	90.0	4.0	3.0	1.0
0.0	0.0	0.0	0.0	0.0	13.0	80.0	80.0	75.0	90.0	5.0	4.0	0.0
0.0	0.0	1.0	1.0	21.0	4.0	3.0	10.0	100.0	135.0	1.0	1.0	0.0
2.0	0.0	1.0	1.0	2.0	6.0	60.0	80.0	90.0	70.0	3.0	2.0	0.0
1.0	0.0	1.0	1.0	0.0	13.0	80.0	80.0	90.0	70.0	3.0	2.0	0.0
1.0	0.0	0.0	1.0	2.0	9.0	90.0	90.0	100.0	120.0	4.0	2.0	0.0
0.0	0.0	1.0	1.0	7.0	17.0	60.0	40.0	100.0	95.0	6.0	3.0	0.0
0.0	0.0	1.0	1.0	3.0	10.0	15.0	10.0	100.0	120.0	5.0	2.0	0.0
0.0	0.0	1.0	1.0	2.0	11.0	60.0	50.0	100.0	120.0	5.0	3.0	0.0
1.0	0.0	1.0	1.0	0.0	15.0	70.0	70.0	80.0	65.0	8.0	4.0	0.0
0.0	0.0	0.0	1.0	0.0	24.0	85.0	80.0	100.0	90.0	5.0	4.0	0.0
3.0	0.5	1.0	1.0	4.0	26.0	30.0	20.0	90.0	60.0	6.0	3.0	1.0
0.0	0.0	1.0	1.0	3.0	13.0	50.0	50.0	100.0	55.0	7.0	3.0	1.0
0.0	0.0	0.0	1.0	0.0	4.0	75.0	60.0	100.0	55.0	6.0	3.0	1.0
0.0	0.0	0.0	1.0	2.0	28.0	50.0	35.0	80.0	50.0	3.0	3.0	0.0
2.0	0.0	1.0	0.0	80.0	9.0	0.0	2.0	100.0	270.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	6.0	24.0	15.0	10.0	100.0	80.0	3.0	2.0	0.0
1.0	0.0	1.0	0.0	19.0	16.0	20.0	20.0	100.0	120.0	2.0	1.0	0.0
1.0	0.0	1.0	0.0	100.0	14.0	0.0	5.0	100.0	120.0	2.0	1.0	0.0
0.0	0.0	1.0	1.0	15.0	6.0	15.0	10.0	100.0	100.0	1.0	1.0	1.0

ISLAND-FLORES COLONY-57 STATUS-UNMIXED DATA-RANDOM POINTS

HABITAT VARIABLES

0.	0.0	1.0	1.0	10.0	11.0	3.0	10.0	100.0	120.0	5.0	1.0	0.0
1.0	0.0	1.0	0.0	65.5	3.0	0.0	5.0	100.0	240.0	1.0	1.0	0.0
0.0	0.0	1.0	1.0	55.0	12.0	0.0	5.0	80.0	300.0	0.0	2.0	0.0
2.0	0.5	1.0	0.0	60.0	7.0	0.0	10.0	75.0	40.0	6.0	2.0	0.0
2.0	0.0	1.0	1.0	26.0	7.0	5.0	5.0	100.0	37.0	2.0	2.0	1.0
0.0	0.0	1.0	1.0	70.0	19.0	0.0	4.0	90.0	120.0	2.0	2.0	1.0
0.0	0.0	1.0	1.0	35.0	30.0	15.0	10.0	100.0	70.0	3.0	3.0	0.0
3.0	0.0	1.0	1.0	12.0	10.0	5.0	10.0	100.0	120.0	1.0	2.0	0.0
0.0	0.0	0.0	1.0	4.0	12.0	60.0	70.0	100.0	65.0	4.0	1.0	1.0
2.0	0.0	1.0	1.0	15.0	16.0	40.0	40.0	100.0	75.0	5.0	3.0	1.0
0.0	0.0	1.0	1.0	6.0	40.0	40.0	50.0	100.0	58.0	4.0	1.0	1.0
0.0	0.0	1.0	0.0	5.0	4.0	85.0	85.0	100.0	75.0	2.0	3.0	0.0
1.0	0.0	0.0	1.0	0.0	30.0	60.0	50.0	100.0	230.0	0.0	4.0	0.0
0.0	0.0	1.0	1.0	2.0	24.0	70.0	70.0	100.0	120.0	1.0	5.0	0.0
0.0	0.0	1.0	1.0	28.0	19.0	15.0	20.0	100.0	68.0	1.0	4.0	0.0
0.0	0.0	1.0	1.0	46.0	24.0	2.0	10.0	100.0	160.0	1.0	1.0	0.0
0.0	0.0	1.0	1.0	4.0	28.0	50.0	40.0	90.0	90.0	1.0	1.0	0.0
1.0	0.0	1.0	1.0	60.0	21.0	1.0	3.0	100.0	180.0	1.0	2.0	0.0
2.0	0.0	1.0	1.0	22.0	18.0	3.0	2.0	100.0	135.0	2.0	1.0	1.0
2.0	0.5	1.0	1.0	51.0	5.0	0.0	4.0	100.0	90.0	1.0	2.0	0.0
2.0	0.5	1.0	0.0	60.0	12.0	0.0	3.0	70.0	125.0	1.0	1.0	0.0

ISLAND-FLORES COLONY-60 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLES

2.0	0.0	1.0	1.0	4.0	14.0	40.0	25.0	75.0	110.0	1.0	1.0	0.0
2.0	0.0	1.0	1.0	3.0	14.0	40.0	20.0	90.0	100.0	1.0	1.0	0.0
3.0	0.0	1.0	1.0	9.0	12.0	35.0	40.0	100.0	100.0	1.0	1.0	0.0
1.0	0.5	1.0	1.0	3.0	17.0	50.0	40.0	40.0	60.0	2.0	1.0	0.0
3.0	0.0	1.0	1.0	3.0	7.0	10.0	40.0	100.0	60.0	2.0	1.0	0.0
1.0	0.5	0.0	0.0	6.0	6.0	20.0	30.0	80.0	120.0	2.0	1.0	0.0
3.0	0.5	1.0	1.0	2.0	16.0	60.0	30.0	75.0	120.0	4.0	1.0	0.0
0.0	0.0	1.0	1.0	3.0	17.0	60.0	40.0	40.0	80.0	5.0	1.0	1.0
1.0	0.0	0.0	1.0	7.0	6.0	40.0	60.0	100.0	60.0	5.0	2.0	1.0
2.0	1.0	1.0	0.0	17.0	8.0	20.0	30.0	0.0	17.0	5.0	2.0	1.0
3.0	0.5	1.0	1.0	8.0	16.0	10.0	20.0	70.0	18.0	5.0	1.0	1.0
2.0	0.0	0.0	0.0	0.0	17.0	35.0	35.0	50.0	45.0	5.0	2.0	1.0
1.0	1.0	0.0	1.0	7.0	34.0	100.0	90.0	0.0	110.0	1.0	4.0	0.0
0.0	0.0	0.0	1.0	6.0	40.0	100.0	95.0	20.0	110.0	1.0	4.0	0.0
0.0	0.0	0.0	1.0	3.0	29.0	90.0	90.0	35.0	120.0	1.0	3.0	0.0
2.0	0.5	0.0	0.0	2.0	26.0	20.0	15.0	80.0	70.0	5.0	3.0	0.0
0.0	0.0	0.0	1.0	2.0	15.0	85.0	85.0	90.0	100.0	1.0	3.0	0.0
1.0	0.5	1.0	1.0	6.0	25.0	75.0	60.0	25.0	90.0	6.0	2.0	1.0
0.0	0.0	0.0	1.0	4.0	23.0	15.0	25.0	80.0	75.0	2.0	2.0	0.0
2.0	0.0	0.0	1.0	3.0	15.0	40.0	40.0	75.0	100.0	2.0	2.0	0.0
2.0	0.0	0.0	1.0	3.0	16.0	20.0	10.0	100.0	100.0	2.0	1.0	0.0

ISLAND-FLORES COLONY-60 STATUS-MIXED DATA-RANDOM POINTS

HABITAT VARIABLES

2.0	0.5	0.0	1.0	3.0	13.0	30.0	20.0	100.0	45.0	5.0	1.0	0.0
2.0	0.0	1.0	0.0	10.0	4.0	10.0	7.0	100.0	80.0	4.0	1.0	0.0
0.0	0.0	1.0	1.0	5.0	18.0	35.0	30.0	100.0	134.0	2.0	5.0	0.0
0.0	0.0	1.0	0.0	23.0	5.0	10.0	10.0	100.0	100.0	4.0	1.0	0.0
0.0	0.0	1.0	0.0	96.0	6.0	0.0	5.0	100.0	180.0	2.0	2.0	0.0
0.0	0.0	1.0	0.0	94.0	13.0	0.0	5.0	100.0	97.0	3.0	2.0	1.0
0.0	0.0	0.0	1.0	7.0	24.0	50.0	40.0	100.0	26.0	6.0	3.0	1.0
3.0	0.0	1.0	1.0	24.0	11.0	10.0	10.0	80.0	238.0	0.0	2.0	1.0
0.0	0.0	1.0	0.0	8.0	35.0	20.0	40.0	90.0	52.0	9.0	1.0	1.0
0.0	0.0	0.0	0.0	30.0	16.0	7.0	25.0	100.0	60.0	5.0	2.0	0.0
0.0	0.0	1.0	0.0	11.0	17.0	20.0	30.0	100.0	180.0	1.0	5.0	0.0
2.0	0.0	1.0	0.0	7.0	30.0	80.0	70.0	100.0	90.0	2.0	4.0	0.0

ISLAND-FAIAL COLONY-2 SATAUS-UNMIXED DATA-COMMON TERN

HABITAT VARIABLES

0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	1.0	3.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	1.0	3.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	500.0	0.0	3.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	240.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	310.0	0.0	3.0	0.0
0.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	310.0	0.0	1.0	1.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	380.0	0.0	2.0	1.0
0.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	20.0	195.0	1.0	1.0	1.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	195.0	1.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	330.0	0.0	1.0	0.0
0.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	60.0	360.0	0.0	3.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	400.0	0.0	3.0	1.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	400.0	0.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	400.0	0.0	4.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	600.0	0.0	1.0	0.0

ISLAND-PICO COLONY-4 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLE

4.0	0.0	1.0	0.0	4.0	8.0	5.0	5.0	50.0	150.0	1.0	3.0	0.0
2.0	0.5	1.0	1.0	13.0	16.0	3.0	3.0	40.0	170.0	1.0	3.0	0.0
2.0	0.0	1.0	0.0	12.0	17.0	3.0	5.0	100.0	90.0	4.0	2.0	0.0
3.0	0.0	1.0	0.0	40.0	3.0	0.0	3.0	100.0	105.0	3.0	3.0	0.0
3.0	0.0	1.0	0.0	2.0	9.0	40.0	30.0	100.0	120.0	3.0	2.0	1.0
1.0	1.0	1.0	0.0	5.0	8.0	50.0	50.0	0.0	30.0	6.0	1.0	1.0
1.0	0.5	1.0	0.0	0.0	20.0	60.0	40.0	60.0	50.0	7.0	1.0	1.0
2.0	0.5	0.0	0.0	25.0	4.0	2.0	5.0	50.0	100.0	4.0	4.0	1.0
2.0	0.5	1.0	0.0	4.0	4.0	4.0	15.0	40.0	190.0	1.0	3.0	0.0
4.0	0.5	1.0	0.0	0.0	6.0	4.0	15.0	80.0	200.0	2.0	3.0	0.0
0.0	0.5	0.0	0.0	30.0	6.0	5.0	5.0	85.0	130.0	2.0	1.0	0.0
0.0	0.0	0.0	0.0	3.0	5.0	10.0	6.0	100.0	180.0	1.0	1.0	0.0
1.0	0.0	1.0	0.0	8.0	6.0	10.0	5.0	100.0	250.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	1.0	6.0	50.0	30.0	100.0	80.0	3.0	1.0	0.0
3.0	0.0	1.0	0.0	0.0	6.0	3.0	1.0	100.0	120.0	2.0	1.0	1.0
2.0	0.0	1.0	0.0	4.0	2.0	5.0	5.0	100.0	120.0	2.0	1.0	1.0
2.0	0.0	0.0	0.0	120.0	30.0	0.0	3.0	100.0	75.0	4.0	1.0	1.0
3.0	0.0	0.0	0.0	100.0	0.0	30.0	5.0	70.0	75.0	2.0	1.0	0.0
1.0	0.0	1.0	0.0	2.0	30.0	0.0	1.0	100.0	190.0	1.0	3.0	0.0
1.0	0.5	1.0	0.0	27.0	6.0	7.0	5.0	35.0	80.0	4.0	2.0	0.0
2.0	0.0	1.0	0.0	0.0	30.0	40.0	40.0	60.0	60.0	2.0	3.0	1.0
2.0	0.0	1.0	0.0	0.0	15.0	20.0	10.0	60.0	60.0	3.0	2.0	1.0
3.0	0.0	1.0	0.0	1.0	16.0	15.0	30.0	20.0	120.0	4.0	2.0	1.0
1.0	0.0	1.0	0.0	2.0	8.0	40.0	30.0	60.0	120.0	3.0	2.0	1.0
2.0	0.0	1.0	0.0	2.0	2.0	7.0	5.0	100.0	230.0	0.0	1.0	0.0
2.0	0.0	0.0	0.0	4.0	3.0	2.0	1.0	100.0	180.0	1.0	1.0	0.0

ISLAND-PICO COLONY-4 STATUS-MIXED DATA-COMMON TERN

HABITAT VARIABLES

2.0	0.0	1.0	0.0	10.0	10.0	30.0	20.0	100.0	150.0	1.0	1.0	0.0
1.0	0.0	1.0	0.0	10.0	10.0	5.0	20.0	100.0	230.0	0.0	3.0	0.0
0.0	0.0	1.0	0.0	5.0	3.0	20.0	10.0	100.0	200.0	1.0	2.0	0.0
1.0	0.0	1.0	0.0	2.5	5.0	60.0	50.0	100.0	140.0	2.0	3.0	0.0
0.0	0.0	1.0	0.0	6.0	7.0	15.0	15.0	100.0	120.0	2.0	1.0	0.0
1.0	0.0	1.0	0.0	28.0	25.0	10.0	10.0	100.0	300.0	0.0	2.0	0.0
3.0	0.0	1.0	0.0	4.0	4.0	5.0	9.0	100.0	100.0	1.0	2.0	0.0
2.0	0.0	1.0	0.0	3.0	5.0	5.0	10.0	100.0	90.0	1.0	2.0	0.0
0.0	0.0	1.0	0.0	1.0	10.0	35.0	35.0	100.0	80.0	2.0	1.0	0.0
0.0	0.0	1.0	0.0	2.0	25.0	30.0	20.0	100.0	30.0	6.0	4.0	0.0
0.0	0.0	1.0	0.0	2.0	7.0	80.0	70.0	85.0	40.0	3.0	3.0	0.0
0.0	0.0	0.0	0.0	5.0	12.5	75.0	50.0	100.0	30.0	6.0	3.0	0.0
3.0	0.0	1.0	0.0	0.0	6.0	15.0	10.0	100.0	50.0	2.0	1.0	0.0
0.0	0.0	1.0	0.0	220.0	5.0	0.0	1.0	100.0	70.0	2.0	3.0	0.0
1.0	0.0	1.0	0.0	8.0	6.0	40.0	40.0	100.0	75.0	3.0	1.0	0.0
0.0	0.0	0.0	0.0	13.0	5.0	40.0	30.0	100.0	110.0	2.0	1.0	1.0
2.0	0.0	0.0	0.0	48.0	6.0	1.0	25.0	100.0	75.0	2.0	1.0	1.0
2.0	0.0	1.0	0.0	7.0	10.0	25.0	45.0	100.0	170.0	2.0	1.0	0.0
2.0	0.0	0.0	0.0	74.0	4.0	0.0	5.0	100.0	98.0	2.0	1.0	0.0

ISLAND-PICO COLONY-4 STATUS-MIXED DATA-RANDOM POINTS

HABITAT VARIABLES

2.0	0.0	1.0	0.0	30.0	20.0	5.0	2.0	100.0	190.0	1.0	3.0	0.0
2.0	0.5	1.0	0.0	40.0	15.0	2.0	10.0	100.0	100.0	3.0	3.0	0.0
1.0	0.0	1.0	0.0	0.0	4.0	15.0	10.0	100.0	35.0	5.0	1.0	1.0
1.0	0.0	1.0	0.0	8.0	13.0	40.0	40.0	100.0	30.0	3.0	1.0	1.0
4.0	0.0	1.0	0.0	25.0	10.0	10.0	15.0	100.0	60.0	2.0	2.0	1.0
0.0	0.0	1.0	0.0	10.0	4.0	10.0	15.0	100.0	150.0	1.0	3.0	1.0
2.0	0.0	1.0	0.0	8.0	45.0	60.0	70.0	80.0	250.0	0.0	3.0	0.0
3.0	0.5	1.0	0.0	0.0	7.0	20.0	10.0	75.0	300.0	0.0	1.0	0.0
0.0	0.0	1.0	0.0	40.0	35.0	5.0	15.0	100.0	200.0	1.0	1.0	0.0
0.0	0.0	1.0	0.0	120.0	17.0	0.0	10.0	100.0	280.0	0.0	1.0	0.0
1.0	0.0	1.0	0.0	230.0	17.0	0.0	1.0	100.0	250.0	0.0	1.0	0.0
2.0	0.5	1.0	0.0	45.0	15.0	1.0	5.0	80.0	125.0	1.0	3.0	0.0
3.0	0.0	1.0	0.0	8.0	16.0	2.0	1.0	100.0	100.0	1.0	3.0	0.0
2.0	0.0	1.0	0.0	20.0	25.0	5.0	2.0	100.0	200.0	2.0	3.0	0.0
0.0	0.0	1.0	0.0	10.0	2.0	2.0	5.0	100.0	90.0	1.0	3.0	0.0
0.0	0.0	0.0	0.0	7.0	5.0	40.0	30.0	100.0	30.0	3.0	1.0	1.0
3.0	0.0	1.0	0.0	0.0	14.0	4.0	3.0	75.0	120.0	1.0	1.0	0.0
1.0	0.0	1.0	0.0	60.0	13.0	0.0	30.0	100.0	35.0	4.0	1.0	0.0
1.0	0.0	1.0	0.0	4.0	8.0	20.0	30.0	100.0	120.0	2.0	1.0	0.0
2.0	0.0	0.0	0.0	5.0	10.0	50.0	40.0	80.0	130.0	1.0	3.0	0.0

ISLAND-PICO COLONY-11 *STATUS-UNMIXED* *DATA-COMMON TERN*

HABITAT VARIABLES

2.0	0.0	1.0	0.0	2.0	9.0	10.0	3.0	100.0	175.0	2.0	4.0	0.0
2.0	0.0	1.0	0.0	7.0	4.0	35.0	40.0	100.0	90.0	6.0	4.0	0.0
1.0	0.0	1.0	0.0	1.0	7.0	10.0	10.0	100.0	90.0	6.0	4.0	0.0
1.0	0.0	1.0	1.0	1.0	15.0	35.0	70.0	100.0	65.0	6.0	4.0	1.0
1.0	0.0	1.0	1.0	0.0	34.0	50.0	40.0	50.0	65.0	8.0	4.0	0.0
1.0	0.0	0.0	0.0	1.0	10.0	70.0	45.0	100.0	110.0	7.0	4.0	1.0
0.0	0.0	0.0	0.0	4.0	12.0	60.0	70.0	100.0	110.0	8.0	4.0	1.0
1.0	0.0	1.0	0.0	12.0	15.0	15.0	15.0	100.0	120.0	5.0	4.0	1.0
0.0	0.0	1.0	0.0	3.0	5.0	40.0	60.0	100.0	160.0	1.0	4.0	0.0
0.0	0.0	0.0	1.0	6.0	35.0	70.0	50.0	70.0	180.0	2.0	4.0	0.0
1.0	0.0	1.0	0.0	4.0	27.0	50.0	50.0	40.0	170.0	1.0	4.0	0.0
3.0	0.0	0.0	1.0	8.0	15.0	15.0	15.0	100.0	240.0	0.0	3.0	0.0
2.0	0.0	0.0	0.0	4.0	8.0	10.0	10.0	100.0	240.0	0.0	4.0	1.0
0.0	0.0	1.0	1.0	4.0	8.0	8.0	10.0	100.0	165.0	1.0	2.0	0.0
0.0	0.0	1.0	0.0	0.0	2.0	5.0	15.0	100.0	170.0	1.0	4.0	0.0
0.0	0.0	0.0	0.0	2.0	4.0	60.0	40.0	100.0	60.0	6.0	3.0	1.0
0.0	0.0	1.0	0.0	3.0	40.0	0.0	30.0	100.0	50.0	3.0	1.0	1.0
2.0	0.5	0.0	0.0	5.0	10.0	5.0	40.0	100.0	78.0	6.0	3.0	1.0
0.0	0.0	1.0	1.0	10.0	13.0	10.0	50.0	100.0	140.0	2.0	2.0	0.0
1.0	0.0	1.0	0.0	3.0	6.0	40.0	60.0	100.0	97.0	4.0	3.0	0.0
0.0	0.0	1.0	0.0	5.0	7.0	15.0	40.0	100.0	76.0	5.0	2.0	1.0
2.0	0.0	1.0	0.0	10.0	4.0	5.0	20.0	100.0	165.0	1.0	2.0	0.0
0.0	0.0	1.0	0.0	5.0	4.0	15.0	40.0	100.0	170.0	1.0	1.0	0.0

ISLAND-TERCEIRA COLONY-4 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLES

3.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	60.0	130.0	3.0	2.0	0.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	3.0	1.0	0.0
4.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	130.0	2.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	320.0	0.0	2.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	80.0	3.0	2.0	1.0
3.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	75.0	80.0	3.0	2.0	1.0
4.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	100.0	4.0	1.0	1.0
3.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	100.0	5.0	1.0	1.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	85.0	5.0	1.0	1.0
3.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	90.0	160.0	3.0	1.0	1.0
1.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	60.0	60.0	4.0	2.0	1.0
2.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	80.0	60.0	3.0	2.0	1.0
4.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	80.0	150.0	2.0	2.0	1.0
1.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	150.0	2.0	2.0	1.0
1.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	140.0	5.0	1.0	1.0
3.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	85.0	50.0	3.0	1.0	1.0
2.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	50.0	3.0	1.0	1.0
4.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	8.0	1.0	1.0
4.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	25.0	6.0	1.0	1.0
4.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	25.0	8.0	1.0	1.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	110.0	5.0	1.0	1.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	75.0	8.0	1.0	1.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	140.0	3.0	1.0	1.0

ISLAND-TERCEIRA COLONY-4 STATUS-MIXED DATA-COMMON TERN

HABITAT VARIABLES

2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	320.0	0.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	145.0	3.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	100.0	4.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	100.0	6.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	120.0	5.0	2.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	85.0	5.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	85.0	6.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	63.0	5.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	5.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	6.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	170.0	3.0	1.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	110.0	3.0	1.0	1.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	90.0	2.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	4.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	130.0	4.0	1.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	90.0	4.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	90.0	4.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	125.0	3.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	130.0	5.0	1.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	280.0	0.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	240.0	0.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	120.0	3.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	220.0	0.0	1.0	0.0

ISLAND-TERCEIRA COLONY-4 STATUS-MIXED DATA-RANDOM POINTS

HABITAT VARIABLES

2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	300.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	57.0	1.0	2.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	210.0	0.0	1.0	0.0
0.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	70.0	125.0	3.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	128.0	2.0	1.0	0.0
0.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	30.0	80.0	3.0	2.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	120.0	4.0	2.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	90.0	6.0	1.0	1.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	37.0	7.0	1.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	130.0	2.0	1.0	1.0
2.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	300.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	161.0	2.0	3.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	40.0	2.0	3.0	0.0
0.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	85.0	250.0	0.0	2.0	0.0
1.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	90.0	260.0	0.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	196.0	1.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	198.0	1.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	3.0	1.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	70.0	8.0	1.0	1.0
0.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	120.0	4.0	2.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	116.0	4.0	2.0	1.0
1.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	100.0	94.0	3.0	1.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	180.0	1.0	2.0	0.0

ISLAND-GRACIOSA COLONY-1 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLES

2.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	80.0	200.0	1.0	1.0	0.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	7.0	1.0	0.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	80.0	25.0	4.0	1.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	50.0	7.0	1.0	1.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	6.0	1.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	75.0	15.0	2.0	1.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	45.0	12.0	1.0	1.0
1.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	85.0	50.0	9.0	2.0	1.0
2.0	1.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	17.0	6.0	1.0	1.0
3.0	1.0	0.0	1.0	700.0	5.0	0.0	0.0	0.0	60.0	10.0	1.0	1.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	80.0	7.0	1.0	1.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	30.0	9.0	3.0	1.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	13.0	1.0	1.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	65.0	10.0	1.0	1.0
3.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	70.0	3.0	1.0	0.0
3.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	70.0	24.0	15.0	1.0	1.0
3.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	18.0	14.0	1.0	1.0
2.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	80.0	90.0	1.0	2.0	0.0
2.0	1.0	1.0	1.0	700.0	5.0	0.0	0.0	0.0	90.0	1.0	1.0	0.0
3.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	30.0	350.0	0.0	3.0	0.0
4.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	7.0	2.0	0.0
2.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	80.0	26.0	8.0	1.0	1.0
2.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	90.0	80.0	4.0	2.0	1.0
1.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	90.0	70.0	9.0	1.0	1.0
4.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	85.0	70.0	7.0	1.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	45.0	16.0	2.0	0.0
1.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	85.0	85.0	4.0	1.0	0.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	118.0	1.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	235.0	0.0	1.0	0.0
2.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	90.0	77.0	6.0	1.0	0.0

ISLAND-GRACIOSA COLONY-1 STATUS-MIXED DATA-COMMON TERN

HABITAT VARIABLES

0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	94.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	217.0	0.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	75.0	6.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	120.0	4.0	1.0	1.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	255.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	290.0	0.0	1.0	0.0
1.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	95.0	159.0	5.0	1.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	180.0	3.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	160.0	1.0	1.0	1.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	300.0	0.0	1.0	1.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	160.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	90.0	2.0	1.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	175.0	2.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	180.0	2.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	295.0	0.0	1.0	1.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	172.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	172.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	235.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	180.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	250.0	0.0	1.0	0.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	134.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	170.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	195.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	168.0	2.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	310.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	310.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	120.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	120.0	1.0	1.0	1.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	180.0	1.0	1.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	107.0	4.0	1.0	1.0

COLONY-GRACIOSA COLONY-1 STATUS-MIXED DATA-RANDOM POINTS

HABITAT VARIABLES

0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	300.0	0.0	1.0	0.0
2.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	300.0	0.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	330.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	60.0	10.0	1.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	30.0	13.0	2.0	1.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	65.0	9.0	2.0	1.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	130.0	2.0	2.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	310.0	0.0	1.0	0.0
1.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	130.0	3.0	2.0	1.0
2.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	70.0	245.0	0.0	3.0	1.0
1.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	80.0	145.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	45.0	3.0	2.0	1.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	320.0	0.0	3.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	50.0	4.0	2.0	0.0
2.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	80.0	230.0	0.0	3.0	0.0
2.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	90.0	57.0	5.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	160.0	4.0	1.0	0.0
1.0	0.5	0.0	1.0	700.0	5.0	0.0	0.0	90.0	280.0	0.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	285.0	0.0	1.0	0.0
0.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	217.0	0.0	1.0	0.0
2.0	0.0	1.0	1.0	700.0	5.0	0.0	0.0	100.0	210.0	0.0	1.0	0.0
1.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	400.0	0.0	1.0	0.0
2.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	75.0	230.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	135.0	2.0	1.0	0.0
3.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	150.0	2.0	1.0	1.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	100.0	98.0	1.0	1.0	0.0
0.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	100.0	193.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	700.0	5.0	0.0	0.0	70.0	136.0	1.0	1.0	0.0
2.0	0.5	1.0	1.0	700.0	5.0	0.0	0.0	75.0	55.0	5.0	2.0	1.0
2.0	1.0	0.5	1.0	700.0	5.0	0.0	0.0	30.0	60.0	5.0	1.0	1.0

ISLAND-GRACIOSA COLONY-9 STATUS-UNMIXED DATA-COMMON TERN

HABITAT VARIABLES

1.0	0.0	0.0	0.0	300.0	6.0	0.0	0.0	100.0	27.0	5.0	2.0	1.0
0.0	0.0	0.0	0.0	360.0	6.0	0.0	0.0	100.0	52.0	5.0	2.0	1.0
0.0	0.0	0.0	0.0	365.0	6.0	0.0	0.0	100.0	52.0	5.0	2.0	1.0
0.0	0.0	0.0	0.0	4.0	5.0	10.0	4.0	100.0	140.0	5.0	3.0	1.0
0.0	0.0	0.0	0.0	3.0	8.0	80.0	75.0	100.0	82.0	5.0	3.0	1.0
2.0	0.0	0.0	0.0	5.0	5.0	35.0	50.0	100.0	200.0	2.0	4.0	0.0
0.0	0.0	0.0	0.0	2.0	3.0	95.0	75.0	100.0	210.0	0.0	4.0	0.0
0.0	0.0	0.0	0.0	5.0	3.0	60.0	70.0	100.0	300.0	0.0	4.0	0.0
0.0	0.0	0.0	0.0	6.0	4.0	60.0	50.0	100.0	200.0	1.0	4.0	0.0
1.0	0.0	0.0	0.0	4.0	5.0	10.0	10.0	100.0	94.0	4.0	4.0	1.0
1.0	0.0	0.0	0.0	46.0	5.0	2.0	3.0	100.0	310.0	0.0	1.0	0.0
2.0	0.0	1.0	0.0	600.0	5.0	0.0	0.0	100.0	240.0	0.0	2.0	0.0
1.0	0.0	0.0	0.0	900.0	5.0	0.0	0.0	100.0	230.0	0.0	1.0	0.0
2.0	0.0	0.0	0.0	900.0	5.0	0.0	0.0	100.0	230.0	0.0	1.0	0.0

ISLAND-SANTA MARIA COLONY-13 STATUS-MIXED DATA-ROSEATE TERN

HABITAT VARIABLES

1.0	1.0	0.0	0.0	70.0	7.0	0.0	5.0	0.0	100.0	3.0	1.0	0.0
1.0	0.5	1.0	0.0	25.0	7.0	5.0	15.0	60.0	130.0	4.0	1.0	0.0
1.0	0.0	1.0	0.0	0.0	13.0	60.0	40.0	100.0	75.0	2.0	1.0	1.0
0.0	0.0	0.0	0.0	0.0	10.0	35.0	45.0	100.0	40.0	4.0	1.0	1.0
1.0	0.5	1.0	0.0	2.0	15.0	25.0	5.0	60.0	260.0	0.0	2.0	1.0
3.0	0.0	1.0	0.0	40.0	9.0	3.0	2.0	100.0	55.0	10.0	2.0	0.0
2.0	0.5	1.0	0.0	85.0	9.0	0.0	1.0	80.0	17.0	9.0	3.0	0.0
4.0	0.0	1.0	0.0	0.0	10.0	30.0	5.0	100.0	45.0	8.0	3.0	0.0
3.0	0.0	1.0	0.0	5.0	7.0	20.0	5.0	85.0	25.0	7.0	2.0	0.0
3.0	0.5	1.0	0.0	6.0	12.0	10.0	20.0	40.0	35.0	4.0	1.0	0.0
3.0	0.5	1.0	0.0	13.0	6.0	10.0	5.0	80.0	20.0	2.0	2.0	1.0
1.0	0.5	1.0	0.0	4.0	7.0	20.0	5.0	15.0	35.0	2.0	3.0	1.0
2.0	0.0	1.0	0.0	4.0	7.0	35.0	10.0	100.0	40.0	6.0	2.0	1.0
1.0	0.0	0.0	0.0	2.0	30.0	70.0	40.0	85.0	45.0	8.0	1.0	1.0
2.0	0.0	1.0	0.0	15.0	10.0	25.0	40.0	100.0	90.0	4.0	1.0	1.0
4.0	1.0	0.0	0.0	9.0	10.0	20.0	15.0	100.0	65.0	7.0	1.0	1.0
3.0	0.5	0.0	0.0	0.0	4.0	40.0	40.0	80.0	30.0	6.0	1.0	1.0
2.0	0.0	0.0	0.0	2.0	6.0	25.0	35.0	100.0	25.0	7.0	2.0	1.0
3.0	0.5	1.0	0.0	0.0	5.0	40.0	25.0	80.0	170.0	2.0	2.0	0.0
2.0	0.5	1.0	0.0	4.0	9.0	10.0	40.0	60.0	50.0	8.0	1.0	1.0
3.0	0.5	0.0	0.0	9.0	8.0	10.0	20.0	85.0	170.0	3.0	2.0	1.0
2.0	0.0	1.0	0.0	2.0	14.0	30.0	40.0	100.0	48.0	5.0	3.0	0.0
4.0	0.5	1.0	1.0	7.0	14.0	3.0	15.0	75.0	48.0	2.0	1.0	0.0
2.0	0.0	0.0	0.0	2.0	27.0	50.0	35.0	80.0	197.0	3.0	1.0	0.0
3.0	1.0	0.0	0.0	17.0	35.0	10.0	15.0	0.0	47.0	4.0	2.0	0.0
1.0	1.0	0.0	0.0	15.0	4.0	4.0	35.0	0.0	140.0	3.0	1.0	1.0
3.0	0.0	1.0	0.0	16.0	27.0	4.0	1.0	100.0	200.0	1.0	1.0	0.0
4.0	0.5	1.0	0.0	45.0	8.0	2.0	1.0	70.0	90.0	7.0	2.0	1.0
2.0	0.0	1.0	0.0	150.0	6.0	0.0	3.0	100.0	110.0	4.0	2.0	0.0
4.0	1.0	1.0	0.0	320.0	6.0	0.0	0.0	0.0	180.0	1.0	3.0	0.0
3.0	0.0	1.0	0.0	160.0	9.0	0.0	1.0	100.0	165.0	3.0	3.0	0.0
2.0	0.0	1.0	0.0	0.0	6.0	35.0	10.0	95.0	65.0	4.0	3.0	0.0

ISLAND-SANTA MARIA COLONY-13 STATUS-MIXED DATA-COMMON TERN

HABITAT VARIABLES

0.0	0.0	0.0	0.0	8.0	9.0	5.0	10.0	100.0	150.0	2.0	1.0	0.0
1.0	0.0	0.0	0.0	4.0	5.0	7.0	30.0	100.0	310.0	0.0	1.0	0.0
1.0	0.0	0.0	0.0	25.0	8.0	10.0	30.0	100.0	70.0	2.0	2.0	0.0
1.0	0.0	1.0	0.0	4.0	6.0	15.0	35.0	100.0	140.0	3.0	3.0	0.0
2.0	0.0	0.0	0.0	4.0	9.0	40.0	40.0	100.0	130.0	1.0	3.0	0.0
0.0	0.0	0.0	0.0	13.0	5.0	10.0	35.0	100.0	130.0	1.0	3.0	0.0
0.0	0.0	0.0	1.0	0.0	17.0	40.0	60.0	100.0	290.0	0.0	2.0	0.0
1.0	0.0	0.0	0.0	4.0	12.0	40.0	40.0	100.0	90.0	1.0	3.0	0.0
0.0	0.0	0.0	0.0	0.0	6.0	30.0	50.0	100.0	195.0	1.0	2.0	0.0
2.0	0.0	0.0	0.0	5.0	6.0	60.0	60.0	100.0	180.0	1.0	2.0	0.0
0.0	0.0	0.0	0.0	4.0	8.0	30.0	40.0	100.0	180.0	1.0	4.0	0.0
0.0	0.0	0.0	0.0	10.0	13.0	15.0	30.0	100.0	230.0	0.0	4.0	0.0
0.0	0.0	0.0	0.0	2.0	3.0	80.0	90.0	100.0	190.0	1.0	1.0	0.0
1.0	0.0	0.0	0.0	0.0	2.0	90.0	90.0	100.0	340.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	2.0	6.0	60.0	80.0	100.0	105.0	1.0	1.0	0.0
1.0	0.0	0.0	0.0	6.0	8.0	70.0	80.0	100.0	105.0	1.0	1.0	0.0
0.0	0.0	0.0	0.0	0.0	2.0	80.0	65.0	100.0	96.0	1.0	1.0	0.0
0.0	0.0	0.0	0.0	2.0	2.0	80.0	80.0	100.0	300.0	0.0	1.0	1.0
0.0	0.0	0.0	0.0	2.0	3.0	90.0	90.0	100.0	400.0	0.0	1.0	1.0
0.0	0.0	0.0	0.0	2.0	5.0	90.0	90.0	100.0	150.0	1.0	1.0	0.0
0.0	0.0	0.0	0.0	3.0	7.0	80.0	80.0	100.0	105.0	1.0	1.0	0.0
2.0	0.0	0.0	0.0	5.0	8.0	40.0	80.0	100.0	105.0	1.0	1.0	0.0
0.0	0.0	0.0	0.0	10.0	13.0	10.0	35.0	100.0	260.0	0.0	4.0	0.0
0.0	0.0	0.0	0.0	8.0	9.0	20.0	75.0	100.0	130.0	1.0	2.0	1.0
0.0	0.0	0.0	0.0	3.0	19.0	20.0	60.0	100.0	400.0	0.0	2.0	0.0
0.0	0.0	0.0	0.0	12.0	12.0	10.0	40.0	100.0	230.0	0.0	2.0	0.0
2.0	0.0	1.0	0.0	5.0	19.0	2.0	10.0	100.0	140.0	2.0	1.0	1.0
1.0	0.0	1.0	0.0	0.0	5.0	40.0	10.0	100.0	65.0	4.0	2.0	1.0
1.0	0.0	0.0	0.0	15.0	13.0	15.0	40.0	100.0	180.0	1.0	3.0	1.0

ISLAND-SANTA MARIA COLONY-13 STATUS-MIXED DATA-RANDOM POINTS

HABITAT VARIABLES

2.0	0.0	1.0	0.0	15.0	5.0	10.0	50.0	100.0	90.0	1.0	1.0	0.0
1.0	0.0	1.0	0.0	30.0	3.0	5.0	15.0	100.0	135.0	3.0	1.0	0.0
1.0	0.0	0.0	0.0	4.0	35.0	40.0	60.0	100.0	350.0	0.0	1.0	1.0
0.0	0.0	1.0	0.0	20.0	15.0	15.0	30.0	100.0	70.0	4.0	1.0	1.0
0.0	0.0	1.0	0.0	45.0	15.0	2.0	30.0	100.0	30.0	1.0	1.0	1.0
2.0	0.0	1.0	0.0	38.0	9.0	5.0	20.0	100.0	140.0	3.0	1.0	1.0
1.0	0.0	1.0	0.0	30.0	28.0	3.0	15.0	100.0	150.0	3.0	1.0	1.0
0.0	0.0	1.0	1.0	60.0	8.0	0.0	15.0	100.0	98.0	1.0	3.0	1.0
2.0	0.5	0.0	0.0	65.0	6.0	0.0	5.0	80.0	190.0	1.0	4.0	1.0
3.0	0.0	1.0	0.0	140.0	12.0	0.0	2.0	100.0	78.0	3.0	4.0	0.0
1.0	0.0	1.0	0.0	300.0	8.0	0.0	0.0	100.0	180.0	2.0	3.0	0.0
1.0	0.0	1.0	0.0	90.0	5.0	0.0	2.0	100.0	95.0	5.0	1.0	0.0
0.0	0.0	1.0	0.0	300.0	12.0	0.0	0.0	100.0	290.0	0.0	3.0	0.0
2.0	0.0	1.0	0.0	350.0	8.0	0.0	0.0	90.0	280.0	0.0	3.0	1.0
0.0	0.0	0.0	0.0	60.0	9.0	0.0	4.0	100.0	90.0	7.0	2.0	1.0
0.0	0.0	0.0	0.0	0.0	11.0	50.0	50.0	100.0	560.0	0.0	1.0	0.0
1.0	1.0	0.0	0.0	12.0	8.0	25.0	50.0	100.0	800.0	0.0	1.0	0.0
1.0	0.0	0.0	0.0	4.0	2.0	25.0	40.0	100.0	950.0	0.0	1.0	0.0
2.0	0.0	1.0	0.0	5.0	16.0	40.0	70.0	100.0	955.0	0.0	1.0	0.0
0.0	0.0	1.0	0.0	2.0	10.0	70.0	70.0	100.0	800.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	0.0	24.0	100.0	100.0	100.0	987.0	0.0	1.0	0.0
0.0	0.0	0.0	1.0	10.0	18.0	40.0	80.0	100.0	60.0	1.0	1.0	0.0
0.0	0.0	0.0	1.0	0.0	20.0	100.0	100.0	100.0	850.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	0.0	8.0	50.0	35.0	100.0	400.0	0.0	1.0	0.0
0.0	0.0	1.0	0.0	112.0	4.0	0.0	15.0	100.0	310.0	0.0	3.0	0.0
2.0	0.0	0.0	1.0	3.0	6.0	15.0	40.0	100.0	300.0	0.0	1.0	0.0
1.0	0.0	0.0	0.0	10.0	7.0	15.0	35.0	100.0	996.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	30.0	6.0	3.0	25.0	100.0	999.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	0.0	7.0	25.0	25.0	100.0	974.0	0.0	1.0	0.0
0.0	0.0	1.0	0.0	37.0	10.0	3.0	20.0	100.0	630.0	0.0	4.0	0.0
0.0	0.0	0.0	0.0	2.0	3.0	25.0	25.0	100.0	230.0	0.0	5.0	0.0
0.0	0.0	0.0	0.0	5.0	7.0	30.0	50.0	100.0	300.0	0.0	5.0	0.0
0.0	0.0	1.0	0.0	56.0	10.0	0.0	30.0	100.0	330.0	0.0	4.0	0.0
0.0	0.0	0.0	1.0	8.0	14.0	50.0	30.0	100.0	150.0	1.0	4.0	0.0
0.0	0.0	1.0	0.0	3.0	17.0	15.0	40.0	100.0	450.0	0.0	3.0	0.0

ISLAND-SANTA MARIA COLONY-13 STATUS-MIXED DATA-LATE ROSEATE TERN

HABITAT VARIABLES

1.0	0.5	0.0	0.0	4.0	19.9	40.0	10.0	60.0	35.0	1.0	2.0	1.0
3.0	0.0	1.0	0.0	2.0	20.0	60.0	10.0	85.0	35.0	1.0	2.0	1.0
4.0	0.0	1.0	0.0	8.0	26.0	45.0	45.0	100.0	95.0	1.0	2.0	1.0
2.0	0.0	1.0	0.0	6.0	12.0	5.0	20.0	100.0	200.0	0.0	1.0	1.0
2.0	0.0	1.0	0.0	4.0	23.0	70.0	50.0	100.0	180.0	1.0	1.0	1.0
0.0	0.0	1.0	0.0	3.0	19.0	7.0	30.0	60.0	70.0	1.0	1.0	0.0
3.0	0.0	1.0	0.0	160.0	19.0	5.0	15.0	100.0	190.0	1.0	3.0	0.0
2.0	0.5	1.0	0.0	6.0	18.0	20.0	40.0	50.0	195.0	1.0	1.0	1.0
3.0	0.5	1.0	0.0	8.0	28.0	60.0	35.0	90.0	300.0	0.0	1.0	1.0
1.0	0.5	0.0	0.0	10.0	17.0	70.0	20.0	20.0	270.0	0.0	1.0	1.0
2.0	0.0	1.0	0.0	4.0	21.0	60.0	40.0	80.0	190.0	1.0	1.0	1.0
0.0	0.5	0.0	0.0	3.0	14.0	55.0	40.0	95.0	250.0	0.0	2.0	1.0
3.0	0.0	1.0	0.0	60.0	7.0	3.0	5.0	100.0	130.0	1.0	3.0	0.0
2.0	0.5	0.0	0.0	8.0	16.0	50.0	40.0	85.0	120.0	3.0	3.0	0.0
3.0	0.0	1.0	0.0	6.0	20.0	40.0	35.0	100.0	45.0	1.0	1.0	1.0