~~A. J. del Nevo~~
Euan Dunn

Açores Tern Survey 1984

Euan Dunn

AZORES TERN SURVEY 1984

Report to RSPB by Euan Dunn

March 1989

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INTRODUCTION

The Roseate Tern: status and distribution

The Roseate Tern Sterna dougallii enjoys a cosmopolitan but widely dispersed distribution mostly within 30° of the equator (tropical north Atlantic, Indian, and western Pacific Oceans) but also in several temperate regions: north-eastern North America, north-western Europe, the Azores, South Africa, the Ryu Kyu Islands, and Western Australia. Almost throughout its range the species faces a variety of escalating pressures, and in recent years at least three of the temperate region populations (North America, Europe, and South Africa) have declined dramatically, while two significant local populations (Bermuda and Tunisia) are known to have become extinct. Concern for the welfare of the species has led to growing concern for,and scrutiny of, this hitherto little-known species. Status and trends have been reviewed by Nisbet (1980, on which the above outline is based); life-history details are documented by Nisbet (1981) and, for the western Palearctic, by Cramp (1985).

The Roseate Tern is now Europe's rarest breeding seabird, having suffered a major decline in recent decades. In the mid-1960's there was a relatively healthy population of around 3500 pairs in about 20 main colonies in Britain, Ireland, and France. By 1969, however, a major reduction to about 2500 pairs in 13 colonies was evident, and the decline proceeded apace through the 1970's. By 1983 the total did not exceed 600 pairs in about 5 colonies, a reduction of about 80% in 20 years. The decline of this population has been described and analyzed by Thomas (1978), Dunn (1981), and Dunn and Mead (1982), and attributed to displacement by gulls from the breeding colonies and trapping in the West African winter quarters, chiefly Ghana. Initiatives have been taken to implement remedial measures both on the breeding and the wintering grounds , and although the rate of decline has since shown a heartening reduction, the current status shows no improvement on the 1983 census.

The Azores population

In June 1963, the Bannermans (1966) discovered a breeding colony of several hundred pairs on Praia Islet off Graciosa, and they also saw large numbers (possibly hundreds) carrying food off Santa Cruz (Flores). They also summarized earlier breeding on islets off Santa Maria, Faial, and probably Pico and São Miguel. In 1980 a survey by resident ornithologist Gérald Le Grand (Univ. of Azores) yielded an estimated breeding population of c.300 pairs; in 1981 another survey gave about 500 pairs of which c.400 were located on Flores, the remainder in small colonies on São Jorge and Terceira; none were found on São Miguel (Le Grand in litt.) However, Le Grand was not able to make a complete census and thought his counts likely to be underestimates. Nevertheless, even 500 pairs would have made an addition of almost 100% to the north-eastern Atlantic tally of Roseate Terns and pinpointed the Azores as a major breeding station for the species.

The expedition

G. Le Grand was handicapped in mounting a more accurate survey by logistical problems and lack of funds. With few exceptions the tern colonies are inaccessible from land, and can only be censused properly by a sea approach. A readily available vessel with a carefully managed itinerary was thus a prerequisite for success, the more so considering that the birds are only present in their colonies from April-July, dispersing rapidly (to yet uncertain winter quarters) from the end of July till the end of September. Boat hire on the Azores is prohibitively expensive, with rates equivalent to charter for prestigious fishing trips. Given these difficulties, Le Grand invited support from Britain, preferably in the form of a chartered vessel crewed by seabird biologists. Le Grand's appeal was passed via Dr Gareth Thomas (RSPB) to the Seabird Group which appointed E.K. Dunn to coordinate an expedition and seek financial backing for it.

The chief objectives of the Azores Tern Survey 1984 were:
(1) To locate and census all the breeding Roseate Terns on the Azores, concentrating this effort in June 1984.

(2) To ring, in liaison with CEMPA, a representative proportion of Roseate Tern pulli with a view to discovering the wintering grounds (thought likely to be West Africa) of the Azores population.

(3) To census also the breeding Common Terns S. hirundo, Yellow-legged Herring Gulls Larus cachinnans atlantis, and, as time and opportunity permitted, to determine the breeding status of Cory's Shearwaters Calonectris diomedea and other procellariiformes on the Azores.

(4) To collect biometric data on these seabirds for comparison with other populations.

In the event, shortage of time largely prevented the realization of aim 3 (insofar as a realistic assessment of the immensely abundant C. diomedea was concerned) and aim 4. From the outset, the UK team liaised closely with G. Le Grand, the University of the Azores, and related Azorean authorities, thus ensuring the widest possible impact on local conservation awareness and management.

ACKNOWLEDGEMENTS

Official endorsement for the expedition was granted by E. Lisboa (Cultural Counsellor, Portuguese Embassy, London). We gratefully acknowledge generous financial support from the following sponsors:

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Royal Society for the Protection of Birds

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University of St Andrews

British Ecological Society

Seabird Group

Mr & Mrs Warren

The launch of the joint Seabird Group/ICBP project also benefited enormously from Paul Goriup (then of ICBP) whose efforts in promotion, organisation, home back-up, and sundry advice, proved invaluable. Dr C. Imboden (ICBP) and Dr C.M. Perrins (Edward Grey Institute, Oxford University) kindly endorsed sponsorship applications. We are grateful to The Royal Geographical Society for approving the expedition and providing guidance through The Expeditionary Advisory Centre, and to the Laboratory of Applied Ecology (Univ. of Azores) for their cooperation in giving G. Le Grand and Fátima Melo the facilities and time to participate in the expedition. Dr Cardigo kindly censused the inland colonies on Corvo.

A special debt of gratitude is owed to Richard Speir without whose enterprise and commitment nothing would have been possible. Richard was first contacted in November 1983 after his desire to start chartering for marine ecological research became known to the Seabird Group. At this stage he had no vessel for the purpose but by February 1984 he had purchased the 13,2m (43 ft) Bermudan ketch 'Gaia Quest' expressly for the Azores expedition and subsequent ventures. Richard Speir and Jackie Lemlin worked tirelessly to refit and equip the yacht in record time for her launch on 16 March and her departure for the Azores from St Catherine's Dock (London) on 6 May (with a crew of five). Further thanks go to Jackie Lemlin for her role as general catering manager, and for securing donations of food supplies (see below). For unfailing confidence in 'Gaia Quest' as a safe vessel in often difficult sea conditions we owe much to the helmsmanship of skipper Steve Hawksley. We also thank Arthur Davies and John Adams who gave of their time and expertise to help sail 'Gaia Quest'

to the Azores without the incentive of participating in the survey thereafter.

We also thank; the authorities at St Catherine's Dock for facilitating our mooring there prior to departure (this contributing to the publicity and local fund-raising for the expedition); the help of the port authorities at various anchorages in the Azores; the master and crew of the freighter 'Porto Garca' for donating engine oil ad lib and mechanical know-how when we encountered engine problems on Flores; and Erik Trabant who came to our rescue when 'Gaia Quest' was under repair by putting his trimaran 'Tripple Trapple' at our disposal for the survey of São Jorge.

We also acknowledge the following people who assisted the expedition in sundry ways; L.C. Taylor (Calouste Gulbenkian Foundation), Dr Chris Tydeman (WWF), Dr Paul James, Chris Mead (BTO), Rui Rufino (CEMPA), Nick Hughues, Tony Martin, Dr Ian Nisbet, Dr Bill Bourne, the editor of Açoriano Oriental, Azores Television, Mario, Fátima Le Grand, Robert B. Silverman, Peter Azevedo (and Cafe Sport, Horta, Faial), Lorraine Da'Luz Vieira, Lin, Danny, and Jodie Brown, and all those who helped 'Gaia Quest' on her way.

Last but not least we are glad to take this opportunity of thanking the people of the Azores for the unsolicited support and generosity they were ever willing to extend to the expedition on land and at sea.

Donations of food and materials

We are grateful to the following companies and individuals for generously donating supplies:

Dunlop Marine Safety Products

Hanimex (UK) Ltd (Fuji Film)

Colman's of Norwich

St Ivel Ltd

RHM Foods Ltd

Bowater Scott Corp.

CPC (United Kingdom) Ltd

Kavli Ltd

Tate & Lyle

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Chris Gomersall (RSPB)

J. Stewart Pritchard (Univ. of St Andrews)

Barbara Smith (Univ. of St Andrews)

Fatima Melo (Univ. of Azores)

Crew

Richard Speir (Owner)

Steve Hawksley (Skipper)

Lisa Clark

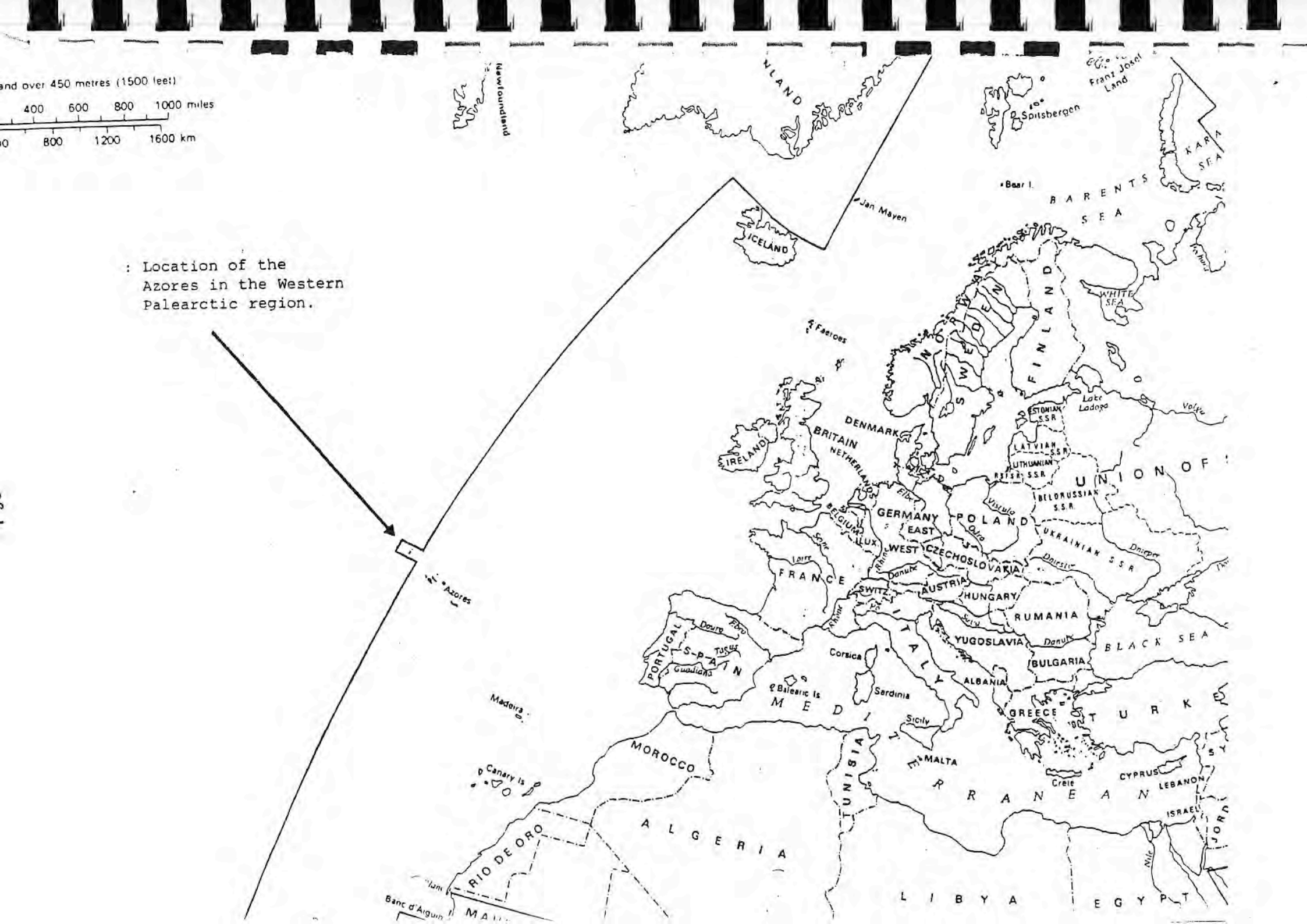
Jackie Lemlin

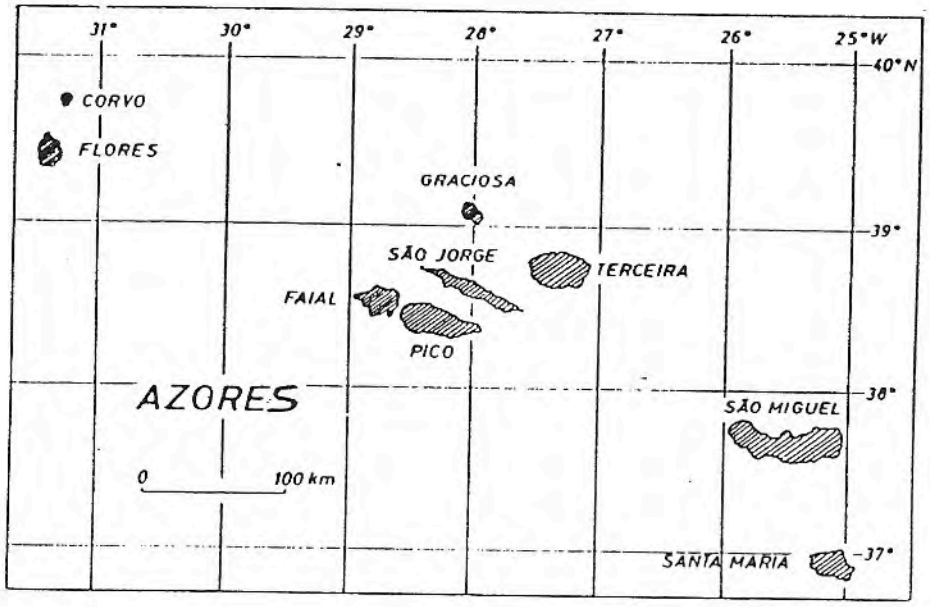
John Andrews (England to Azores)

Arthur Davies (London to Falmouth)

DEDICATION

I have little idea how this project will go, or what my part in it might be, but I wish it all success. Do avoid the obvious trap of target fixation -- taking unreasonable chances. My posture is an apprehensive crouch (Arthur Davies).


and over 450 metres (1500 feet)
400 600 800 1000 miles
800 1200 1600 km
: Location of the Azores in the Western Palearctic region.
Newfoundland
VLAND
Franz Josef Land
Spitsbergen
KARA SEA
Bear I.
BARENTS SEA
Jan Mayen
ICELAND
Faeroes
SWEDEN
FINLAND
WHITE SEA
Lake Ladoga
Volga
ESTONIAN S.S.R.
LATVIAN S.S.R.
LITHUANIAN S.S.R.
DENMARK
BRITAIN
IRELAND
NETHERLANDS
BELGIUM
LUX.
GERMANY EAST
GERMANY WEST
POLAND
Vistula
Oder
Elbe
Rhine
Seine
Loire
FRANCE
CZECHOSLOVAKIA
BELORUSSIAN S.S.R.
UKRAINIAN S.S.R.
Dniester
Dnieper
Azores
Danube
SWITZ.
AUSTRIA
HUNGARY
RUMANIA
Po
Arno
ITALY
YUGOSLAVIA
BULGARIA
BLACK SEA
Douro
Tejo
Guadiana
PORTUGAL
S-P-A-I-N
Corsica
Sardinia
Balearic Is
ALBANIA
GREECE
TURKEY
Madeira
Canary Is
Sicily
MALTA
MOROCCO
TUNISIA
MEDITERRANEAN
CYPRUS
LEBANON
ISRAEL
Crete
RIO DE ORO
ALGERIA
LIBYA
EGYPT
Nile
Banc d'Arguin


31°
30°
29°
28°
27°
26°
25°W
40°N
39°
38°
37°
CORVO
FLORES
GRACIOSA
SÃO JORGE
TERCEIRA
FAIAL
PICO
AZORES
SÃO MIGUEL
SANTA MARIA
0
100 km

MAP 2

THE AZORES : BACKGROUND INFORMATION

The Azores archipelago is situated in the Atlantic, between 24° 26' -- 31° 16'W and 36° 55' -- 39° 43'N, i.e. c.1200km from Lisbon and c. 3400km from New York (Map 1). The archipelago, covering 2335sq km, comprises 3 groups of, in total, 9 islands, orientated roughly north-west to south-east (Map 2). The central group, consisting of Terceira, Graciosa, São Jorge, Pico and Faial, is flanked to the east by São Miguel and Santa Maria, and to the west by Flores and Corvo. Over 600km separates the most easterly and westerly of the island chain. All the islands are of volcanic origin, dating from Miocene to the present. For detailed geology see Krejci-Graf (1956, 1961a and b, 1962). In keeping with these origins, the islands are mountainous (maximum Mount Pico 2350m), bounded by precipitous, often deeply dissected cliffs, with numerous caves, stacks, and islands ('ilh'eus') . Inland are commonly found the craters (caldeiras) of extinct volcanos, and, in a few places, fumaroles, geysers, and hot springs.

The climate is temperate, with a mean annual temperature of 17° C (63° F). Temperatures are markedly even, coldest February-March, warmest August. Rain occurs throughout the year, mostly November - December, least July-August, but varies widely with topography, aspect, winds, and altitude; in general the central mountains receive high rainfall while the southern coastlines tend to be drier and sunnier. Relative humidity is high, averaging 76-82% annually, and cloudless days are consequently rare. The celebrated 'Azores High' (anticyclone) is something of a misnomer as it does not form over the archipelago although it does lie nearest to the pressure centre. The Azores are, indeed, situated in an area of rather frequently changing atmospheric conditions. In the summer, anticyclones predominate, and winds are mainly north-east Trades. The wind belt shifts south in autumn and winter, bringing moist tropical air from the south and west (Agostino 1940). August and September are the calmest months, while hurricane-force winds are not uncommon in winter. Stormy, rainy weather typically persists into the spring, accounting for the late start to breeding by land birds (generally not before the last 10 days of April ;Knecht and Scheer 1971).

The mild moist oceanic climate results in vegetative cover right up to the summit regions, with the exception of the 'misterios' (barren lava zones) of Pico which are still devoid of cover owing to the slightly drier climate since the eruption there at the end of the 18th Century. Tutin (1953) listed about 500 plant species, not including cryptogams and cultivated plants. Of these, 45 are endemics, 222 of Eurasian origin, 12 from Madeira and the Canaries, 4 from America, 2 from Africa, and 216 introduced (mostly from Europe). Remnants of the endemic flora are found at higher elevations, notably in the caldeiras.

Strongly influenced by the Gulf Stream, favourable sea temperatures (17-24° C) support a rich marine food web, notably shoals of minute fish fry which pass along the coasts after April and are exploited by the terns (Bannerman and Bannerman 1966). Tides in the Azores are small, averaging 4-5ft (1.23-1.54m) and semi-diurnal. Their effects in producing currents are most noticeable in the channels between Pico and Faial, and between Pico and São Jorge. Here they may reach 2 knots if running with the wind (Silverman 1982).

METHODS

Sailing from São Miguel (30 May) first to Santa Maria, the expedition then proceeded westwards via Terceira, Graciosa and Faial to the most westerly outliers (Flores and Corvo) before returning to complete surveying the central group (Faial, Pico, São Jorge). The survey of São Jorge was completed on 7 July, effectively concluding 'Gaia Quest's' involvement. No special census was made in 1984 of São Miguel but its (modest) tern population was well known to G. Le Grand from surveys there in several previous years, and his figures have been used here.

Circumnavigating each island close inshore, it was not difficult to locate active tern colonies either with the naked eye or with the aid of binoculars. Once a colony was located, a team of two or three was shuttled ashore by inflatable dinghy powered by outboard motor, and wherever sea conditions permitted a landing was attempted. Later in the survey this strategy proved unworkable because of mechanical problems with 'Gaia Quest's' engine (windless conditions often necessitating motoring rather than sailing) and the islands of Flores, Corvo, Faial, and Pico were then surveyed entirely by inflatable. A borrowed trimaran effected the survey of São Jorge and so completed the central group itinerary.

For every tern colony a standard record card was completed, noting details of location, topography, vegetation, numbers of Roseate and Common Tern nests, their clutch and brood sizes, and approximate limits and dispersion of subcolonies/colonies. Many of the smaller outliers had not been surveyed before and we were attentive to the possibility of some being good refugia for endemic plants. Any sites of special botanical interest were therefore noted. Distinguishing between Roseate and Common Terns, also their eggs and young, presented little difficulty after a brief familiarisation period for those not previously acquainted with the species. Once the flight silhouettes, sometimes aided by the calls, had been mastered, it was possible to count and then apportion mixed flying flocks to the respective species, a necessary expedient when landing proved impossible. It was sometimes necessary to make a loud noise from the vessel to ensure an upflight of all colony members. Head counts were judged to be accurate to plus or minus 10% in such circumstances. An estimate of breeding numbers was then extrapolated from the head count of adult birds present; a ratio of 3 flying birds to 2 breeding pairs was assumed throughout the survey period, which could be expected to yield a minimum estimate (Bullock and Gomersall 1981). Subsequent field observations in the Azores suggested that this would lead to a slight underestimate of breeding numbers, although at the majority of tern colonies better data were achievable, i.e. counts of viable clutches and/or broods of young were the preferred measure, but again this probably produces a conservative estimate of total breeding pairs since no account is taken of clutches which had already failed or of birds yet to lay. However this restriction was inevitable given that, with a few exceptions, it was only possible to visit a given colony once in the course of the survey.

Wherever possible, pulli of both tern species were ringed with a Portuguese (CEMPA) monel ring on the right leg, and Roseate Tern chicks were also fitted with a bright yellow plastic 'Hughes' ring on the left leg. The age of all chicks, whether ringed or not, was estimated. Any available evidence of factors contributing to egg failure or chick death were recorded. It was originally intended to measure eggs and perhaps young of Roseate Terns, but this course was decided against because the colonies often proved hard to census, given that cryptic (especially in the case of Roseate Terns which often nested under boulders and overhangs) and often dispersed nests proved difficult to locate quickly, particularly with a team which included some

members with little first-hand experience of the task. Given that the priority was to find as many nests as possible with the least disturbance to the birds, it was felt necessary to abandon procedures which would have prolonged our stay in, and unduly disturbed, the birds. In certain cases (e.g. Terceira) high ambient temperatures vindicated this procedure.

Counts were also made of Herring Gulls, although no nest counts were attempted so the estimates are necessarily less reliable than those for the terns. Presence or absence of other nesting seabirds, i.e. procellariiformes, was also noted as well as any other birds, e.g. waders, present but not breeding. This latter exercise was not without interest since the Azores intercepts an unusual number of New World vagrants. During the often lengthy sea voyages between islands, the opportunity was also taken to log seabird, cetacean, and turtle sightings, and to keep a watch out for Monk Seals Monachus monachus. The turtle species involved is the Loggerhead Caretta caretta, yearlings of which drift across to Azorean waters from the Gulf of Mexico (Carr 1987). For a list of bird species seen during the course of the survey, along with their scientific names (these being omitted in the main body of the text), see Appendix 1; for cetacean and turtle sightings, see Appendix 2.

CENSUS RESULTS

The grand total of breeding pairs for the whole survey, along with some indication of the number of colonies on each island, are shown in Table 1. The census yielded 645 pairs of Roseate Terns, 2000 pairs of Common Terns, and 2725 pairs of Herring Gulls. While no special survey of São Miguel was made in 1984, this island (accommodating as it does the Univ. of Azores at Ponta Delgada) was the most familiar of all to G. Le Grand and he was well acquainted with the breeding strength of the terns there in the years immediately preceding. This enabled a reliable estimate of 30 max. pairs of Roseate Terns (in a single colony), 5 colonies of Common Terns totalling 100+ pairs (including 3-5 pairs on Fogo Lake), and 6 Herring Gull colonies totalling 650 pairs. Missing 1984 counts on São Jorge and Corvo were supplied by local sources (see those island accounts for details).

The main concentration of Roseate Terns was found on Flores (270 pairs), followed by Graciosa (110 pairs), then Santa Maria and Faial each with 70 pairs. Corvo was the only island not to support any Roseate Terns, although Common Terns were quite numerous there. Common Terns were most abundant on Flores (440 pairs), followed by Faial (320 pairs), with roughly equal numbers (200-250 pairs) each on Santa Maria, Terceira, Graciosa, and São Jorge. There follows a detailed breakdown of census by island, starting with Santa Maria, the first island visited.

SANTA MARIA

Background information

Santa Maria is the most southerly and easterly (1460km from mainland Europe) of the Azores. Its surface area is c. 97 sq km, and its longest dimensions 18km E-W and 10km N-S. It has a markedly mild climate, with average temperature 12° C (54° F) in winter and 25° C (77° F) in summer. The island is noted for having the most sunshine and least rain in the archipelago. The main settlement of Vila do Porto is situated in the south-west corner of the island, not far from a significant offlier called Ilheu da Vila. Other than this the main concentration of stacks and islets is off the north coast in the Baia de Tagarefe area. The north, east and south coasts of Santa Maria are steeply cliffbound, the west coast less so, though nowehere is there a gently sloping shore.

The island was surveyed anti-clockwise from the south-west corner. A successful landing was made on Ilhéu da Vila, while a major colony (Laghoinas east: see below) on the north coast, located during the circumnavigation, was accessed from land.

Details of colonies (See Map 3)

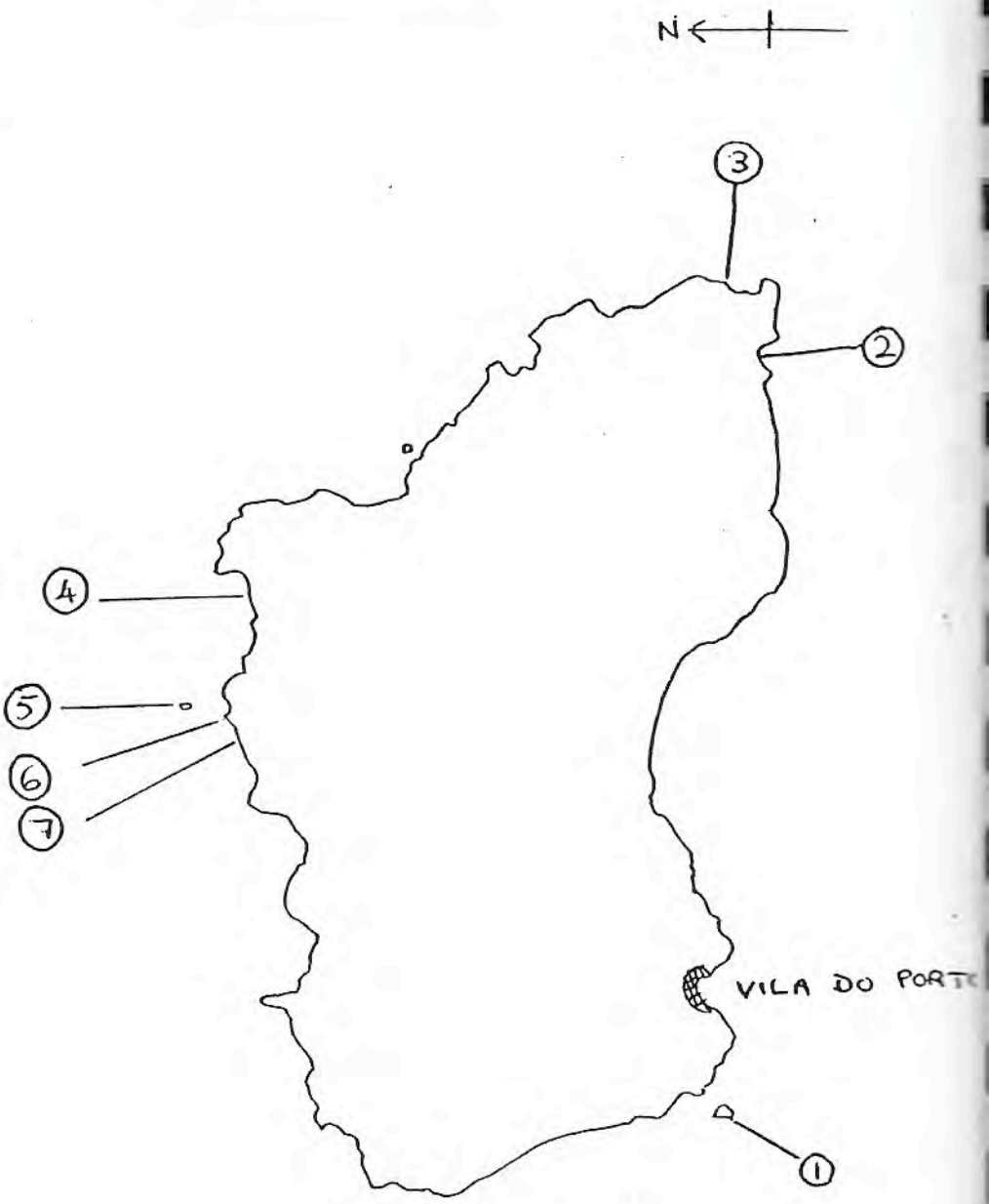
1) Ilhéu da Vila The island perimeter is a cliff mixture of columnar basalt, boulders, and frothy ash. The top supported a rich maritime vegetation, with four identified endemics: Azorina vidalia, Rumex azoricus, Spergularia, and Lotus azoricus. Also thistle and bugloss Echeum plantagineum. A large stepped area of basalt cliff in the south-west corner showed evidence of mass roosting, but the species involved was not clear. G. Le Grand had seen c. 10 pairs of Roseate Terns breeding there in 1980 (?)

Island	Total breeding pairs Roseate Tern		Common Tern		Herring Gull
São Miguel	30 (1)	4.7	100 (5)	5.0	650
Santa Maria	70 (2)	11.0	260 (7)	13.0	90
Terceira	42 (2)	6.5	220 (5)	11.0	430
Graciosa	110 (4)	112 17.4	230 (4)	231 11.5	260
São Jorge	35 (3)	5.4	230 (8)	11.5	560
Faial	70 (1)	11.0	320 (5)	16.0	270
Pico	20 (1)	3.1	110 (6)	112 5.6	250
Flores	270 (10)	263 40.9	440 (18-24)	444 22.0	105
Corvo	0		90 (4)	89 4.4	90
Total	647 (24)	642 100	2000 (62-68)	2,006 100	2705

Table 1: Number of breeding pairs in summer 1984. The number of colonies of 5 or more pairs is shown in brackets for Roseate and Common Terns; for Flores, where some groups were rather dispersed, the range in brackets is min.- max., indicating that numbers of colonies may vary according to the definition of a colony.

69.3

SANTA MARIA



MAP 3

SANTA MARIA: COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect/Ht(m)	
31 May	1	Ilhéu da Vila	630900	Islet	W	20
	2	Pta do Castelo Bay	755890	Cliff stack	S	10-20
1 June	3	Pta do Castelo	767892	Sea stack	E	10-20
	4	Baia do Tagarefe	715980	2 sea stacks	N	10-20
	5	Ilhéu das Laghoinas	698990	Sea stack	E	10-20
2 June	6	Laghoinas (East)	692983	Cliff shore	N	1- 5
1 June	7	Laghoinas (West)	685983*	Cliff stack	N	-

Table 2: Details of colonies identified and surveyed on Santa Maria. The Grid. Ref. marked * is approximate.

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	1	7	0
2	**12**	**40**	0
3	0	20	0
4	0*	60	0
5	0	10	90
6	**56**	**97**	0
7	0	20	0
Total:	69	254	90
Plus remote singletons	70	260	90

Table 3: Number of breeding pairs of terns and gulls on Santa Maria. * = small no. of Roseate Terns present but no count possible. Bold figures are nest counts (landing made). Others are estimates based on flying flock or offshore count of sitting birds.

Colony 1 (Ilhéu da Vila) cont...

1). On our visit, there were few terns and no proof of breeding, though from numbers present one pair of Roseate Terns and seven of Common Terns were thought likely to be breeding. The two Roseates were giving alarm-calls and mobbing a Buzzard (later, Common Terns did likewise in the harbour at Vila do Porto), the Common Terns also performing courtship-flights. Also present on the island were a few scattered burrows of Cory's Shearwater, a small flock of Canaries, and several Rock Pigeons and Starlings nesting on the cliffs. A later ( ) survey of this island suggested in addition a population of 150 pairs of Little Shearwaters and an unknown number of Madeiran Storm Petrels.

2) Bay of Pta do Castelo Typical Roseate nest-sites in this cliff-spur colony were under a rocky ledge, sometimes behind a screen of Festuca). The Twelve (approx.) clutches had apparently been predated quite recently by rats, as indicated by the manner of puncturing and breakage of the shells, and the presence of rat droppings. Rabbits also frequented the colony and one was mildly mobbed while we were there. It was not immediately obvious why the Roseate clutches had succumbed while those of the Common Terns survived. EKD wondered if the the latter had avoided predation by nesting later and in greater strength but GLG pointed out that as a rule Roseate Terns arrive later in the Azores, and thus perhaps start nesting after Common Terns. Another possibility is that the Roseate Terns had abandoned their clutches for some other reason and that the eggs subsequently fell victim to rats.

3-5) Pta do Castelo, Baia de Tagarefe, and Ilhéu das Laghoinas A landing was impossible in any of these sites. Colonies were seen in all three, with birds sitting, and colony size estimates were based on flying flock counts from offshore.

6) Laghoinas (east) The colony was located on the shore of the mainland, at the bottom of a steep vegetated spur c.150m high. The Roseate Terns nested in two fairly compact subcolonies, many nests 1m or less apart. Most nests were under boulders, but quite a few were in the open. The Common Tern nests were all in the open, mostly behind (landwards of) the Roseates on a compact mudstone conglomerate, the remainder mainly on rocky flats below (seawards of) the Roseate Tern colony. Clutch sizes are shown in Table 4 (below).

Santa Maria: Conclusions

Already two potentially important predators have been revealed on Santa Maria: rats (egg losses at colony 2) and cats (droppings at colony 1). In addition, Buzzards are evidently mobbed by both species of terns, though experience elsewhere (Britain) suggests they pose no threat. Rabbits were also seen being mobbed (at colony 2) but are unlikely to be more than a mild disturbance factor. Starlings are known to puncture and eat the contents of tern eggs in some British colonies but whether they do this on the Azores is not known.

A major mixed colony (number 6) was discovered at Ilhéu das Laghoinas (east). Fortunately, access from both land and sea is hazardous (the former involving a precarious scrambling descent), and the colony is thus unlikely to suffer from human disturbance. Ilhéu da Vila, near the principal town Vila do Porto , despite being short of terns in 1984 (perhaps a fluctuating situation judging by previous sightings there),

readily accessible, it might be a suitable candidate for educational purposes. (The island was subsequently designated a nature reseve, but with no regular supervision, and being made available for grazing by goats, little value can as yet be attached to its new gazetted status).

Clutch	Roseate Tern	Common Tern
1 egg	43	30
2 eggs	13	53
3 eggs	0	14
Total	56	97
Mean clutch	1,23	1,83

Table 4: Clutch sizes of terns on Laghoinas (east) (Santa Maria).

Note: Six of the Common tern clutches were 'starring', showing that hatching was imminent. This suggests that many, if not most of the Common Tern clutches may have been complete, lending some confidence to the average clutch of 1,83. No comparable assessment can be made for Roseate Tern clutches. The terns were reasonably tame, settling quickly when we moved off a little way and sat down.

TERCEIRA

Background information

Terceira is the most populated island in the central group. About 400 sq km in area, with maximum dimensions 30km E-W and 18km N-S, it lies 140km north-west of São Miguel and 106km north-east of Faial. Like the other islands, its climate is mild with no great variations in temperature :26° C (79° F) in summer to 11° C (52° F) in winter. The main settlements are Angra do Heroísmo on the south coast and Vila Praia da Vitória in the east. Compared to some of the other main islands, Terceira has a relatively smooth coastline, with few offliers, the only notable exception being Ilhéus das Cabras (2 large islets) off the south coast. The highest point (Caldeira de Sta Barbara) on the mainland is situated in the west and while the terrain slopes quite steeply to the coast in the western half of Terceira, the cliffs are nowhere very high (not more than 25m). The volcanic heights in the west slope gently to the east of the island, resulting there in an even lower and more level coastline (not more than 10m cliffs).

After making landfall at Vila Praia da Vitória, the itinerary was clockwise and completed in two days (6-7 June). Stewart Pritchard and Barbara Smith joined the expedition at Vila Praia da Vitória on 8 June.

Details of colonies (See Map 4)

1) Ilhéu da Mós The island was separated from the mainland by the narrowest (jumpable) gap. The Roseate Tern clutches were in deeply pitted crusty lava rock, the Common Terns generally higher up, i.e. more on top of the rocks than in hollows. Rat bones were found on the island, suggesting a possible cause of the nest losses found. Clutch and brood sizes were as follows:

Clutch/Brood	Roseate Tern	Common Tern
1 egg	5	2
2 eggs	2	4
3 eggs	0	3
1 chick 1 egg	1	0
1 chick	1	0
Total	9	9

Table 5: Clutch and brood sizes of terns on Ilheu da Mós (Terceira). Roseate Tern total is 4 less than in Table 8 because 2 single young were ringed (from unknown nests) and 2 clutches were found destroyed. The Common Tern total is 1 less because a single egg found abandoned is not included here.

TERCEIRA

N

MAP 4

TERCEIRA: COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect/Ht(m)
6 June	1	Ilhéu da Mós	MH935780	Inshore islet	SE <10m
	2	Ilhéu das Cabras (E)	MH873763	Offshore islet	N <20m
	3	Ilhéu das Cabras (W)	MH873763	Offshore islet	- <20m
	4	Monte Brasil	MH800768	Cliff	S 10-20m
7 June	5	Ponta do Queimado(S)	MH675905	Cliff	SW 20-25m
	6	Ponta do Queimado(N)	MH675910	Cliff	NE 25m
	7	N of Pta do Queimado	*	Cliff	NW -

Table 6: Details of colonies identified and surveyed on Terceira. * = grid. ref. not ascertained but = the first prominent headland north of Ponta do Queimado.

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	**13**	**10**	0
2	**28**	**130**	250
3	0	0	150
4	**0**	**30**	0
5	1	30	0
6	0	20	0
7	0	0	30
Total	42	220	430

Table 7: Number of breeding pairs of terns and gulls on Terceira. Bold figures are nest counts made either from landing or from

2) Ilhéu das Cabras (east)(Cabras grande) A substantial rocky island topped with a Festuca sward. The Roseate Tern nests were on the grassy slopes and rocky ridges; the two main sub-colonies were on rocky spurs, generally higher than the Common Terns. The Roseate Tern sub-colonies were noticeably compact, and averaged 7 pairs (1-13). The Common Tern sub-colonies were larger and more dispersed, average 25.4 pairs (2-49). Mean clutch size of Roseate Terns was 1.28, that of Common Terns 2.08. No Roseate Tern young were seen, and only 3 Common Tern young (brood of 1 and another of 2, not included in Table 8). In addition, 1 Common Tern egg was chipping. On the basis of this small sample, it appears that Common Terns started laying earlier than Roseate Terns on the island.

It was very hot in the colony, and no attempt was therefore made to prolong our stay by measuring clutches; instead every effort was put into finding and counting clutches. It was noticeable that as soon as we left the colony a lot of birds flew to the sea to bathe, then returned to the colony, probably having belly-soaked to cool eggs. Also on the island were 2 Whimbrel, a Turnstone, and a Bridled Tern which was chased off by the Common Terns whenever it tried to land.

Clutch	Roseate Tern	Common Tern
1 egg	20	38
2 eggs	8	42
3 eggs	0	46
4 eggs	0	0
5 eggs	0	1
Total	28	127
Mean clutch	1.28	2.08

Table 8: Clutch sizes of terns on Ilhéu das Cabras (east) (Terceira).

3) Ilhéu das Cabras (west) (Cabras pequeno) No terns seen, no landing made.

4) Cliffs of Monte Brasil (at town of Angra do Heroismo) The Common Terns were distributed in two main subcolonies, the first very compact comprising c. 12 pairs, the second -- further west -- more diffuse and c. 15 pairs. These birds were the first true cliff-nesters we had encountered, occupying ledges, holes etc. on a sheer face.

5) Ponta do Queimado (south) Another diffuse cliff colony, the birds occupying narrow ledges c. 20-25m high. The composition of the flying flock (43 birds, representing all those initially on or near the cliff) indicated c. 30 pairs of Common Terns and 1 pair of Roseate Terns.

6) Ponta do Queimado (north) A similar cliff situation to colony 5 but sufficiently distant from it (15 minutes motoring by yacht) to justify separate colony status. The birds were nesting c. 25 m up on columnar basalt ledges. The flying flock was 25-28 Common Terns indicating a breeding colony of c. 20 pairs.

Terceira: Conclusions

Ilhéu das Cabras (east) held a major mixed colony of Roseate and Common Terns, and, being readily accessible to fishermen, deserves attention as a possible conservation area. There was no sign of rat predation though it seems unlikely the island can have escaped having its complement of the predator. A much smaller mixed colony (Ilhéu da Mós), being closer to shore, did show positive rat presence (dried bones), and the few destroyed clutches may have been attributable to this agency.

Predation by rats or humans may have promoted the interesting cliff-nesting dispersion of Common Terns found at three sites, although the scarcity of suitable offshore islets may have also played a role in this adaptation.

The finding of a Bridled Tern (first record for Azores) on Ilhéu das Cabras underlines the susceptibility of the Azores to harbour vagrants. The mild mobbing of the bird by the resident nesting terns is typical of any unusual visitor in a tern colony. The Bridled Tern was as perhaps more likely to have arrived from the West Indies than from Africa.

GRACIOSA

Background information

Graciosa is the smallest island in the central group, about 62 sq km in area. Although diverse in topography, it is the least mountainous of the Azores, reaching not more than 400m, and, probably in part due to its relatively low relief, is the least humid. The highest cliffs are on the north coast which comprises a plateau with small scattered volcanic cones. The low hills in the centre are flanked to the south by the main caldeira which represents the foremost landscape feature on the island.

After arriving at Santa Cruz from Terceira, 'Gaia Quest' made an anti-clockwise circumnavigation of Graciosa (9-10 June). EKD and GLG were put ashore on the islet of Ilhéu de Baixo and spent the night of 9 June there.

Details of colonies (See Map 5)

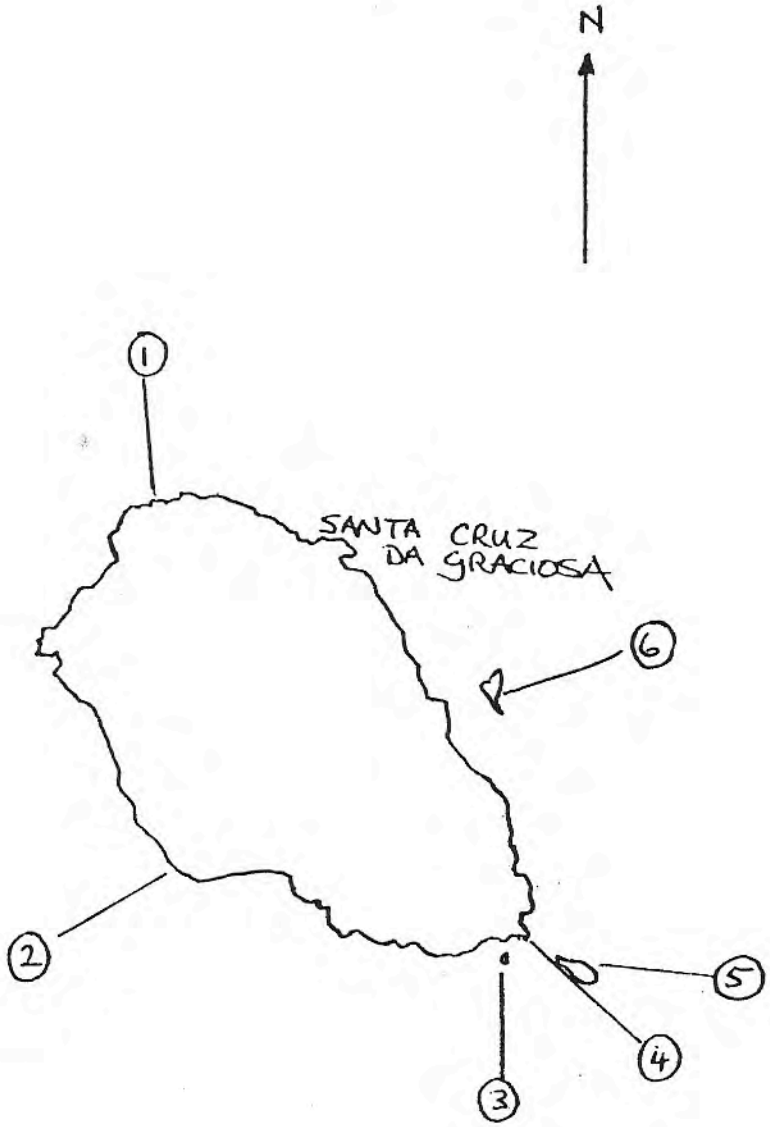
1) Farol da Ponta da Barca A large flock of feeding terns, mostly Roseates, led us to this colony on a steep stack just off shore from the lighthouse at Negro on the north coast of Graciosa. The stack consisted of hard ash encrusting a basalt base, and proved impossible to climb (though would be feasible with a rope). On the basis of c. 150 flying birds, we estimated c. 50 pairs each of Roseate and Common Terns. The Roseate Terns were nesting in 2 subcolonies, one on each (east and west) flank of the stack ridge. A few (not more than 3) young (c. 1-3 days) of both species were found dead. One Roseate chick c. 1 week old was ringed.

2) Ponta Branca This was a mixed colony on a talus slope beneath a cliff. The Roseate Terns nested in the open or under rocks while some of the Common Terns were on cliff ledges up to c. 25m. There were also numerous Cory's Shearwaters and lizards in the colony. The tern nests were partly predated, making it hard to distinguish unused scrapes from those that had lost eggs or chicks. Some small chicks found dead appeared to have stab wounds, perhaps inflicted by conspecifics.

Clutch/Brood	Roseate Tern	Common Tern
1 egg	5	6
2 eggs	1	15
3 eggs	0	5
1 chick	1	3
2 chicks	0	1
Total	7	30

Table 9: Clutch and brood sizes of terns at Ponta Branca colony (Graciosa).

GRACIOSA



GRACIOSA: COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect/Ht(m)
9 June	1	Farol da Ponta da Barca	MJ093280	Stack	N 30-50
	2	Ponta Branca	MJ104202	Cliff talus	SW 0-25
	3	Ponta da Restinga(west)	MJ171183	Stack/islet	W 5-15
	4	Ponta da Restinga(east)	MJ176185	Cliff spur	? 15
9-10 June	5	Ilhéu de Baixo	MJ185182	Large island	70
10 June	6	Ilhéu da Praia	-	Island off Praia	10

Table 10: Details of colonies identified and surveyed on Graciosa.

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	50	50	0
2	**10**	**50**	0
3	**12**	**53**	0
4	**40**	**75**	0
5	**0**	**3**	250
6	**0**	**0**	0
Total	112	231	250

Table 11: Number of breeding pairs of terns and gulls on Terceira. Bold figures are nest counts made after a landing, others estimated. The totals for colony 4 are rounded up from 35 (Roseate) and 67 (Common) (to allow for predation, etc.)

3) Ponta da Restinga (west) stack The colony occupied the level 5-15m on a conical stack c. 15m high. Ten Roseate Tern chicks were ringed and 17 Common Tern chicks. There were several dead Common Tern young, and also many broken eggs, suggesting human interference. No detailed breakdown of clutch/brood sizes was made.

4) Ponta da Restinga (east) promontory The colony, on a rocky spur c. 15 m high, comprised 2 main sub-colonies on the pitted ashy summit ridge, and a smaller one to the east of these. The three sub-colonies are combined in Table 12:

Clutch/Brood	Roseate Tern	Common Tern
1 egg	10	17
2 eggs	4	17
3 eggs	0	7
1 chick	15	5
2 chicks	3	7
3 chicks	0	1
Total	32	54
Mean clutch	1,29	1,76

Table 12: Clutch and brood sizes of terns at Ponta da Restinga (east) (Graciosa). The totals exclude 4 isolated Common Tern clutches and 1 of Roseate Tern, also some dead chicks and destroyed clutches (see below).

Many of the Common Tern young were abandoned and several of the recently hatched ones showed clear signs of starvation. Three Roseate chicks and 7 Common chicks found dead also appeared to have been underfed. According to GLG, the island is frequented by fishermen, so it was not possible to separate possible effects of interference (on feeding rate) from real food shortage. There were also signs of rat predation on 6 Common Tern clutches though the effects seemed to be quite local. The Roseate Tern young varied greatly in age (the 21 ringed ranged from c. 1-18 days old) whereas the Common Tern young were more synchronized (18 ringed all c. 1-7 days).

5) Ilhéu de Baixo Although only 3 pairs of Common Terns were found breeding other features of great interest were discovered. The island is substantial (c. 25ha) and rises steeply to a plateau. The structure is a base of basalt, fragmented into blocks interspersed with lava bombs at the edge, and surmounted by a layer, thick in places, of friable ash. Azorina and to a lesser extent Spergularia were widespread, also a few cushions of a flowering plant resembling forget-me-not (Myosotis). On the tussocky top was a large colony of Herring Gulls, and Cory's Shearwaters were numerous, along with Rock Pigeons, Starlings, and Grey Wagtails. A Grey Heron was also seen.

While searching an area of talus above a deep cove, GLG found an incubating Madeiran Storm Petrel. Both bird and egg were photographed. This provided the first confirmation of breeding by this species on the Azores. As darkness fell, numbers of petrels circled the cove, calling (recorded on tape). Nest-calls led us to several burrows from which 6 birds were retrieved for inspection and measurement (see Appendix 3); sometimes the egg was visible in the burrow. Tail moult was in progress and lots of freshly discarded feathers were found.

In addition, the shore was littered with the remains (chiefly wings) of over 50 Madeiran Storm Petrels, as well as the wings of Little Shearwaters (long suspected of breeding on the island) and a few Common Terns. The remains were carefully searched for Bulwer's Petrel but none were found. While some of the remains were evidently gull regurgitations, the vast majority were the result of fishermen hunting the birds for bait.

6) Ilhéu da Praia No terns were found, but 4 Whimbrel were roosting.

Graciosa:Conclusions

Ilhéu de Baixo is evidently a breeding station of special importance for procellariiformes. As such, the signs of heavy hunting pressure are a cause for concern. The island is uninhabited and relatively remote, and protection measures would be difficult to enforce, but nevertheless it is one of the most deserving cases for some form of surveillance and management. In 1980, GLG recommended that the islands of Praia, Restinga, and Baixo should form a natural integrated reserve, representing as they do breeding sites of certain seabirds not then known to breed elsewhere on the Azores.

FAIAL

Background information

Faial, belonging to the central group, is a pentagonal island of 172 sq km (22 km east-west, 15 km north-south). In the centre is the extinct volcano Cabeco Gordo, 1043 m high, featuring a dramatic caldeira c. 2 km across and 400 m deep, which is a haven (and nature reserve) for luxuriant vegetation. The western extremity of the island is marked by a volcano of much more recent origin; its eruption from the seabed close to the coast in 1957-8 smothered a considerable area of the hinterland with ash, and created a new cliffline which remains highly erosive and unstable.

On 11 June, 'Gaia Quest' sailed from Praia (Graciosa) to Horta (Faial), but on the following day it was decided to embark directly for Flores with the intention of censusing Faial later on. Thus on 18 June, after having surveyed both Flores and Corvo (see pp. and), we returned to Faial, reaching Horta again on 19 June. The Faial colonies were then surveyed by inflatable operating out of Horta.

Details of colonies (See Map 6)

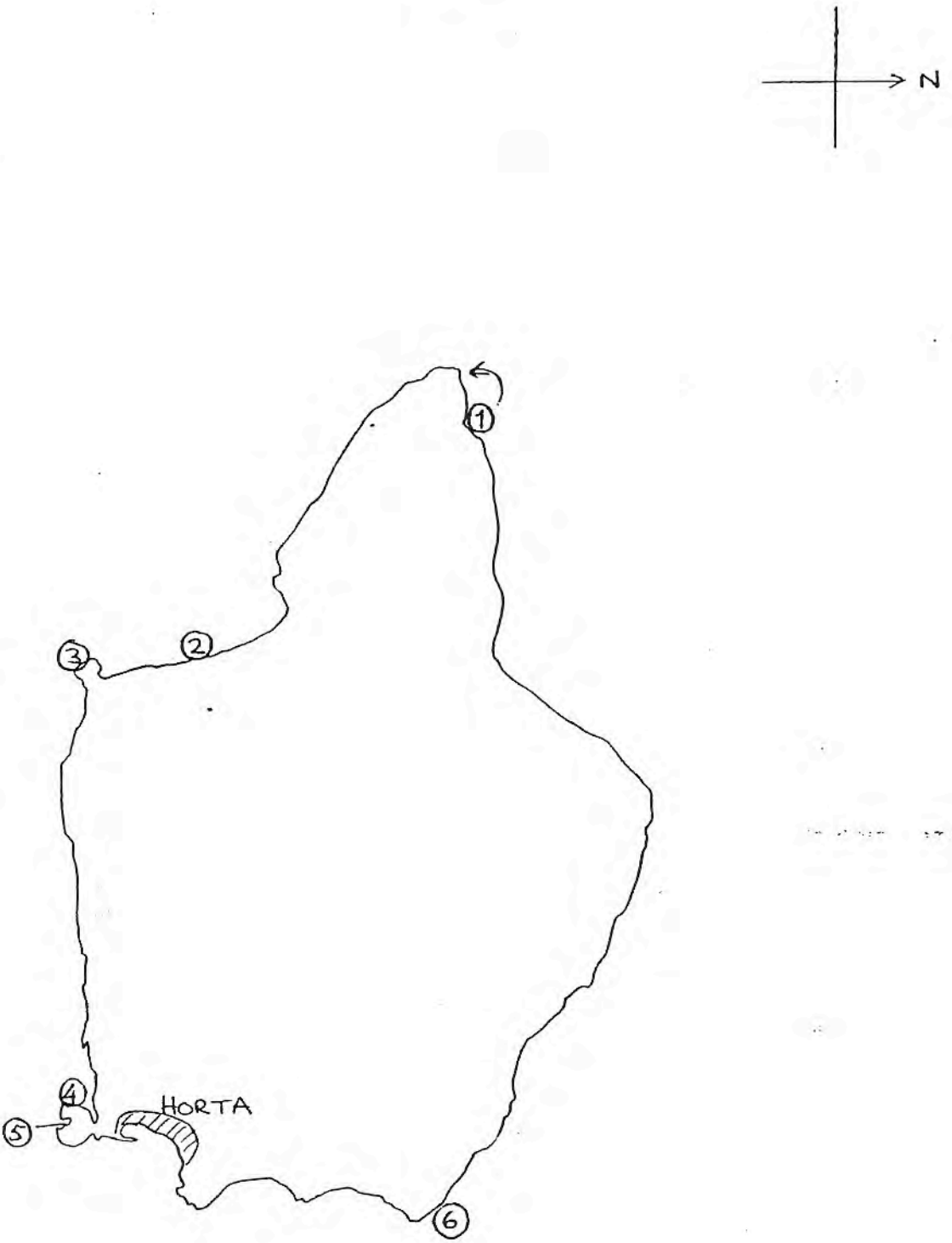
1) Ponta dos Capelhinos This was a substantial Common Tern colony on a boulder beach at the foot of a steep ashy slope thrown up by the 1957-8 eruption. A successful landing was made on 1 July. In the colony area the boulders were more dispersed and most of the nests were on the black lava sand between stones. In addition, up to 20 Common Terns were nesting in a cave at the west end of the cliff. We found 61 clutches (14@1 egg, 29@2, 2!@3; 3 of the latter partly hatched). Since several of the clutches of 1 were abandoned, the calculated average clutch of 2.1 is only an indication. Another 3 clutches were partially hatched. In addition, 94 young were ringed, ranging from 1 day to near-fledging; an estimated two-thirds fell in the age range 10-28 days. If we: (a) estimate that these 94 young represent the production of c. 50 nests, (b) discount the (mostly failed) single-egg clutches, and (c) assume that in the relatively difficult terrain several other nests/young were missed, it is reasonable to suppose that the colony comprised c. 120 pairs. In addition to the Common Terns, 3 Roseate Terns were flying with the flock, but no nests were found and it is not known if they were breeding.

2) Baia do Varadouro A colony of 150+ pairs of Herring Gulls was seen during the south coast survey by inflatable on 22 June. No terns were spotted from offshore (even though close in) and no landing was attempted.

3) Ponta de Castelo Branco Twenty pairs of Common Terns occupied ledges c. 20-30m up this 150m- cliff. In addition, 20 pairs of Herring Gulls were counted from inflatable close inshore.

4) Porto Pim Bay (Monte da Guia) A colony of c. 20 pairs of Common Terns, most (15 pairs) on broad compacted ash-sand ledges c. 7-8m high, the rest on the adjacent steep rocky cliff. Only 10 of the (lower) nests were accessible, 9 containing eggs (1@1 egg, 4@2, 3@3, 1@4), another a recently hatched brood of 2. In addition 3 well-grown singletons (1@2 wks, 2@3 wks) were mobile on the ledges but 2 were caught for ringing. One of the adults was in portlandica (i.e. 2nd Summer) plumage.

FAIAL



MAP 6

FAIAL: COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect	Ht(m)
22 June 1 July	1	Ponta dos Capelhinos	LH417744	Boulder Beach	W	<5
22 June	2	Baia do Varadouro	-	-	S	
	3	Ponta de Castelo Branco	LH468655	Cliff ledges	S	20-30
	4	Porto Pim, Mte da Guia	LH573656	Cliff ledges	N	20-25
	5	Caldeira do Inferno Mte da Guia	LH579652	Ash slope	SW	<15
21,23 June 2 July	6	Farol da Ribeirinha	LH605732	Cliff/Talus	E	5-20

Table 13: Details of colonies identified and surveyed on Faial.

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	**0**	**120**	100
2	0	0	150+
3	0	20	20
4	**0**	**20**	0
5	**0**	**40**	*
6	**70**	**120**	0
Total	70	320	270+

Table 14: Number of breeding pairs of terns and gulls on Faial. Bold figures are colonies at which a landing was made and nests counted directly although an accurate count of Common Terns was not possible at colonies 4 and 5. Also, a small colony of gulls (*) was seen at site 5 but not counted.

5) Caldeira do Inferno (Monte da Guia) A nature reserve, comprising an amphitheatre (of 30-40° slope) of yellow sandy volcanic ash, mostly solid but quite friable under foot-pressure, with scattered Festuca. Our entry was from the sea via a channel to the inner lagoon, but harder access is possible from the Erica(etc.)-clad slopes above. On our arrival a flock of c. 50 Common Terns was flying; 28 nests were counted (1@1 egg, 2@8,7@3 = ave. clutch 1.8) and others were inaccessible on high ledges, leading to an estimated total of 40 pairs. In addition, 3 young chicks were found dead, 3 others of a week or less ringed, and 4 others (3-4 weeks old) seen but not safely accessible for ringing.

6) Farol da Ribeirinha First discovered on 12 June en route from Faial to Flores, EKD reconnoitred this major mixed Roseate-Common colony from land on 21 June. The colony itself was not visible from the cliff-top. On 23 June, EKD, accompanied by CG and BS, made a difficult landing by inflatable (from Horta) on the exposed boulder beach. The colony, as seen from the sea, was complex, with mixed sub-colonies at 3 levels, the upper 2 (B and C) on mainly grassy ash platforms created by cliff falls, the lowest (A) in talus just above sea level. In the highest (20m) sub-colony (C), the Roseate Tern nests were densely aggregated c. 1-2m apart (scrapes separated by Festuca tussocks and rocks) along the sea edge of the platform, while the Common Terns nested on the slope behind (i.e. landward) of the Roseates. On the beach (sub-colony C), there was lateral separation of the Roseate and Common Terns, each tending to form a discrete grouping. The Roseate Tern colony (i.e. sum of sub-colonies) was estimated at 70 pairs, the Common Terns at 120 pairs. The flying flock over the colony (total both species) was c. 260 birds. The average size of viable clutches was 1.04 (n=48) for Roseate Terns, and 1.79 (n=77) for Common Terns. Twelve live Roseate young ranged evenly in age from c. 1-21 days, 22 Common Tern young from c. 1-28 days. In Table 15, sub-colonies are combined:

Clutch/Brood		Roseate Tern	Common Tern
1 egg	:deserted/damaged	13	14
	:viable	46	30
2 eggs	:deserted/damaged	0	5
	:viable	2	33
3 eggs	:deserted/damaged	-	1
	:viable	-	14
1 chick	:dead	8	18
	:alive	10	18
2 chicks	:dead	0	0
	:alive	1	1
2 eggs, 1 chick		-	2

Table 15 : Clutch and brood sizes of terns at Farol da Ribeirinha (Faial).

There is strong evidence here, as in some previous colonies, of widespread failure of both eggs and small young (all dead were <3 days), affecting both species, and suggestive of food shortage. The situation may be summarised as follows: In Roseate Terns, 21.3% of 61 clutches had failed and 40% of 20 young were found dead; in Common Terns, the proportions were 20.6% (n = 97 clutches) and 45% (n = 40 young), respectively. One of the Common Tern day-old chicks was exceptionally light (12g). Two 3-day-old chicks (1 Common, 1 Roseate) were infested with ants. In addition, several unsuitable fish prey were found discarded in the colony (often indicates food shortage) and 2 Common Terns were seen harrying a fish-bearing Roseate. Breeding failure may have induced widespread re-laying and asynchrony, a suggestion reinforced by the broad spread of chick ages from hatching to near-fledged; also, the large number of Roseate 1-egg clutches in sub-colony C (a bias also apparent in Common Terns) may indicate that this was a recently started re-laying group. The colony was re-visited 9 days later (2 July); although several Roseate clutches were then chipping, most had still not hatched, lending further support to the belief that many clutches were re-lays. This hatching distribution means that many of these Roseate young cannot have fledged until the 1st week of August at the earliest. To put this in perspective, a Roseate Tern juvenile was seen with its parent in Horta harbour on 24 June, and others were fledged on Flores on 14 June, indicating probably a 2-month spread of laying. Of Roseate Tern young, 8 were ringed on 23 June and 5 on 2 July, while the totals for Common Terns were 15 and 6 respectively.

Faial: Conclusions

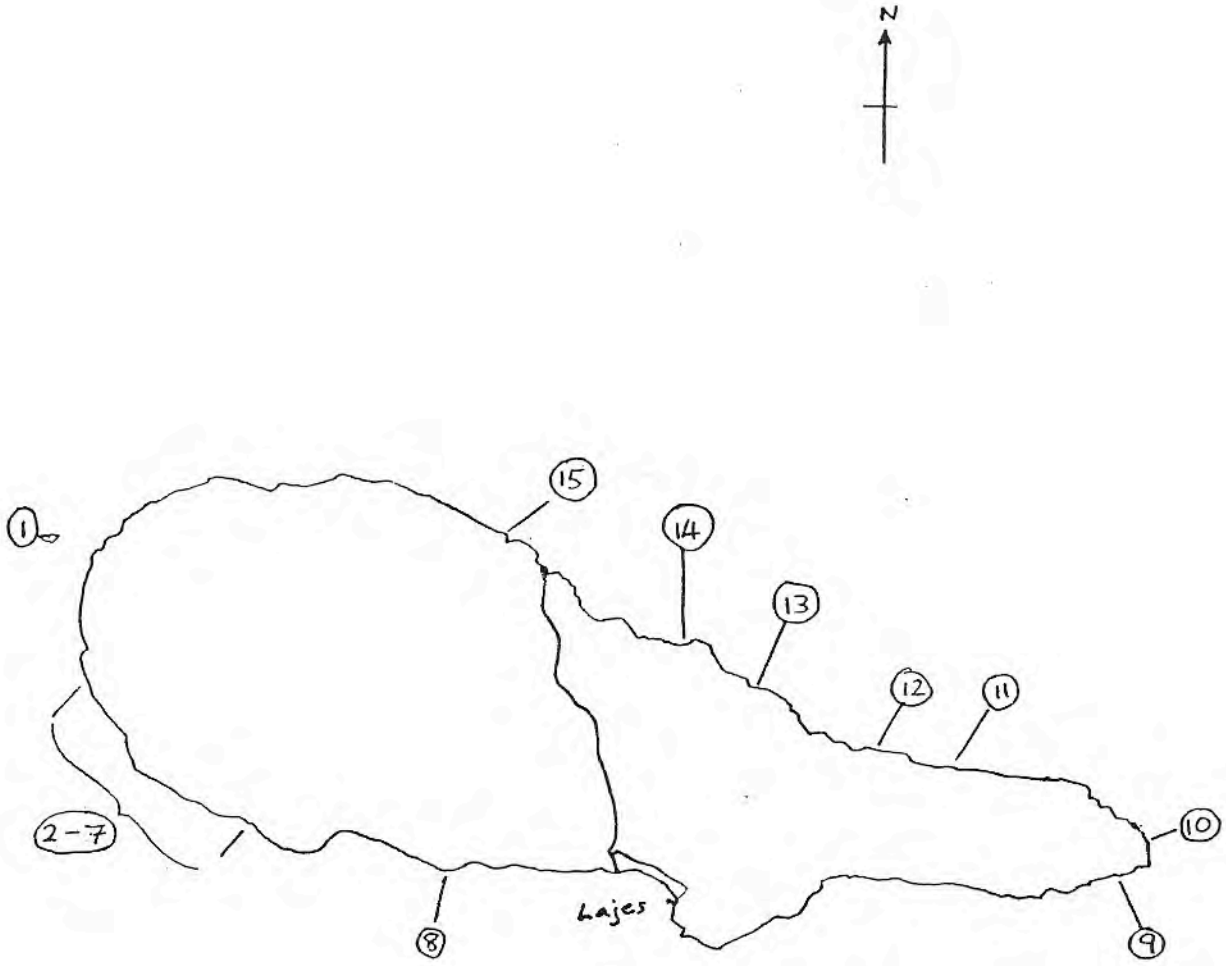
Farol da Ribeirinha is the most important colony on Faial and one of the biggest in the Azores. Access is impossible from land and hazardous from the sea, and as such the colony enjoys natural protection.

PICO

Background information Pico, so named after its remarkable central volcanic peak (2351m), is one of the central group, 8km from Faial and 18km from São Jorge, and is the second largest island in the Azores. Pico is 48km long (roughly east-west) and 15km wide (north-south), giving a total surface area of 433 sq km. The central area comprises a long chain of craters continuing those of Faial. The coastal area varies according to whether this central range slopes directly into the sea or levels out into small coastal plains (fajãs), e.g. the south coast is precipitous in the east but has a gentler aspect towards the west. From the viewpoint of potential breeding sites for seabirds it is noteworthy that the coastline, while sheer in places, is nowhere deeply indented or fractured, so there are few islets or stacks of the kind found, e.g., on Flores. From another point of view, Pico holds special ornithological interest: the broad bay at Lajes with its shallow littoral zone and rocky foreshore, and importantly its westerly aspect to the open Atlantic and the Americas, is a significant catchment area for Nearctic vagrants.

With continuing engine problems on 'Gaia Quest' it was decided to proceed with the survey of Pico by inflatable. The strategy was to have a shore team, as back-up and relief, tracking the survey team on its (anti-clockwise) circumnavigation from Madalena (north-west corner of Pico), the two teams making a rendez-vous at prearranged campsites for the night.

PICO



MAP 7

SAO JORGE; COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect	Ht(m)
5 July	1	Pico dos Cutelos	LH870892	Boulder beach	S	<5
	2	Pico da Baleia	LH872888	Boulder beach	S	<5
	3	Morro do Lemos	LH928838	Cliff ledges	W	10
	4	Morro Grande	c.1km E of (3)	-	W	-
6 July	5	Fajã do Cardoso	MH265662	Cliff/beach	S	2-10
	6	Ilhéu do Topo	MH353672	Grassy islet	-	<10
	7	Ponta das Vinhas	MH308693	Cliff base	N	-
	8	Fajã do Nortezinho	c.2.8km W of (7)	-	N	-
	9	Fajã dos Cubres	-	-	N	-
	10	Fajã Isabel Pereira	MH093811	Rocky spur	N	10-12
	11	Farol da Rosais	<1km E of lighthouse	-	N	-

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	0	25	0
2	5	20	0
3	0	**15**	0
4	0	0	45
5	0	25	35
6	20	50	300
7	0	20	0
8	0	0	30
9	10	40	0
10	0	35	0
11	0	0	150
Total	35	230	560

Table 18 (top); Colony details. Table 19 (bottom); Colony counts (pairs). Bold figure is a fairly accurate nest count, others extrapolated.

SÃO JORGE

Background information

São Jorge is in the middle of the central-island group of the Azores. In clockwise order from the north are Graciosa (32km N), Terceira (60km NE), Pico (20km S) and Faial (30km SW). All four islands can be seen on a clear day from Pico da Esparança, the highest mountain (1053m) on São Jorge. São Jorge is a long (53km) narrow (6-8km) island running NW-SE along its long axis; the surface area is 246 sq km. A central plateau, containing Pico da Esparança with its three volcanic caldeiras, contrasts with the coastal plains which meet the sea in often high cliffs. The cliffs on the north coast are noted for their dense luxuriant vegetation and bays, often harbouring waterfalls. However, like Pico, the coastline of São Jorge is relatively little indented, and there is only one significant outlier: Ilhéu do Topo off the easternmosat headland. Accordingly, a substantial presence of Roseate Terns was not anticipated.

After the second visit to the Ribeirinha colony on Faial (see p.) on 2nd July, 3 days elapsed, during which 'Gaia Quest' remained under repair, before alternative arrangements could be made, in the shape of the loaned trimaran 'Tripple Trapple', to survey São Jorge. CG and SP thus left Horta on the morning of 5 July, reaching São Jorge that same evening and anchoring at Velas a short way along the south coast. The general itinerary was to survey, by inflatable, the south coast from west to east, then the north coast from east to west, and thence back to Horta (Faial).

Details of colonies (See Map 8)

1) Pico dos Cutelos The boulder beach was at the base of a cliff less than 20m from the sea. Estimated colony size based on offshore count was 25 pairs of Common Terns.

2) Pico da Baleia The site description was the same as for (1)(above). Estimated c. 5 Roseate terns and c. 20 Common Terns based on offshore count of c. 35 birds in mixed flying flock.

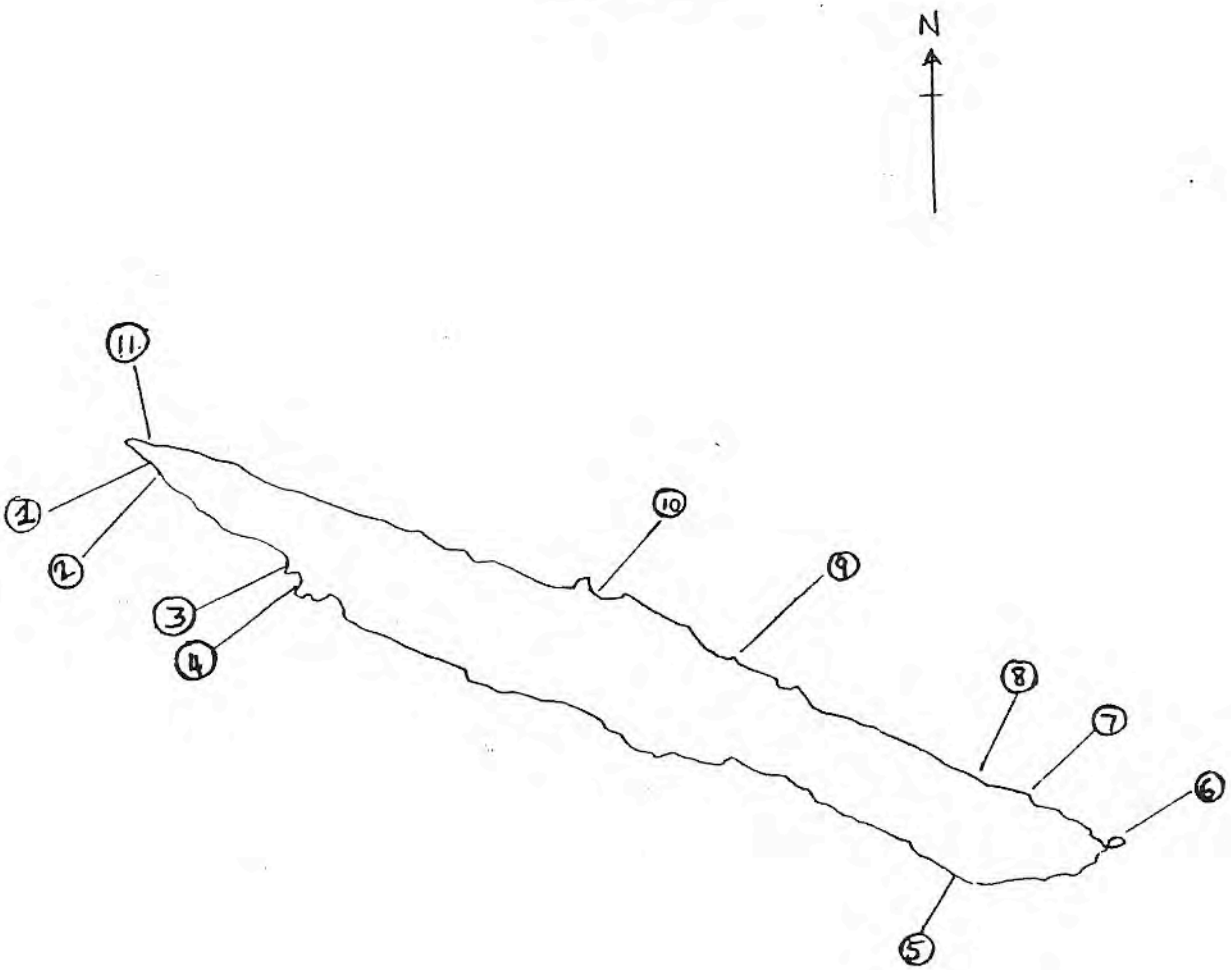
3) Morro do Lemos Fourteen Common Terns were seen from offshore to be nesting on cliff ledges, yielding a colony estimate of 15 pairs.

4) Morro Grande No terns but c. 45 pairs of Herring Gulls.

5) Faiã do Cardoso The site combined a boulder beach and cliff ledges. Estimated colony size 25 pairs Common Terns based on flying flock of 35, including at least 1 strong-flying juvenile. GLG could find no evidence of this colony in 1985.

6) Ilhéu do Topo Though the swell prevented landing, the colony was disturbed at one point, giving a flying flock count of c. 90 mixed terns in which Common Terns apparently predominated; from this the colony was tentatively put at c. 50 pairs Common Terns and c. 20 pairs Roseate Terns. The edge of the island was rocky, but the centre was cattle-grazed turf, over which was spread a large gull colony estimated at c. 300 pairs.

SÃO JORGE



MAP 8

SÃO JORGE: COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect	Ht(m)
5 July	1	Pico dos Cutelos	LH870892	Boulder beach	S	<5
	2	Pico da Baleia	LH872888	Boulder beach	S	<5
	3	Morro do Lemos	LH928838	Cliff ledges	W	10
	4	Morro Grande	c.1km E of (3)	-	W	-
6 July	5	Fajã do Cardoso	MH265662	Cliff/beach	S	2-10
	6	Ilhéu do Topo	MH353672	Grassy islet	-	<10
	7	Ponta das Vinhas	MH308693	Cliff base	N	-
	8	Fajã do Nortezinho	c.2.8km W of (7)	-	N	-
	9	Fajã dos Cubres	-	-	N	-
	10	Fajã Isabel Pereira	MH093811	Rocky spur	N	10-12
	11	Farol da Rosais	<1km E of lighthouse	-	N	-

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	0	25	0
2	5	20	0
3	0	**15**	0
4	0	0	45
5	0	25	35
6	20	50	300
7	0	20	0
8	0	0	30
9	10	40	0
10	0	35	0
11	0	0	150
Total	35	230	560

Table 18 (top): Colony details. Table 19 (bottom): Colony counts (pairs). Bold figure is a fairly accurate nest count, others extrapolated.

7) Ponta das Vinhas Based on an offshore count, this colony on an ash slope at the base of a cliff was estimated at 20 pairs of Common Terns. The nearest place-name of this site is Faj~a dos Cubres but this name has been avoided here to prevent confusion with a colony (see 9, below) of the same name c. 13km further west along the north coast.

8) Faiã do Nortezinho No terns but a gull colony of c. 30 pairs.

9) Faiã do Cubres This colony on a lagoon separated from the sea by a boulder-bank was evidently not visible from inflatable, and was missed. However, GLG received information in late July that the colony held 50-60 pairs of terns, including apparently some Roseates, so we have tentatively allocated 10 pairs of Roseate Terns and 40 of Common Terns to this colony.

10) Faiã Isabel Pereira 25+ Common Terns were seen from offshore nesting on a rocky spur, yielding a colony estimate of 35 pairs.

11) Farol da Rosais The actual site (not described) was less than 1km east of the Farol (lighthouse). There were no terns, but c. 150 Herring Gulls.

São Jorge: Conclusions

As anticipated, São Jorge's coastal topography, being similar to Pico's, yielded a similar distribution of terns, notably a marked paucity of Roseate Terns. There was a site difference from Pico, however, in that more of the colonies on São Jorge were on boulder beaches than on cliff ledges. Of special interest on São Jorge was the marked concentration of tern colonies at the east and west extremities of the island. Indeed all the colonies except two (Faiã Isabel Pereira, and the lake colony at Faiã dos Cubres not visited) were not more than 11km from their nearest headlands. At the western end, this belt of colonies was concentrated on the south coast, while at the eastern end no such bias was apparent. One possible reason for this distribution on São Jorge is the northerly current which prevails in the Azores. Since São Jorge lies roughly along an east-west axis, there is probably a scouring effect at its extremities. None of the other islands show such a strikingly polarised dispersion of colonies although it is clear that the biggest colonies elsewhere are on local headlands or skerries where strong currents must prevail. The implicit biological connection is that such currents are frequently favoured by shoaling fish which in turn benefit the terns. Finally for São Jorge, the sighting of a Willet on Ilhéu do Topo was only the second record of this North American wader for the Azores.

FLORES

Background information

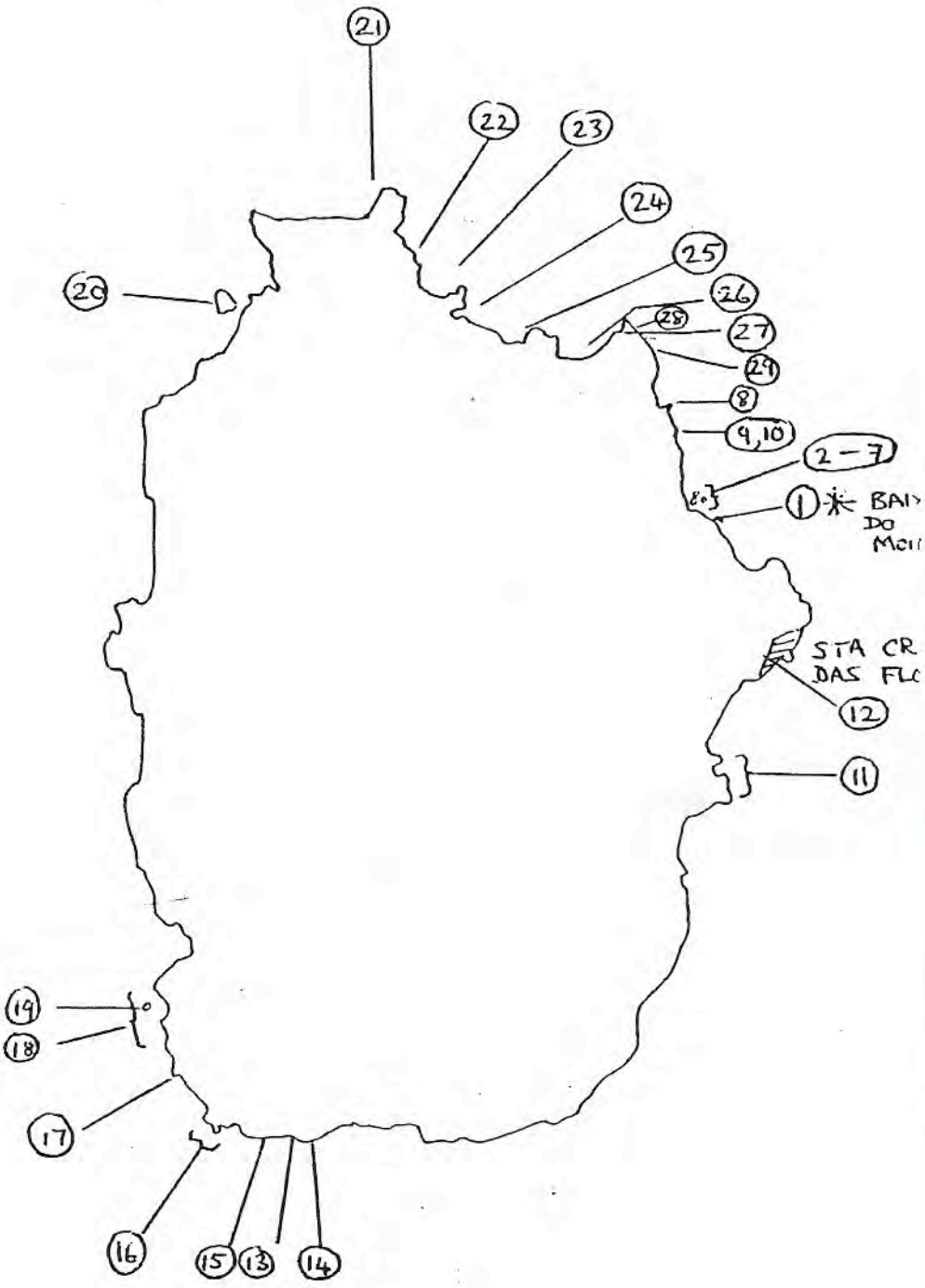
Flores is the westernmost island, not only in the Azores but also in Europe and the west Palearctic region; it is situated c. 220km from the central Azores group and 3750km from the North American mainland. With a land area of 143 sq km, Flores is probably the most beautiful of all the Azores taking its name from a luxuriant vegetation and abundance of flowers. The island is dominated by a central plateau (c. 600m a.s.l.) which acts as a catchment for the high rainfall generated by the Gulf Stream depression track, and which provides an aquifer for the rest of the island. The high rainfall also feeds two groups of lakes in the centre and southern plateau area. The coast is rugged, with deep ravines, stacks and caves. On the west coast, waterfalls cascade from the plateau on to a narrow coastal strip. Especially spectacular cliff scenery graces the southern coast, while the north and east coasts are deeply indented and, with a gentler slope to the plateau, support most of the human habitation. Flores has no Robins, Wood Pigeons or Buzzards but does, however, support Mallard (see also below for new records).

En route to Flores from Faial (12-13 June) we first encountered Roseate Terns c. 20-22 naut. miles south-east of Flores. After mooring just north of Santa Cruz das Flores on 13 June, we censused the coast either side of Sta Cruz on 14 June (north to Cedros, south to Caveira); on the 15th, from Caveira round he south coast as far as Mosteiro (see Map 10); there the inflatable was beached for the night, and re-launched the next day to complete the circumnavigation round the west and north coast. Soon after arrival in Sta Cruz, our sightings of 2 House Sparrows were apparently the first confirmed sightings for the island. Also near Sta Cruz, on 16 June, EKD saw a Little Tern Sterna albifrons -- the 1st record for the Azores.

Details of colonies (See Maps 9 and 10)

1) Baixa do Moinho (Sta Cruz) This was by far the biggest colony of Roseate Terns (no Common Terns) on the entire survey, with an estimated 12[illegible] nests and flying young. The colony was on an easily accessible islet close inshore near Lagoa, north of the capital (Sta Cruz) of Flores on the east coast. The islet had a rocky apron and a number of eroded stacks (up to 15 high) vegetated with Festuca. The colony was divided into 3 or possibly 4 subcolonies as shown in Table 19. In addition to the clutches and broods listed, we found 3 dead chicks, 3 abandoned clutches, and 2 fledged young. The spread of laying was considerable: apart from unhatched clutches, young ranged in age from newly hatched to free-flying juveniles. (For discussion of laying dates, see final conclusions for Flores, below). Forty-two young, mostly up to 2 weeks old, were ringed.

FLORES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MAP 9

FLORES: COLONY AND CENSUS DETAILS

Date	Colony	Name	Grid Ref.	Descr.	Aspect	Ht(m)
14 June	1	Baixo do Moinho	FD604707	Rocky islet	E	5-15
	2	Porto da Lagoa; S. Stack	FD598709	Stack	NE	12
	3	Porto da Lagoa; Centre Stk.	FD599709	Stack	NE	22
	4	Porto da Lagoa; NE Stack	FD599710	Stack	NE	15
	5	Porto da Lagoa; NW Stack	FD598711	Stack	NE	40
	6	Porto da Lagoa; Cliff	FD602707	Islet cliff	NE	55
	7	Porto da Lagoa; Stack	-	Stack	-	72
	8	Islet of Cedros	FD597720	Islet	E	28
	9	Ilhéu Garajau	-	Island	-	-
	10	Bay N of Cedros(Ribeira da Privada)	FD594723	Cliff	SE	-
	11	Ponta da Furnão Jorge south to Ponta da Caveira	FD605660	1.5km coast	E	15
15 June	12	Sta Cruz Observatório	FD614681	Steep stack	E	10-15
	13	Ponta da Rocha Alta (W)	FD528596	Boulder beach	S	1-3
	14	Ponta da Rocha Alta (E)	FD529596	Boulder beach	S	1-3
	15	Formigas	FD523597	Cliff stack	S	-
	16	Ponta dos Ilhéus	FD510598	Islet group	SW	-
	17	Rocha do Pico	FD511603	Islet	SW	-
	18	Rocha do Pico, North to Mosteiro	FD506607 -FD504612	Cliff/islets	SW	-
	19	Ilhéu do Cartário	FD501620	Islet	SW	-
16 June	20	Ilhéu de Maria Vaz	-	Islet	NW	-
	21	João Martins/Ilhéu Franscisco	FD539764	Islet	-	-
	22	Ponta Delgada	FD548754	Stack	-	-
	23	Pta Delgada Bay -Pta do Ilhéu	FD550747	1km Cliff	NE	-
	24	Pta do Ilhéu - Ilhéu dos Abrões (Cabouco Bay)	FD555743	0.5km Cliff	NE	-
	25	Ilhéu dos Abrões - Pta das Barrosas	FD566737	Cliff	N	-
	26	Ilhéu da Muda	FD582741	Islet	-	-
	27	Pta Ruiva West	FD585742	Cliff	NW	-
	28	Baixa Rasa (Pta Ruiva East)	FD587742	Cliff	NE	-
	29	Baixa Rasa islet	FD588741	Steep islet	-	-

Table 20; Details of colonies identified and surveyed on Flores.

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	**126**	0	0
2	0	**16**	0
3	**9**	**50**	0
4	**7**	**3**	0
5	**1**	**23**	0
6	0	20*	0
7	0	5	0
8	0	0	50
9	0	3	0
10	0	10	0
11	15†	25†	0
12	0	3	0
13	**5**	**30**	0
14	**5**	**50**	0
15	0	5	0
16	10	20†	0
17	5	0	0
18	10	20†	0
19	0	5	10
20	0	0	40
21	0	**60**	0
22	20	5	0
23	0	32†	0
24	0	12†	0
25	0	13†	0
26	0	1	5
27	0	7	0
28	0	16	0
29	**50**	**10**	0
Total:	263	444	105

Table 21: Number of breeding pairs of terns and gulls on Flores.

Bold figures are nest counts (landing made).

* = Visited but total count not possible.

† = Summed figures for dispersed small colonies (see text for numbers comprising the sum).

Note: For Common Terns, with the addition of the substantial colony (c. 20-30 pairs) on Caldeira Funda lake, Flores total may be c. 470 pairs, perhaps nearer 500 pairs if there are 20 pairs on the west coast below Rocha dos Bordões.

Clutch/Brood	Subcolony A	B	C	Totals
1 egg	21	20	21	62
2 eggs	3	4	7	14
1 egg/1 chick		1		1
1 chick	12	17	14	43
2 chicks		2	1	3
Totals	36	44	43	123

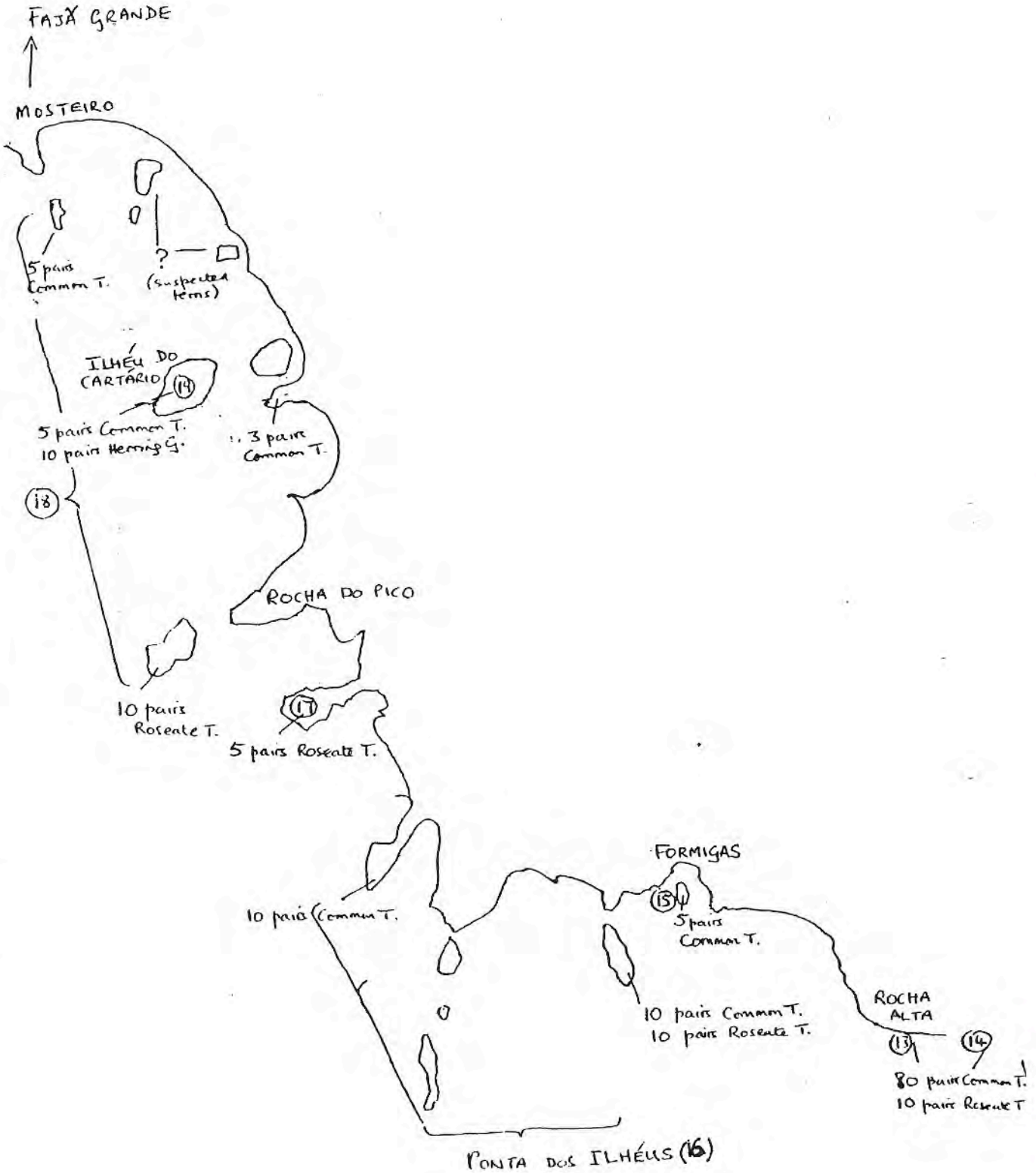
Table 19; Clutch and brood sizes of Roseate Tern subcolonies at Baixa do Moinho.

2-7) Porto da Lagoacomplex. A series of 6 steep stacks, close inshore, varying in height from 12-72m, with varying amounts of Festuca cover, and collectively representing a major site for Common Terns (117 nests), much less so for Roseate Terns (17 nests). For Roseate Terns, the numbers of nests and fledged young at the respective colonies were as follows: 9 at colony 3; 7 at 4; 2 at 5, average clutch 1.10 (n=10). The numbers comprising the 117 nests and fledged young of Common Terns were :- 16 at colony 2; 50 at colony 3; 3 at colony 4; 23 at colony 5; c.20 at colony 6, c.5 at colony 7. The average clutch was 2.31 (n = 80). Of the 5 Roseate young ringed, estimated ages were 1 @ 4-6 days, 1 @ 6-8 days, and 3 @ 20-22 days. In addition, at least one Roseate juvenile was flying strongly. By contrast, of the 16 Common Tern young, 11 were 4 days old or less, and only 1 was 20-22 days. Thus, the Roseate population here, as in Baixa do Moinho, was more advanced than that of the Common Terns.

At stack colonies 3 and 4, GLG found many small Common Tern chicks heavily infested with ants and clearly distressed. Chicks were also found dead, their dried carcasses evidently already consumed by ants.

8-10) Cedros islet (8) was devoid of terns but held c. 50 pairs of Herring Gulls. Ilhéu Garaiau (9) and the bay north of Cedros (10; Ribeira da Privada) supported respectively c. 3 and c. 10 pairs of Common Terns but no Roseate Terns.

11) Ponta da Furnão Jorge south to Ponta da Caveira In the evening of 14 June, EKD, GLG, and CHG surveyed this 1.5-km stretch of spectacular coastline, which includes two sheer coves (Furnão Jorge and Furnão dos Inchareus). We found c. 25 pairs of Common Terns and c. 15 of Roseates, most nesting singly or in very loose small groups on ledges and recesses. The Roseates included a chick of c. 3-4 weeks and 2 fledged young (of which 1 perhaps 5 weeks), again indicating an early start to laying.


FAJÃ GRANDE
MOSTEIRO
5 pairs Common T.
?
(suspected terns)
ILHÉU DO CARTÁRIO
(14)
5 pairs Common T.
10 pairs Herring G.
3 pairs Common T.
(18)
ROCHA DO PICO
10 pairs Roseate T.
(17)
5 pairs Roseate T.
10 pairs Common T.
FORMIGAS
(15)
5 pairs Common T.
10 pairs Comm T.
10 pairs Roseate T.
ROCHA ALTA
(13)
(14)
80 pairs Common T.
10 pairs Roseate T
PONTA DOS ILHÉUS (16)

MAP 10

13-14) Ponta da Rocha Alta On 15 June, water was discovered in the engine oil of 'Gaia Quest' and hereafter most of the detailed survey work was satisfactorily accomplished by inflatable. On the evening of 15 June, therefore, EKD, GLG and SH journeyed south from Sta Cruz to Lajes on the south-eastern tip of Flores, and thence along the south coast to survey first the boulder beach formed by the partial collapse 2-3 years earlier of the 500m cliff-face just landward of the shore. On landing here ('Rocha Alta West': see map 10) c. 80 birds, mostly Common Terns, were airborne. A maximum of 30 Common Tern pairs and 5 Roseate pairs was estimated. 1 Roseate juvenile was with the flock, though no Roseate nests were located. All the Common Tern nests were strung out along the shore among the huge boulders which fanned down from the landslip. About 200m further east ('Rocha Alta East': see map 10), a colony of similar strength (flock c. 80 Common Terns, 5 Roseates + 1 fledged) was found, again on talus. The Common Terns were divided into 2 linear subcolonies, themselves 200m apart on the shoreline, and in both cases among the bigger boulders higher up the beach while the Roseate nests were lower down. A pair of Common Terns was seen chasing a fish-carrying Roseate.

At both West and East colonies, the Common Terns were clearly at an early stage of advancement, with only 2 newly hatched chicks, and all other production still at the egg stage. Common Tern clutches averaged 2.0 (n=25) at Rocha Alta West, 2.47 (n=40) at Rocha Alta East, while the 5 Roseate clutches at the East colony were all of 1 egg.

15-19) (Rocha Alta to) Formigas north to Mosteiro (to Faiã Grande)
From Rocha Alta we continued by inflatable west along the south coast o Flores to its south-west corner (Ponta dos Ilheus), then north along the west coast to Mosteiro, a total distance of c. 11km. The dramatic coastline looked ideal for terns: deeply indented rocky cliffs with caves, stacks and islets (bare or topped with Festuca. Most of these offliers supported small numbers of Common (total c. 50 pairs) and/or Roseate Terns (total c. 25) nesting usually quite high (say 6-10m) at the edge of the Festuc cover. The 20 Common Terns at site 16 (several islets : see Table 21) wer made up of 2 groups of 10 each. The 20 Common Terns at site 18 (cliffline plus islets) are an upward estimate, actual counts being 5 + 3 pairs. Th approximate distribution of colonies, pinpointed as we sped along in th Zodiac, is shown in Map 10. There were no terns between Mosteiro and Faiã Grande where the cliff scenery gave way to a lower gentler aspect. For census details see Table 21.

20-28) Faiã Grande north to Ponta Delgada, then south-west to Baixa Rasa
On 16 June, the rest of Flores was circumnavigated as far as Baixa Rasa islet (north of Cedros, surveyed 14 June). The time restrictions of havi to cover so much coastline by inflatable in one day, coupled with th exceptional concentration of colonies found on the north-east coast (Ponta Delgada to Baixa Rasa, and beyond to Sta Cruz) limited opportunities fo shore landings and detailed fieldwork. Nevertheless, the overall census (b GLG, CHG, and SH) established the north-east coast as the most importa concentration of Common Terns and Roseate Terns on Flores and indeed on an of the main islands on the Azores (see Flores conclusion). Below are liste such details as were discovered for individual colonies. For head counts other colonies, see Table 21.

Colony 21: João Martins/Ilhéu Francisco
Though mostly a flat islet, a steep climb to the top, c. 25m a.s.l. Most rocks and mud, not grassy. Of 58 nests of Common Terns found (estimate

total 60 pairs), 5 were on an inaccessible cliff. No Roseates were found. In addition to active Common Tern nests, 8 were found apparently abandoned, with eggs embedded in dried mud, and had perhaps been flooded after heavy rain. The distribution of 53 Common Tern clutches/broods was: 1 egg, 11; 2 eggs, 20; 3 eggs, 19; 1 chick 1; 1 chick, 1 egg 2. Mean clutch 2.13.

Colony 22: Ponta Delgada
A steep-sided grassy stack, difficult of access. The estimate of 20 pairs Roseate Terns and 5 Common Terns was based on a flock count of 30 and 8 respectively, and a nest count of 8+ and 1+ respectively. Most nests were on an inaccessible cliff. For Roseates, 5 1-egg clutches (+ 1 abandoned) and 4 well-grown young (1 @ 2 weeks, 3 @ 3 weeks) were found. The 1 Common Tern nest inspected contained a chick of c. 2 weeks old.

'Colony' 23 : Ponta Delgada Bay to Ponta do Ilhéu
A stretch of c. 1km containing 32 Common Tern nests, highly dispersed as follows: 8,4,1,12,5,2.

'Colony' 24 : Ponta do Ilhéu to Ilhéu dos Abrôes
A stretch of c. 0.5km of cliff containing 12 Common Tern nests dispersed in 2 groups (7 and 5 pairs).

'Colony' 25 : Ilhéu dos Abrôes to Ponta das Barrosas Bay (Peniche)
About 0.5km of cliff containing c. 13 Common Tern nests dispersed in 2 groups (10 and 3 pairs).

Colonies 26-28 : See Tables 20 and 21.

Colony 29 : Baixa Rasa islet
Described as more vegetated than colony 21, but not as steep nor as grassy as colony 22. Supported a major colony of estimated 50 pairs of Roseate Terns (30+ nests) and 10 pairs of Common Terns (5 nests). Seventeen Roseate young, ranging from newly hatched to 4 weeks, were ringed, with the majority (12) 3 weeks or older; in addition c. 12 fledged Roseates counted, along with some recently fledged young on an adjacent islet. Only 2 Common Tern young (respectively c. 2-3 days and 25-28 days old) were ringed.

Flores : conclusions

1) Status and dispersion

Flores emerges as the most important breeding station for terns on the Azores with c. 263 pairs of Roseate Terns. With a colony of Common Terns on the Caldeira Funda lake (which shortage of time prevented us from visiting) estimated (by GLG) at 20-30 pairs, the total tally of this species may be c. 470 pairs, maybe even c. 500 pairs if a possible colony of 20 pairs on the west coast below Rocha dos Bordões is added. Around Flores, the distribution shows a concentration of both species on the north-east coast from Sta Cruz north to Ponta Delgada, and to a lesser extent on the south-west coast from Ponta da Rocha Alta north to Mosteiro. The north-east coast section (including the stretch from Sta Cruz south to Ponta da Caveira) held 228 pairs of Roseates (87% of total) in 5 colonies each equal to or larger than 5 pairs. The same section of coast held 314 pairs of Common Terns (71% of the 444 coastal pairs) in 17 colonies each equal to or larger than 5 pairs. The south-west coast section held all the others : 35 pairs of Roseate Terns (13% of total) in 5 colonies each equal to or larger than 5 pairs, and 130 pairs of Common Terns (29% of total) in 6 colonies each equal to or larger than 5 pairs.

The concentration of terns in these two sections of Flores becomes clear from the coastal topography. Both sections are the most deeply indented and eroded, correspondingly well endowed with rocky promontories, stacks, and islets suitable as colony sites. The other (south-east and north-west) coastlines of Flores are cliffbound but relatively smooth, with few or none of the outliers favoured by nesting terns of both species.

Outstanding among the Roseate colonies is the Baixa do Moinho (Sta Cruz) with 126 pairs. This status, together with its proximity to the fishing community of Sta Cruz, and its extreme inshore position and easy access from the mainland render it especially worthy of protection measures.

Overall (Table 22) the average colony size of Roseate Terns was 22.6 pairs and of Common Terns 12.3 pairs. Given the scattered singletons and other small (less than 5) uncounted nests of Common Terns, the actual average colony size of Common Terns must be less than 12.3, and perhaps nearer 5-10. This reflects the generally more scattered dispersion of Common Terns than Roseate Terns, consistent with the relatively stronger preference of Common Terns for occupying cliff ledge sites.

2) Laying dates

Throughout Flores we found numerous hatched Roseate young of various ages including a small proportion of fledged young, indicating an earliest hatching date of mid-May, corresponding to laying in ~~early~~ mid to late April, thus about 6 weeks earlier than the start of laying in the British Isles. The Common Terns were typically later, most nests containing eggs or at best small young, creating the impression that a widespread hatch was imminent. Table 23 shows that overall 39.6% of Roseate Tern nests contained at least 1 young, compared with only 10% for Common Terns; comparing only colonies which held both species, the figures are 43.5% and 11.5% respectively. Table 23 also shows that in general the young of Roseate Terns were much older than those of Common Terns. It is also interesting that this implies an order of laying (Roseate before Common) opposite to the sequence invariably found in Britain and Eire, e.g. on Coquet Island (England) 1968-70, the earliest laying date of Common Terns preceded that of Roseate Terns by 4-13 days (minimum and maximum for the 3 years), the peak laying dates by 5-10 days (Dunn 1972). However, it is necessary here to voice a cautionary note, especially as (a) GLG has pointed out that Common Terns typically arrive in the Azores before Roseate Terns and thus presumably start nesting earlier. (b) At the major colony of Ilhéu das Laghoinas (east) on Santa Maria, the indications were that Common Terns were the first of the two species to lay.

At the Porto Lagoa complex, a number of quite long-abandoned Common Tern eggs were found, while, at João Martins/Ilhéu Francisco, others were found embedded in the mud as if flooded out some time earlier. There was no evidence at these 2 colonies of similar egg losses among Roseates. This raises the possibility of a widespread re-lay by Common Terns, so they could thus still have made their first laying attempt before the Roseates. The wide range of breeding advancement in Common Terns, from eggs to fledged young, lends some support to this, although Roseate Terns also showed considerable within-colony variation in this respect. In conclusion, it is clear that Roseate Terns must have started laying on Flores from early April. Superficially it also appears that the majority laid before Common Terns, but judgement on this is reserved because the possibility of wholesale re-laying among Commmon Terns on Flores cannot be eliminated.

FLORES; FREQUENCY DISTRIBUTION OF COLONY SIZES

	Number of colonies		
Colony size (pairs)	Roseate Tern	Common Tern	Herring Gull
0--5	4	16	1
6--10	4	8	1
11--15	0	1	0
16--20	1	3	0
21--25	0	1	0
26--30	0	1	0
31--35	0	0	0
36--40	0	0	1
41--45	0	0	0
46--50	1	2	1
51--55	0	0	0
56--60	0	1	0
61--...,125	0	0	0
126--130	1	0	0
Total no. of colonies*	11	33	4
Total no. of pairs	248†	407Δ	105
Δ mean colony size (pairs)	22,6	12,3	26,3

Table 22: Frequency distribution of colony sizes of Roseate and Common Terns and Herring Gulls on Flores.

* includes 1 singleton Roseate and 2 singleton Common Terns.

† = 15 fewer than total in Table 21 which includes estimated pairs mostly scattered on rather poorly surveyed cliffs.

Δ = 37 fewer than total in Table 21 (for same reason as described for '†').

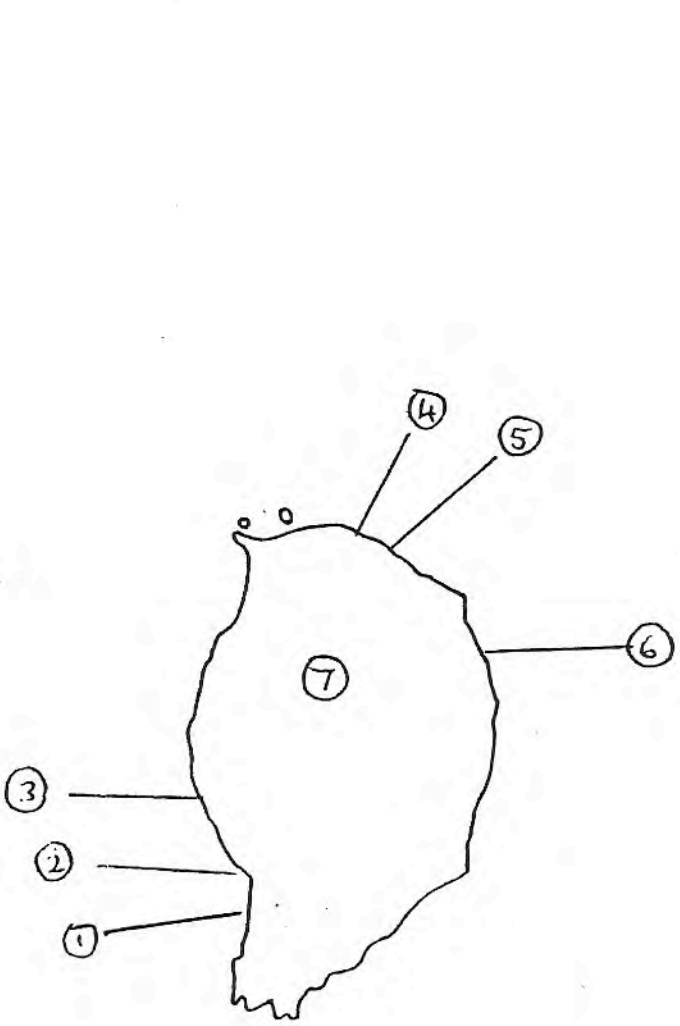
Note: Singletons and groups less than 5 pairs are therefore underestimated in this Table (22) which excludes, e.g., breakdown of pairs at site 11.

FLORES: STATE OF BREEDING ADVANCEMENT

Colony name	Total nests	% nests with at least 1 chick	Age of prefledged young (days)
		ROSEATE TERN	
Baixo do Moinho	123	38.2	Mostly ≤ 14
Porto do Lagoa	17	17.6	Over ½ = 20-22
Rocha Alta	5	0.0	
Baixa Rasa	24	70.1	Mostly 20-28
Totals and means	169	39.6	
		COMMON TERN	
Porto da Lagoa	96	20.0	Mostly ≤ 6
Rocha Alta	65	1.6	Recent hatch
João Martins/ Ilhéu Francisco	53	56.6	Recent hatch
Baixa Rasa	6	33.3	1@2-3,1@25-28
Totals and means	220	10.0	
Totals and means for colonies at which both species represented:			
ROSEATE TERN	46	43.5	
COMMON TERN	165	11.5	

Table 23: Breeding advancement of Roseate and Common Terns at main colonies on Flores, measured by: (a) proportion of nests with at least 1 young hatched, (b) age of young.

CORVO



MAP 11

CORVO

Background information

With Flores, Corvo forms the western island group of the Azores. It is only 13km north of Flores. Corvo is easily the smallest of the Azores, with a surface area of 17.45 sq km. What it lacks in area, however, it makes up for in forbidding cliff scenery, lending a fortress aspect, especially from the north. Sheer cliffs, 300m high places, culminate in the peak of the island -- Monte Gordo (770m). The other outstanding feature is Caldeirão, an enormous crater 300m deep and 3400m in perimeter, containing two lakes of which one has twin islets. The only settlement is on the south coast where nestles the picturesque township of Vila Nova do Corvo.

We left Flores at 09.30 hrs on 17 June and, after slow tacking north along the east coast of Flores, caught a fair breeze and reached Corvo at 18.00 hrs. The survey was conducted the next day by circumnavigating Corvo (clockwise from the south-west corner) by inflatable.

Corvo: Conclusions

No Roseate Terns were found on Corvo. The sheer cliffs and absence of outliers (with the exception of a few stacks on the south-west and north coasts) do not favour this species. Common Terns, howver, were found nesting on cliff ledges c. 15-35m above sea level. In every case the cliffs rose much higher than this and, e.g. at Ponta do Marco (site 4) the Herring Gull colony was over 100m higher up the cliff face than the Common Terns.

We were fortunate in having the Caldeirão lake colonies surveyed to give a reasonably complete count of Common Terns on Corvo. At Cancela do Pico (site 6) we saw a Common Tern flying steeply upwards with a fish, heading towards the summit lakes. This indicated that the Caldeirão colonists forage at sea, and appear to expend great amounts of energy ascending to the lakes with food for their young.

CORVO: COLONY DETAILS (See Map 11)

Date	Colony	Name	Grid Ref.	Descr.	Aspect/Ht(m)	
18 June	1	Pão de Açúcar	FD617943	Cliff ledges	W	-
	2	Cova Vermehla	FD616947	Cliff ledges	W	-
	3	Pingas	FD610955	Cliff ledges	W	-
	4	Pta do Marco:Bay 1	FD627993	Cliff ledges	N	30-35
	5	Pta do Marco:Bay 2	E of Bay 1	Cliff ledges	N	-
	6	Cancela do Pico	FD642980	Cliff ledges	E	15
July (date not known)	7	Caldeirão	-	2 islets	-	470

CORVO; CENSUS DETAILS

Colony No.	Roseate Tern	Common Tern	Herring Gull
1	0	3	2
2	0	6	0
3	0	2	1
4	0	25	60*
5	0	0	20
6	0	3	0
7	0	50†	0
Total	0	89	83

Table 24 (top); Colony details. Table 25 (bottom); Colony counts (pairs). All are estimates (no landings possible in colonies 1-6).
* = Though Common Terns at 30-35m up cliff, Herring Gulls higher on grassy ledges c. 150m up.
† = one colony on each of the 2 islets on the Caldeirão lake, respectively 10 and 40 pairs (estimated by Dr Cardigo on Corvo after the main expedition finished.)

AZORES TERN SURVEY 1984: OVERALL CONCLUSIONS AND RECOMMENDATIONS

1) Coverage and Census. The survey proved highly successful. The engine problems with 'Gaia Quest' may even have helped inasmuch as subsequent survey by inflatable probably facilitated more shore landings and close reconaissance. All 9 islands were visited in 5-6 weeks from 30 May -- 6 July. While no thorough survey of São Miguel was made, a sure knowledge of the breeding strength of tern species over several years enabled GLG to supply good estimates of the missing counts: for Roseates, only 25-30 pairs, for Common Terns 100+ pairs (including 3-5 pairs on Fogo lake) (see Table 1) . Missing 1984 counts on São Jorge (Fajã dos Cubres) and Corvo (Caldeirão lake) were supplied by local sources. GLG estimated that the Caldeira Funda lake on Flores may support 20-30 pairs of Common Terns.

A total of 647 pairs of Roseate Terns, 2000 pairs of Common Terns, and 2705 pairs of Herring Gulls was estimated foe the Azores (Table 1). While a fair proportion of the colony estimates had to be based on counts of flying flocks (due to, variously, shortage of time or inability to land safely), these figures are thought to be a reasonable (perhaps ± 10%) census of the breeding populations. As special efforts were made to visit Roseate Tern colonies, the census for this species is the most reliable. Of 22 Roseate Tern colonies of ⩾5 pairs (10 of which were on Flores: Table 21), a landing was made on 16 (73%) and an accurate count on 15 (68%). Of 56 Common Tern colonies of ⩾5 pairs (at least 18 of which were on Flores), a landing was made on 24 (43%) and an accurate count on 18 (32%). Of 7 estimates (rather than counts by on-the-spot location of nests) of colonies of ⩾5 pairs of Roseate Terns, 4 were based on counts of sitting birds, 3 on the flying flock. Counts from close inshore of sitting birds on small cliff colonies were presumed to give a reasonably accurate census, and a high proportion of the Common Tern colonies fell into this category. Of 40 estimates for Common Terns (again colonies of ⩾5 pairs) 26 were based on sitting birds, 14 on flying flock. These data are summarized in Tables 26 and 27 (below):-

Table 26: Census methods and census accuracy for Roseate tern colonies:-

Island	Colonies ⩾5 pairs	Landing made	Accurate Count	Count from Sitting birds	Count from Flying flock
Santa Maria	2	2	2	0	0
Terceira	2	2	2	0	0
Graciosa	4	3	3	0	1
Faial	1	1	1	0	0
Pico	1	1	0	0	0
São Jorge	2	0	0	0	2
Flores	10	7	7	4	0
Corvo	0	0	0	0	0
Totals	22	16	15	4	3

Table 27: Census methods and census accuracy for Common Tern colonies:-

Island	Colonies ⩾5 pairs	Landing made	Accurate Count	Count from Sitting birds	Count from Flying flock
Santa Maria	7	3	2	0	5
Terceira	5	3	3	1	2
Graciosa	4	3	3	0	1
Faial	5	4	2	1	0
Pico	6	2	0	4	0
São Jorge	7	0	0	2	5
Flores	18+	9	8	15	1
Corvo	4	0	0	3	0
Totals	56+	24	18	26	14

2) Distribution of Roseate Terns and major colonies. Roseate Terns were found on all islands except Corvo. Table 26 indicates, however, the outstanding importance of Flores (claiming almost half the colonies of ⩾5 pairs, and 40% of the total Azores population of c. 650 pairs). Most (87%) of the Flores population in 1984 occupied 5 colonies (each ⩾5 pairs) on the north-east coast between Sta Cruz and Ponta Delgada. This coastal section also held 71% of the 444 Common Tern pairs on Flores, underlining its prime quality as tern habitat. Important Roseate Tern colonies on Flores and the other islands are as follows: (Table 28):-

Island	Site and Description	Pairs
Sta Maria	Laghoinas (east) (foot of steep cliff)	56
Terceira	Ilhéu das Cabras (east) (offshore islet)	28
Graciosa	Farol da Ponta da Barca (stack)	c.50
	Ponta da Restinga (east) (cliff spur)	40
Faial	Farol da Ribeirinha (cliff/talus)	70
Pico	Nariz de Ferro (lava stacks)	c.20
São Jorge	Ilhéu do Topo (grassy islet)	c.20
Flores	Baixa do Moinho (rocky islet)	126
	Ponta Delgada (stack)	20
	Baixa Rasa (steep islet)	50

These ten colonies together account for 480 pairs of Roseate Terns, i.e 74% of the total for the Azores. Outstanding among them are Baixa do Moinho and Baixa Rasa (both Flores), Farol da Ribeirinha (Faial), Ilhéu das Laghoinas (east) (Santa Maria), Farol da Ponta da Barca and Ponta da Restinga (east) (both Graciosa).

3) Conservation problems and recommendations Any conservation measures should take account of the ten colonies listed above, though it is not known, of course, how stable they are from year to year. It will therefore be necessary to monitor a sample of colonies (e.g. those with 50 pairs or over) to determine how consistently these sites support substantial colonies (RECOMMENDATION 1).

In the end, the choice of key colonies may be based on accessibility, as observers are unlikely to be able to extend coverage as widely as we did with the advantage of 'Gaia Quest' at our disposal. If the choice is severely restricted, regular monitoring of Baixa do Moinho should be a priority, as should Ilhéu de Baixo (Graciosa) for its colony of Madeiran Storm Petrels (RECOMMENDATION 2).

Most tern colonies on the Azores are naturally secure from casual disturbance by virtue of inaccessibility, although their qualities vary in this respect. All ten colonies listed above are easily accessible from the sea, as our landings by inflatable have shown. In addition, Laghoinas (east) (Santa Maria) is accessible from land, but only after a hazardous descent. Farol de Ribeirinha (Faial) is inaccessible from land, and the swell can make shore landing difficult. Lastly, the biggest colony Baixa do Moinho (Flores) is so close inshore as to be easily accessible from that direction, and it shares with Nariz de Ferro (Pico) proximity to human habitation as an additional hazard. Direct human persecution is not thought to be a problem, although some colonies (see Ilhéu de Baixo, Graciosa) are probably disturbed (to a degree hard to evaluate) by fishermen landing to seek bait (sometimes taking petrels and shearwaters for this purpose). However, evaluation of the incidence and effects of disturbance by fishermen on breeding performance should constitute part of any future monitoring problem (RECOMMENDATION 3).

The possibility of seeking statutory protection for key colonies deserves consideration (RECOMMENDATION 4). Its consideration should include assessments of Recommendations 1 and 3 (above), i.e. protection measures will be more easily implemented if colonies are stable from year to year, but stability may, in turn, depend on the level of disturbance suffered by key colony sites.

4) Ringing programme Colour-ringing should be continued to investigate the wintering grounds of the Azores Roseate population (RECOMMENDATION 5). The total numbers ringed by the 1984 expedition were 117 Roseate Tern pulli and 213 Common Tern pulli. Three subsequent sightings of colour (yellow)-ringed Roseate Terns have been reported from West Africa: the first from Tema in Ghana on 22 January 1986 (R. Scott and A.J.M. Smith, pers. comm.), the 2 others by A del-Nevo in Ghana in winter 1988. This tends to confirm the belief that the Azores population of Roseate Terns shares the same wintering grounds as the north-west European population.

5) Biological interest Clearly the Azores Roseate Terns (and indeed Common Terns) would bear comparison with more northerly populations in a number of respects. This survey has indicated that the Azores Roseates may start breeding as much as 6 weeks earlier than their northerly counterparts.

Colonies yielded contradictory results on the relative laying dates of Common and Roseate Terns. There is some suggestion that the Azores terns may have suffered in 1984 from food shortage, and this may be a general phenomenon worthy of study. Virtually nothing quantitative is known about the terns' food supply. Its availability may even be related to the local tuna industry (EK Dunn has speculated that wholesale removal of tuna stocks may reduce availability of their prey to terns by removing the agents (tuna) which drive them to the surface. Investigation of the food supply could be linked with susceptibility to other mortality factors identified, such as predation by rats (and possibly cats) and vulnerability to infestation by ants. Availability of food may also have influenced the generally low clutch size found on the Azores. The mean for Roseate Terns was 1.18 (n = 257), comprised of 211 @ 1 egg and 46 @ 2 eggs. The mean for Common Terns was 2.02 (n = 664), comprised of 191 @ 1 egg, 268 @ 2, 204 @ 3, and 1 @ 5. For both species, these are significantly lower than in Britain (where Roseate 1.38-1.59; Common 2.55-2.65), and the Azores Roseates even lower in comparison with the USA (mean 1.76) (Cramp 1985). Very little information was collected on egg sizes in the present study and it would be interesting to look at this, not just in relation to overall food supply, but on an inter-island basis, as Ian Nisbet has done in North America for Common Terns.

Still to be added to this report

1) Bibliography

2) Appendices — (a) Bird sightings (i.e. annotated
list of species other th
Rot. & Common Terns +
Herring Gulls)

(b) Turtle & Cetacean sightin

(c) Measurements of
Madeiran Storm Petrel

Euan Dunn
15/3/89.