

BIRD OBSERVATIONS IN THE SELVAGENS ISLANDS
(21-23 October 1978 and 27 May — 7 June 1981)

(Cancap Project. Contributions to the zoology, botany and paleontology of the Canarian-Cape Verdean Region of the North Atlantic Ocean, nr. 16).

By

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With 2 plates, 1 figure and 2 tables

SUMARIO. No âmbito do trabalho do Projecto-CANCAP do Rijksmuseum van Natuurlijke Historie, Leiden, Holanda, as Selvagens foram visitadas duas vezes; em 1978 (21-23 de Outubro) e em 1980 (26 de Maio a 7 de Junho) respectivamente. Em ambas as ocasiões foram feitas observações ornitológicas. Neste trabalho é apresentado e discutido um estudo das aves nidificantes e é incluído o primeiro anilamento de *Sterna dougallii* nidificando nas Selvagens. É apresentada uma estimativa da população das Cagarças (*Calonectris diomedea borealis*) na Selvagem Grande na altura em que a população — agora grandemente reduzida — estava ainda em equilíbrio ou perto deste. Esta estimativa aponta para cerca de 350 a 420.000 indivíduos, incluindo alguns 85 a 110.000 pares nidificantes. É apresentada também uma descrição das aves migradoras observadas durante as visitas-CANCAP e é discutido o fenómeno das invasões de migrantes em relação com as condições meteorológicas. É considerado como improvável que o Mõcho (*Asio flammeus*) tenha alguma vez nidificado nas ilhas.

ABSTRACT. In the frame work of the CANCAP-project of the Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands, the Salvage Islands were visited twice: in 1978 (October 21-23) and 1980 (May 26 - June 7), respectively. Bird observations were made on both occasions.

A survey of the breeding birds is given, with discussions on the various species. It includes the first record of Roseate Terns (*Sterna dougallii*) breeding on the Salvage Islands. An estimate is presented of the population of Cory's Shearwater (*Calonectris diomedea borealis*) at Selvagem Grande at the time when the population — now greatly reduced — was still in

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equilibrium, or nearly so. This estimate amounts to about 350-420,000 individuals, including some 85-110,000 breeding pairs.

An account of the migrant birds observed during the CANCAP-visits is given and the phenomenon of migrant invasions in relation to meteorological conditions is discussed. It is not considered likely that the Short-eared Owl (*Asio flammeus*) has ever bred on the Islands.

INTRODUCTION

The Salvage Islands or Selvagens are situated in the East Atlantic at approximately 30° N and 16° W. The archipelago consists of three small islands, the largest being Selvagem Grande (with a maximum diameter of about 2 km). The two other islets, Selvagem Pequena and Ilheu de Fora, surrounded by a number of skerries, are situated about 20 km to the south-west. Although the archipelago is closer to the Canaries — about 175 km to Tenerife as opposed to a distance of 290 km to Madeira — they are under Portuguese jurisdiction. The islands and their coastal waters were declared a national wildlife reserve in 1971, but unfortunately their remoteness and the lack of a permanent warden made it possible for fishermen and yachting people to land and some of these unfortunately disturbed and even robbed the bird colonies.

Few scientists have been able to visit the Selvagens and accordingly our knowledge of the islands shows large gaps, even with regard to the breeding seabirds to which the islands mainly owe their fame. During the last two decades, however, this knowledge has improved significantly, especially due to the research of Jouanin (1964), Jouanin & Roux (1965, 1966), Zino (1971), Jouanin et al. (1977, 1979, 1980a, 1980b), and Mougín & Stahl (1982). Data regarding migrants are scarce (Baring & Ogilvie Grant, 1895; Ogilvie Grant, 1896; Howe, 1932; Bannerman, 1963, 1969; Bannerman & Bannerman, 1965; Santos Junior, 1971; Bacallado & Oromi, 1978; Câmara & Teixeira, 1980; Jensen, 1981; Roux, 1983). Therefore, since there have been no continuous studies for longer periods, additional incidental observations may add important information on breeding activities, behaviour, migration etc.

In the frame-work of the CANCAP-project of the «Rijksmuseum van Natuurlijke Historie» (RMNH), the Rijksherbarium (both Leiden, Netherlands) and the Department of geology of the university of Groningen (Groningen, Netherlands) (cf. Den Hartog & Lavaleye, 1981; Den Hartog, 1984), the Selvagens were visited twice. In 1978 one of us (Den Hartog, in the company of a geologist, dr. G. J. Boekschoten) visited Selvagem Grande from 21-23 October. In 1980 Selvagem Grande was visited again from 26 May — 7 June by the three of us, while short visits were paid to Ilhéu de Fora (Nørrevang & Zino) and Selvagem Pequena respectively.

Selvagem Grande is shaped like a flat cake, consisting of a fairly flat plateau surrounded by steep cliffs and slopes, up to about 80 metres

high. The plateau slopes gently up to three peaks of 154, 136 and 107 metres height respectively, all situated on the periphery of the island, which is composed mainly of tufa and basalt. Rocks and stones form a very rough surface except in two areas, on the north-east side and the south-east side respectively, where sand has accumulated. The vegetation is sparse and poor in species, a circumstance mainly due to the presence of rabbits, introduced long ago. Four species are predominant: two species of ice-plants, *Mesembryanthemum crystallinum* and *M. nodiflorum*, shrub tobacco, *Nicotiana glauca*, and a species of seablite, *Sueda vera*. Of these only the seablite is indigenous. Additional indigenous species occur mainly in inaccessible places along the cliffs.

The smaller islands of the Selvagens group are surrounded by treacherous reefs so that landing is possible only in very calm weather. Accordingly they have been visited by few ornithologists. Selvagem Pequena (Great Piton) is mostly low and covered with sand, gravel and rocks. Towards the north the volcanic rock rises to 49 metres at Pico do Veado. A large area with deep sand is found in the southern part of the island. Ilhéu de Fora (Little Piton) is even lower, but again the northern parts are higher (up to 15 m above sea level) with scattered basaltic rocks. In the southern part of the islet there are dunes, some five metres high. Both islets have been saved from the introduction of rabbits and consequently their flora is much more varied and original than that of Selvagem Grande, even including several endemics (Perez de Paz & Acebes Ginoves, 1978). Ornithologically, however, these islets are less important.

BREEDING BIRDS OF THE SELVAGENS :

As mentioned in the introduction, the Selvagens are well known for their populations of seabirds. No less than five species of petrel (Procellariidae) breed on the islands, all of which were encountered during our visits. Jensen (1981 : 2) suggested that yet another species, viz. the British Stormpetrel (*Hydrobates pelagicus*) might breed in the islands. Although this is quite possible — the species has been recorded as breeding in the nearby Canary Islands (Bannerman, 1963 : 4) — evidence so far is meagre as Jensen (l.c.) only heard (what he recognized as) the cry of this species on Selvagem Grande.

In addition to the petrels a few other species, both seabirds and terrestrial birds, are known to breed in small numbers in the archipelago. A survey of all the breeding birds recorded, with discussions on our observations, is presented below:

1. Bulwer's Petrel (*Bulweria bulwerii*)

In 1980, from May 26 to June 6, we found this species breeding around most of the island, in rock crevices, in old stone walls, and in

heaps of boulders. We opened a few nests and nearly always found one bird sitting on an egg. One nest contained a pair without an egg. This is well in accordance with the observations of Jouanin et al. (1979) who found that laying occurs between May 9 and June 6. In 1978 (October 21-23) no signs of Bulwer's Petrel were noted, this also being in accordance with earlier observations.

2. Madeiran Storm Petrel (*Oceanodroma castro castro*)

This petrel was found in breeding sites very much like those of Bulwer's Petrel. In 1980 we found a few individuals and heard many more calling from their nests. On our visit in October 1978 we also found several pairs sitting on their nests, but there were no eggs. In late December 1980 Jensen (1981 : 2-3) evidently witnessed the start of the breeding season. He concluded that the species either breeds throughout the year or that two different populations are involved. He estimated the population at about 1,500 pairs. It may be noted that the breeding data available from the Cape Verde Islands (cf. Bannerman & Bannerman, 1968 : 159) also indicate a very extended breeding period, eggs having been found from January until the end of May, with an additional record from October. Nørrevang & Den Hartog (1984) found an occupied nest on July 15. Snow & Snow (1966 : 283-284) suggested that the species may breed twice a year. They established the presence of two breeding peaks in the Galapagos population, one in the period May-June and another, less important peak in December-January.

3. Little Shearwater (*Puffinus assimilis baroli*)

According to Jouanin (1964) the young of the Little Shearwater leave the nests around June 1st, but we did not see a single bird during our visit in 1980, although we involved the most experienced warden, Almada, in our search. We did, however, hear some birds calling during the night. In 1978 two birds were forced to the ground by the beam of an electric torch. These are the first records for late October. Jensen (1981) was able to ring no less than 250 individuals in December-January but no eggs were found. Obviously much remains to be discovered concerning the breeding activities of this species.

4. White-faced Frigate Petrel (*Pelagodroma marina hypoleuca*)

This petrel has a wide breeding range in the southern hemisphere, while in northern oceans it breeds only on the Cape Verde islands and the Selvagens. It appears to be absent as a breeding bird in the Canary islands (Bannerman, 1963 : 5 ff) and is rarely seen in Madeira (Bannerman

& Bannerman, 1965 : 107, 195). In the Selvagens, as mentioned by Jouanin & Roux (1965), the White-faced Frigate Petrel has established colonies on Ilhéu de Fora, Selvagem Pequena and Selvagem Grande. These colonies are mainly restricted to the sandy areas (generally with scattered vegetation), in which the petrels dig out their superficial, about 60-80 cm long, elbow shaped nesting burrows.

All plant cover favours the stability of the burrows, as the root-systems help to keep the sand together. Moreover, vegetation of any kind retains water and prevents, or at least retards, total desiccation of the soil during dry periods. Taking this into account, the nesting conditions on Ilhéu de Fora and Selvagem Pequena must be regarded as more favourable than on Selvagem Grande. On the former islets the sandy areas still have their rather varied (though scattered) original vegetation, dominated by perennials as *Sueda vera* and *Limonium papillatum* var. *Callibotryum* and to a lesser degree by *Agropyrum junceiforme* and the annual, shallow rooting, introduced *Mesembryanthemum crystallinum* (cf. Perez de Paz & Acebes Ginoves, 1976 : 90, 92 fig. 3, 98, 101, 103). Conditions on the sandy parts of Selvagem Grande must have been about similar before rabbits and goats were introduced on the island (cf. Schmitz, 1893 : 141; Baring & Ogilvie Grant, 1895 : 408). Nowadays, as a result of the introduction by man for the purpose of obtaining soda (Schmitz, 1893 : 144; Perez de Paz & Acebes Ginoves, 1978 : 85), *Mesembryanthemum crystallinum* dominates.

During our short visit to Ilhéu de Fora we roughly estimated the colony there to comprise about 300 breeding pairs. This estimate was based on the area of the breeding colony, the estimated mean distance between the burrows, and a presumed occupation percentage of about 15% (cf. Jouanin & Roux, 1965 : 24). By similar, though more accurate procedures based on countings in quadrangles, Jouanin & Roux (1965 : 25) estimated the size of the colony on Selvagem Pequena to be about 10,000 breeding pairs. In our view this estimate may prove to be a little too high. First of all, the available sandy area certainly does not exceed 12 ha (cf. Bravo & Coelho, 1978 : 23 fig. 15), while Jouanin & Roux based their estimate on an area of 14 ha. Secondly we doubt that the entire area is occupied by the colony. Unfortunately our stay on Selvagem Pequena was too brief to investigate the island properly and to allow any countings to be made.

On Selvagem Grande the number of breeding pairs has been estimated by Jouanin & Roux (1965 : 25) at about 70,000. This estimate was based on: (1.) an occupation-rate of one breeding pair/10 m²; (2.) a total area of 140 ha; and (3.) the presumption that about half of the island was occupied by the colony. This estimate has recently been challenged (Den Hartog, 1981 : 89; Jensen, 1981 : 3-5) and obviously the population has been grossly overestimated. The area where the species can breed, i.e. the sandy plains, comprises roughly only 25-30 ha (cf. Bravo

& Coello, 1978: 17 fig. 1) and we noted that these areas were by no means entirely occupied. Therefore, making a quite similar computation as Jouanin & Roux did (l.c.: 25), we come to a number of only 12,500-15,000 breeding pairs and, taking into account the colonies on Fora and Selvagem Pequena, to a total breeding population of at most 25,000 pairs.

More accurate estimates were made on Selvagem Grande by Jensen (1981: 3-5). Jensen visited the island from December 4, 1981 — January 7, 1982. At the turn of the year he noted that the colonies were being occupied by large numbers of birds. As the first eggs are not laid before the end of March (Jouanin & Roux, 1965: 18 fig. 1, 19), it is obvious that Jensen witnessed the protogamic return of the Frigate Petrels (cf. Jouanin & Roux, 1964: 150). He further found that about 12 hectares of the sandy areas of the island were occupied by the colonies. Basing himself on what he calls «signs of breeding, like presence of feathers, foot prints, signs of burrowing, droppings, and/or calls in the burrows», he made countings of (supposedly) occupied burrows in six quadrangles of 500 m² each. On the basis of these countings he estimated the total breeding population on Selvagem Grande to be 17,800 pairs (i.e. at least one breeding pair/6,7 m² of the area occupied by the colony). Although in principle this estimate may be as good or better than any other so far made, it may nevertheless be questioned whether Jensen's «signs of breeding» indeed represent indications of actual breeding. It may well be that the estimated occupation-rate based on these signs is in reality too high, for it is questionable whether the birds will immediately make a definite choice as to their nest sites. As mentioned above, egg-laying does not start until the end of March and possibly the birds will «inspect» more than one burrow before making their ultimate choice. One further wonders whether sub-adult, non-reproductive birds might be involved in this protogamic return of the Frigate Petrels. There are many more unanswered questions, especially since we know that only a relatively low percentage of the burrows is normally occupied by breeding individuals (Jouanin & Roux, 1965: 24; 15%). This low occupation percentage might indicate a decline of a formerly much more numerous population, but it may just as well be correlated with the habits of the birds; whether they dig a new hole every year, or whether they are apt to re-occupy their original nests; whether digging of a burrow normally implicates subsequent breeding; whether the birds dig more than one hole; whether birds that breed for the first time dig new holes, or whether they will occupy existing burrows when available, etc. There is a great need for additional studies on the breeding of this species.

During our stay in 1980 a number of nests were probed and we happened to find incubated eggs as well as young, most of them newly hatched. One chick may have been as much as two weeks old.

In our experience the Frigate Petrels generally arrived on land after nightfall, mostly between 20.h.00 and 22.h.00, when their soft cries

from the nests could be heard everywhere. As did previous authors, we found many Herring Gull pellets consisting mainly, or entirely, of feathers, bones and legs of these little petrels (cf. p. 30). Herring Gull nests that were found were likewise often lined with such pellets. The composition and structure of the pellets indicated that the victims are swallowed whole, head first (cf. Jouanin, 1974: 26 fig. 3; Den Hartog, 1981: 89, 90 fig.).

On Selvagem Grande a mouse (*Apodemus spec.*), most probably introduced, has been reported to prey upon the Frigate Petrels by biting eggs and even killing adult birds by bites in the nape of the neck (Baring & Ogilvie Grant, 1895: 409; Ogilvie Grant, 1896: 52). During October 1978 mice were plentiful in and around the houses at the Enseada das Cagarras (Den Hartog, 1981: 90). At that time of the year Frigate Petrels were absent. In 1980 we saw very few mice and it is possible that they had left the area of the houses to feed elsewhere. No signs of mice, however, were observed in any of the Frigate Petrel colonies. A similar negative result was reported by Jouanin & Roux (1965: 27 ff), who visited the island in July.

5. Cory's Shearwater (*Calonectris diomedea borealis*)

The Cagarras (the Madeiran name for this bird) were just at the start of their egg-laying season when we arrived on Selvagem Grande on May 26, 1980. Many nests were occupied, but the first eggs were not found until May 28. On the 31st we examined 151 occupied nests on the NE slope of the island. 66 Birds were sitting on empty nests, 81 birds were sitting on an egg, and in 4 nests there was a pair without an egg. On a previous visit Zino marked the Cagarra nests with red paint in two different quadrangles, and we followed the egg-laying progress in one of these at the Pico da Atalaia, in which about 110 nests had been marked. Unfortunately, we did not control individual nests, so that we can present only the figures for the total number of nests (cf. table 1). There was a steady increase in the number of occupied nests, but we were not on the island long enough to be able to evaluate the extent of predation in this area.

The only obvious predators are man and Herring Gulls. In 1977 and 1978 the guard noticed no human interference, and in 1980 we know that only Herring Gulls could have been the culprits. During our stay Herring Gulls constantly patrolled the cliffs for unattended eggs and we found two eggs that had been pecked and sucked out. Jouanin *et al.* (1980: 206, foot-note) state that Herring Gulls will immediately take any egg left uncovered for more than a very short time. Observations by Zino (unpublished) confirm this. He established that eggs are mostly eaten on the spot but he also saw Herring Gulls flying with broken eggs in their beaks to be eaten at a considerable distance from where they were taken.

The Cagarras choose a wide range of nesting sites. The most common sites used on Selvagem Grande are natural ledges, crevices and holes in the volcanic rock. Also crevices between and under boulders and larger stones are used, especially on the coastal slopes.

As noted in the introduction, the island consists of alternating layers of volcanic ash, tufa and basalt. When the softer layers erode ledges are formed which may extend for up to 100 metres. On such ledges the nests are at a fair distance from one another but in crevices and small caves two or three nests, and occasionally more, are sometimes seen less than one metre from one another and within sight of one another.

On the central plateau some nests are found in holes in sandy soil. Most of these nests are undoubtedly abandoned rabbit warrens and there is doubt as to whether any of them at all have been dug out by the

	single bird with egg	single bird without egg	couple without egg	occupied nests	remarks
June 1st	10	7	1	18	one pecked egg
June 3rd	25	11	1	37	—
June 5th	38	14	—	52	—
June 6th	50	10	1	61	—

Table 1. — Egg-progress during the first week of June 1980 in a quadrangle with 110 marked nests.

Cagarras themselves. Zino has visited the islands several times in March and April but has never observed a Cagarra digging out its own nest. Other nests are found under the *Suaeda* bushes, which act as cover.

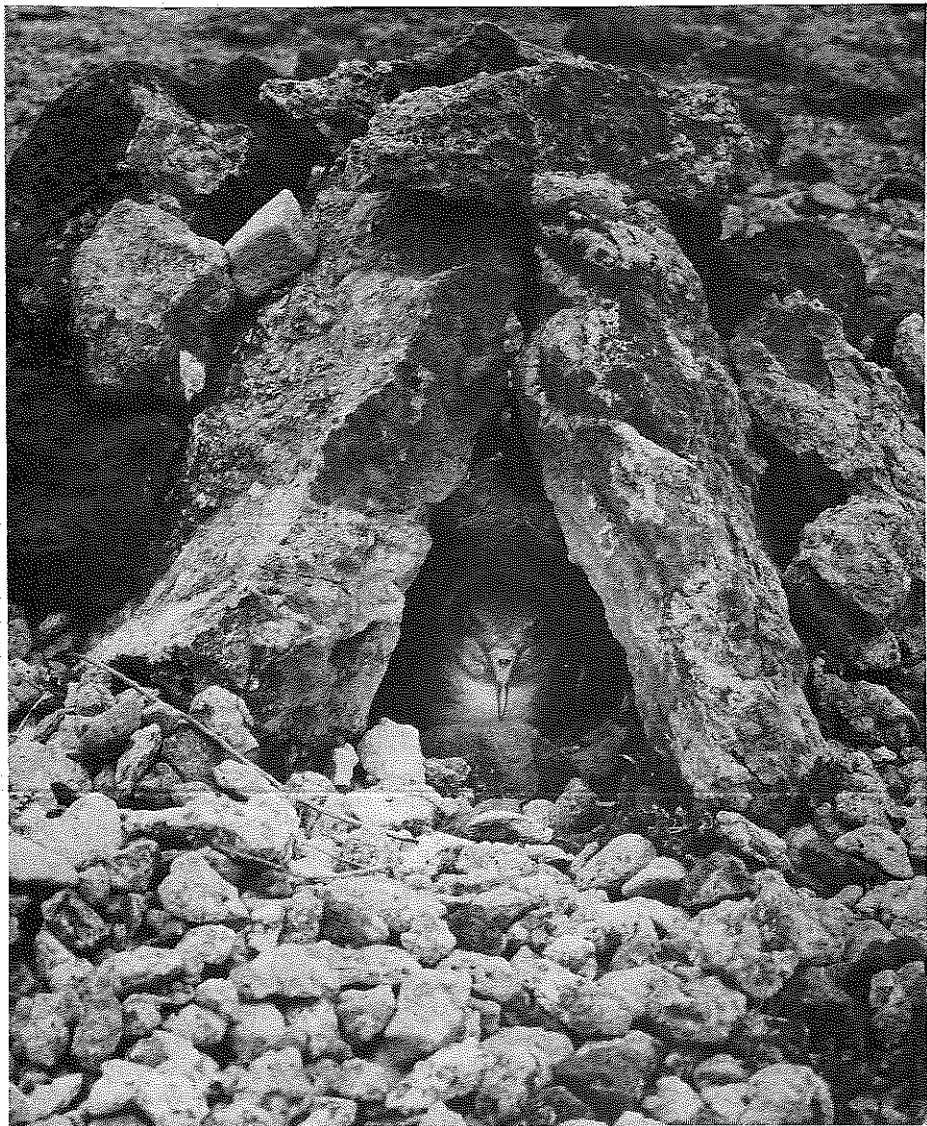
When Pickering (1959) visited the island in 1958 he found: «Quelques oiseaux vivent aussi dans les deux vastes grottes...». When visiting the largest of these caves on the south coast of the island we also found several Cagarra nests inside the cave with birds sitting on their egg some 40 metres from the entrance. Unoccupied, but unmistakable Cagarra nests were present up to the end of the cave, some 150 metres from the entrance. In addition to the natural nest sites, old man-made nests of two different types are found in several places: 1) In the stone walls which are found scattered over the island, some stones have deliberately been left out or have been removed at ground level. Thus a

cavity is formed, suitable for a Cagarra's nest and accepted as such by the birds. On the stony plains pyramid-like constructions of three or more flat stones have been set up enclosing a space (c.q. nest chamber) left open on one side (pls. 1, 2). Most of the pyramids still standing upright were occupied at the time of our departure. These pyramids were already in existence prior to 1895 (Baring & Ogilvie Grant, 1895: 411; Ogilvie Grant, 1896: 49), and it is obvious that both types of artificial nests were robbed each year by the Cagarra hunters. This type of exploitation, therefore, certainly may be referred to as bird farming, a term employed by Lockley (1952: 149) and Bannerman (1963: 15).

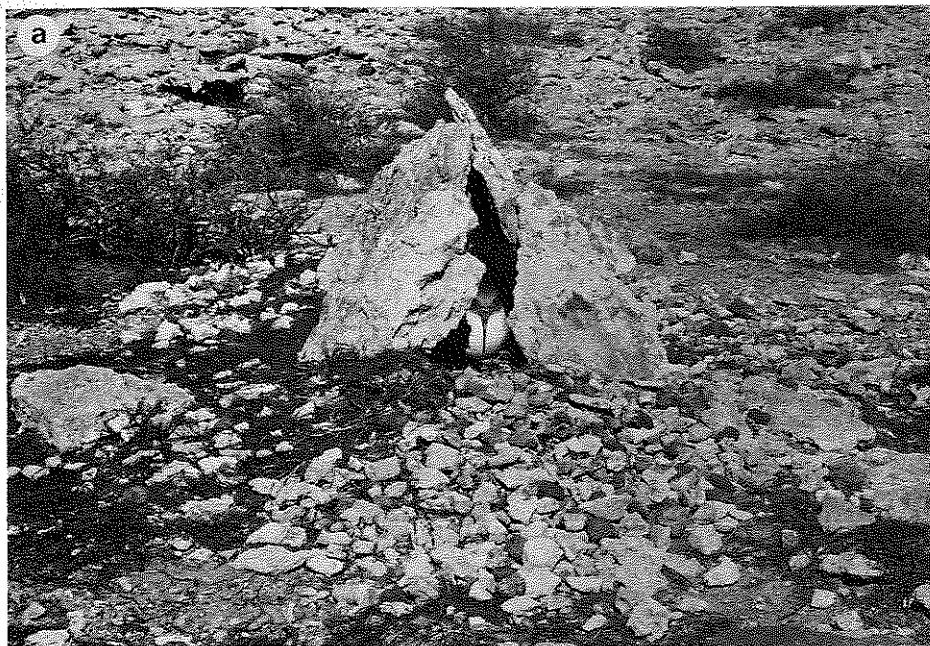
Previous authors, including Jouanin & Roux (1966: 1) have commented upon the nest material assembled in and around some of the Cagarra nests. The artificial nests on the plateau are invariably marked by accumulations of small stones and pebbles lying in the nests, but also spread out or piled up around the entrance. Occasionally such heaps are of remarkable dimensions, amounting to many kilogrammes of stony material (cf. pls. 1, 2), the result of an accumulation process of many years, possibly as part of the nuptial behaviour of the occupants.

We noticed that in some nests, especially on the lee side of the island, bones of Cagarras were heaped together, evidently serving as nest material. Obviously some couples collect stones and/or bones but the majority of the nests were just shallow depressions or the egg was even just placed on the rocky ground. In this context it may be noted that birds breeding on the plateau had ample access to pebbles and small stones, while those nesting in crevices or in sand had not. The presence of Cagarra bones, especially in nests around the Enseada das Cagarras may be correlated with the former activities (i.e. the cutting of wings and legs, etc.) of the Cagarra hunters in this area (cf. Schmitz, 1893; Howe, 1932: 50). Unfortunately this idea did not occur to us until our manuscript was being prepared, so that further research of this phenomenon is needed. By collecting and examining these bones one would be able to estimate their age, and to tell whether they derive from adult or young birds.

In October 1978 the breeding season of the five species of petrels was practically over. Only Cagarras were still numerous, many nests being occupied by almost fully grown juveniles, ready to abandon the nests. At night, in the light of an electric torch, many of the chicks were seen crawling around, exercising their wings and we observed two birds flapping down the slope towards the sea. On the following morning we noticed that several nests, which had been occupied the day or the night before, were now empty. As suggested by the sounds heard, these fully grown young are still visited at night by the parent birds. One act of feeding was observed, when we heard an adult landing and entering a nest hole. Switching on our torch we saw that the adult regurgitated a



Plates 1 & 2. — Examples of artificial, man-constructed Cagarra nests, two of which (pl. 1, pl. 2a) with an almost fully grown chick (Selvagem Grande, October 1978). Note the considerable amounts of stony material piled up especially in front of the nests.



small fish which was swallowed by the chick. On the following morning this particular chick had gone.

As mentioned, most of the juveniles were of about the same age and ready to abandon the nest. This synchrony is in accordance with the synchrony of the egg-laying period reported by Jouanin & Roux (1966: 23) and Zino (1971: 213). There were, however, some nests that were occupied by chicks which seemed only a few weeks behind in development. Of course, such «late» young may have hatched from unusually late eggs, but other reasons might be suggested, e.g. that one parent perished, so that food supply was reduced, resulting in retardation of development.

As has been mentioned by previous authors (e.g. Jouanin & Roux 1966: 19; Mougín & Stahl, 1982: 6) the numbers and the behaviour of the birds approaching land varies from one day to another to such an extent that in fact no general account can be given. On an average day, the first Cagarra were seen to approach the island at about 16h45, landing at sea at a distance of about 1,000 metres from the coast. Shortly afterwards, other birds joined them and soon a raft formed. All the birds lay head into the wind and newcomers usually landed towards the rear of the raft. However, many of these newcomers soon flew up and settled again in the middle or in front of the already formed raft. This pattern of assembly resulted in rafts that were broadest to leeward. Also, the pattern of the rafts might change, some joining others and forming larger units of 1-2,000 birds, and sometimes small rafts were noted in which about a hundred birds were sitting very close, almost body to body. Usually there were Cagarra rafts all around the island, but there were more and larger rafts on the lee side, i.e. to the southeast-southwest.

At about 18h45 the first Cagarra were seen flying over the island, and within half an hour later many birds soared over the precipices and over the central plain. They swooped up and down the slopes circling out towards the sea before approaching again. Sometimes a single bird made up to 20 landing attempts before finally tumbling rather clumsily to the ground, later waddling some distance to enter a nest. Most of the birds on the ground were silent, but sometimes a bird sitting on its nest called repeatedly. Those birds circling in the air made quite a noise, calling incessantly while swooping past the place where they would ultimately land.

As can also be seen from table 1, we usually found only one bird sitting on each nest and whenever we found two birds sitting together, the nest was without an egg. (The same was also noted on other parts of the island). This, however, applies to daytime only, for during the night very often there were couples sitting on the nests. Ogilvie Grant (1896: 50) mentioned that «the male is decidedly the bigger of the two (sexes), and when alive may easily be distinguished by his larger head and thicker neck», while Bannerman (1914: 267) adds the larger size of the bill and the longer tarsus as distinguishing characters. Usually we were quite

able to distinguish a smaller and a larger bird whenever there were two birds on one nest. Although we neglected to collect exact data, we noted that nests without an egg that were occupied by two birds during the day-time usually contained an egg the following day. We further noted that the larger bird, i.e. the male, was the first to incubate (cf. Zino, 1971: 214), as is the general rule in Procellariidae.

Twice we observed fights between two Cagarras (cf. Den Hartog, 1981: 117). In one case a smallish bird, presumably a female, tried to enter a nest in the rocks occupied by a considerably larger bird (presumably a male). The smaller bird, which had just arrived from the sea, was attacked fiercely and chased out, but although wounded (blood was coming from its beak), it made several further attempts to get into the nest, but without success. On another occasion two rather large birds came tumbling down a slope, fighting and screaming, interlocked by holding each others bills and apparently quite unaware of what was happening around them. Blood came from their beaks and stained their feathers. The fight lasted for several minutes and was then interrupted, possibly because we ventured too close to the scene in our efforts to film and photograph this exciting event. It may, however, have been the result of physical exhaustion. One of the birds recovered rather quickly and — apparently becoming more aware of our close presence — flew down the cliffs. The other bird seemed completely exhausted, but after a few minutes it also flew off. One may wonder whether the outcome of this fight would have been the same, had we not been on the spot. It seems quite possible that — in our absence — the fight would have started again. Judging from the fierceness and persistency of the birds, it seems likely that such fights may, at least occasionally, turn out to be fatal for one of the combatants as a result of loss of blood or from physical exhaustion. Especially during March and April, when territories and nest sites are occupied, these fights probably occur more frequently, but very little information on this phenomenon is recorded in the literature. Schmitz (1893: 144) basing himself on information from Constantino Cabral de Noronha, at that time proprietor of the Selvagens, reports: «Jahr für Jahr behält ein Puffinenpaar immer dasselbe Plätzchen; will ein neues, junges Paar dasselbe besetzen, so erfolgt ein Kampf, der manchmal mit dem Tode des schwächeren Concurrenten endigt». Howe (1932: 50), who landed on Selvagem Grande on March 24 writes about the Cagarras: «They are very undemonstrative in their courting. The very presence of the beloved seemed all that was required, although occasionally the male would playfully bite the neck and head of his mate, who suffered this complacently. Any male intruders were roughly driven off however». Lastly, Jouanin & Roux (1980: 164) mention: «... La compétition ne va pas sans des combats, parfois sanglants, qui ont lieu au cours des premières semaines qui suivent le retour en mars...».

When visiting the breeding areas during the night a large number

of birds would be found lying quietly on the ground, either singly or in pairs. Sometimes a bird was lying outside the nest entrance while the other was sitting on the egg. Such birds were very reluctant to fly away and at most they waddled some distance away when disturbed by our arrival with a torch. It seems as if they may lie there in this fashion for many hours, for on one occasion several birds had rain drops on their back after a shower that fell about two hours previously.

When dawn approaches the concert of cries starts all over again, and within an hour or so all birds which do not remain on the nests have flown out to the sea.

Five Cagaras, two males and three females, were collected for the RMNH collections on 6 and 7 June (i.e. 10 days after the first eggs had been found in the nests). The males weighed 1,020 and 940 grammes respectively, the females 850, 920 and 640 grammes. Considering that the first two females still contained an egg (for which we may subtract about 90-100 grammes) it can be stated that the females were significantly lighter than the males. This is in agreement with data published by Zino (1971: 214). To obtain information on their diet, the birds were dissected, revealing that they had fed upon squids (this is in accordance with the general conception; cf. e.g. Watson, 1966: 11, Hollom, 1971: 24). In the gizzard of each of the birds several squid beaks, partly crushed, had accumulated. The glandular stomachs of the birds were empty, except that of the largest male, which contained about 100 spermatophores of a squid species.

Until 1967 the Cagarra colony of Selvagem Grande was exploited annually, about 20,000 young being culled every year. The earliest figures available are from Webb et al. in 1841 and Bolle in 1857 for figures amounting to 30,000 young in good years, somewhat less in normal years (cf. Bannerman, 1963: 15). In 1885 Johnson mentioned that 18,000 to 20,000 birds were killed annually (cf. Pickering 1959: 1). Schmitz (1893) described the culling expedition to Selvagem Grande of 1892 which yielded about 19,400 birds. He mentions that in other years up to 22,000 were taken. Jouanin & Roux (1966: 24) give the following official numbers for the period between 1956 and 1963: 1956 — 22,743; 1957 — 24,132; 1958 — 21,425 (Pickering, 1959: 1, mentions only 16,000 birds); 1959 — 22,720; 1960 — 23,282; 1961 — 19,180; 1962 — 19,090; 1963 — 20,300. However, the actual number of birds killed may have been somewhat higher. A number of birds were presumably eaten on the island by the Cagarra hunters and unauthorized, small scale raids by Canarian fisherman also are likely to have occurred. Although not statistically significant one gets the impression that some over-exploitation took place in the late 1950'es, so that the yield diminished in the following years. The last culling expedition to Selvagem Grande in 1967 yielded no more than 13,000 birds.

A *de facto* protection started in 1968 when Zino bought the culling rights without using them, and officially a protection act was passed in

1971 to make the Selvagens a Portuguese nature reserve. In spite of this a veritable slaughter of adult Cagaras took place in 1975 and especially in 1976, nobody knowing the exact number of birds killed. The massacre of 1976 was on a devastating scale. At the time there were no wardens on the islands, so the fishermen were able to do just as they wished. They not only took a large quantity of eggs but as the season progressed, started to take the young and finally slaughtered all the adults they could lay their hands on.

Tens of thousands of adult Cagaras were slaughtered in this way and the population was decimated. Zino visited the island in September and the scene was one of utter desolation. Only a few isolated chicks were found on the nest, many of them in a pitiable condition, and in the surrounding waters only an occasional adult was seen whereas under normal conditions hundreds should have been flying near the island.

As a result of this massacre the Portuguese government took action. The Nature Reserve now has 3 wardens thus enabling the island to be guarded all the year round. Both the Serviço Nacional de Parques e Reservas in Lisbon and the Regional government in Funchal, greatly assisted by the Portuguese navy which supplies transport, continue to show great interest in the maintenance of this nature reserve and there are positive signs that the amount of breeding birds on the island is on the increase (cf. Mougín & Stahl, 1982). It has been possible to follow the growth of the population after the massacre of 1976 and this is being done by Jouanin, Roux, Mougín and Stahl of the Paris National History Museum, by C.E.M.P.A. in Lisbon and also by Zino.

It is apparent from the above that the size of the Cagarra population of Selvagem Grande is now greatly reduced. Rough estimates of the size of the colony at the time that it used to be in equilibrium, or almost so, have been presented by Jouanin & Roux (1964: 7 — amply exceeding 25,000 pairs), Santos Junior (1971: 68 — 50,000-60,000 pairs) Jouanin & Roux (1980: 161 — a total population of 150,000-200,000 birds) and Den Hartog (1981: 116 — at least 30,000-35,000 breeding pairs and a total population of 150,000-200,000 birds).

Ringling results, although still very incomplete, show that Cagaras do not normally breed until they are seven years old and that at the age of eight or nine years most birds breed for the first time (Jouanin et al. 1980). This information, combined with other known facts and (reasonable) assumptions permits a better founded estimate of the former Cagarra population of Selvagem Grande to be made than hitherto.

We may start from the assumption that for many years a more or less constant number of Cagarra chicks (c. 20,000) used to be taken by the official culling expedition (cf. e.g. Schmitz, 1893) and that an additional number of eggs and chicks, here arbitrarily estimated to about 5,000, were taken illegally by Madeiran and Canarian fishermen. So it can be stated that about 25,000 pairs bred unsuccessfully due to human

interference. Thus, taking for granted that the population was in equilibrium, the following equation used to be valid with regard to the reproductive birds:

(1) $aX = Y + 25,000$ or $Y = aX - 25,000$ (in which X is the total number — i.e. 100% — of breeding pairs, a the breeding success (human predation not taken into account) and Y the number of pairs with fledged chicks).

Accepting the arbitrary figures of Jouanin et al. (1980: 210, fig. 2) mortality of first year birds from natural causes is high (c. 50%) to stabilize soon at a level of about 5% per annum. This means that only about 30%¹⁾ of the chicks fledging each year will reach sexual maturity (at the average age of c. nine years). Reasoning along these same lines, the number of chicks culled each year would, had they lived, also have been reduced to 30% after the same period of 9 years; in other words, 70% of these birds would have died anyway by natural causes before reaching maturity, which partly explains why so many chicks could be taken for so many years without obviously disturbing the equilibrium of the population.

So, about 30% of first-year fledgelings (i.e. $0.3Y$ birds or $0.15Y$ pairs) compensated the yearly 5% loss of reproductive birds by natural causes (i.e. $0.05X$ pairs) plus 30% of the number of culled chicks (i.e. 7,500 birds or 3,750 pairs). This can be expressed in the following equation:

(2) $0.15Y = 0.05X + 3,750.$

From equation (1) and (2) follows:

$$\begin{aligned} 0.15(aX - 25,000) &= 0.05X + 3,750 \\ 0.15aX - 3,750 &= 0.05X + 3,750 \\ 0.05X(3a - 1) &= 7,500 \end{aligned}$$

(3) $X = \frac{7,500}{0.05(3a - 1)}$

Thus, if the breeding success (a) is known, the total number of breeding pairs (X) can be calculated on the basis of equation (3). This factor, however, is difficult to assess. There may be several reasons for unsuccessful breeding: eggs may break accidentally or be taken by predators (notably by Herring Gulls) and the same applies to newly hatched chicks. Furthermore, eggs may prove unfertilized, or one or both

1) This percentage is calculated from a mortality rate of 50% in the first year, 10% in the second year, 8% in the 3d year, 6% in the 4th year and 5% in subsequent years.

parents may perish or abandon the nest for obscure (intrinsic) reasons. Current research (Zino, in progress) suggests a very high percentage of unsuccessful breeding, mainly due to predation by Herring Gulls. But it may be noted that the Herring Gull population of Selvagem Grande has increased considerably in recent years (though, to some extent, it is now under control; cf. p. 128), while at present the Cagarra population has reached its lowest point ever. Therefore, predation by Herring Gulls has recently been proportionally high. Hence, at the time that the Cagarra colony still flourished, the breeding success presumably was much higher and may have varied between 80% and 90%²⁾, so that:

$$(4) \quad 0.8 \leq a \leq 0.9.$$

The total number of breeding pairs (X) (cf. equation (3)) may then have varied between:

$$\frac{7,500}{0.05 (2.7 - 1)} \leq X \leq \frac{7,500}{0.05 (2.4 - 1)}$$

$$(5) \quad 88,235 \leq X \leq 107,143$$

In addition, the population included roughly about eight year-classes of non-reproductive, immature birds. Their number (Z) can be calculated on the basis of the annual number of fledged chicks (Y) and the mortality rates of the various year-classes (cf. page 126, footnote 1)).

According to these rates the total number of immature birds amounted to:

$$(6) \quad Z = Y (0,5 + 0,45 + 0,41 + 0,39 + 0,37 + 0,35 + 0,33 + 0,32) = 3,12Y.$$

From equation (5) ($88,235 \leq X \leq 107,143$) and (2) ($0.15Y = 0.05X + 3,750$) it follows that $54,412 \leq Y \leq 60,714$, so that (cf. equation (6):

$$(7) \quad 169,765 \leq Z \leq 189,420.$$

According to these figures the total sum of reproductive birds (X pairs = $2X$ individuals) and immature, non-reproductive birds (Z) would have fluctuated between 346,235 and 403,714 ($2X + Z$), while the population further included a certain percentage of old, non-reproductive birds. In conclusion therefore, the entire population may have amounted roughly to about 350,000-420,000 individuals, including some 85,000-110,000 breeding pairs (cf. equation (5)).

2) Cf. Zino, 1971 : 215-217 — Zino, in the period May-July 1969, found that of 49 eggs laid, 19 (= 38,8%) did not hatch, 14 of which (= 28,6%) due to human interference and Herring Gulls. Thus, ignoring these eggs, only 5 (= 14%) out of 35 eggs did not hatch. In addition one chick died four days after hatching, but the other 29 chicks (= 83%) were still present on the nests on September 24.

These estimates are considerably higher than those made so far. Considering the raw data on which they are based, we realize that they are far from accurate and they will undoubtedly have to be corrected when less arbitrary figures for mortality rate and breeding success become available. The mortality rate may prove to be much lower than here suggested and if so, this would result in a lower estimate of the population. The breeding success might also be lower than here postulated, and this, taken by itself, would result in a higher estimate.

Little information is available on the breeding of Cagaras on the smaller islands. Pickering (1959: 1) notes: «on ne connaît pas de in-calm weather, and Fora, especially, is surrounded by very treacherous reefs and skerries. Pickering (1959: 1) notes: «on ne connaît pas de nidification de l'espèce dans les îles petites de cet archipel». In 1963 Jouanin & Roux (1966: 89) found one sitting bird on Fora and a broken egg on Selvagem Pequena. Santos Junior (1971: 71, 76) was unable to visit Fora, but found 6 nests on Selvagem Pequena in 1970 and 15 in 1971. As we found about 50 nests on Fora and a few on Selvagem Pequena, one might conclude that an increase is taking place on these islets, but there are probably unrecorded fluctuations. Taking into account that the Cagarra population on Selvagem Grande has been greatly reduced by over-exploitation it would be strange and rather unexpected indeed, if the species would now start to colonize Selvagem Pequena and Fora. Colonisation of these islets would have seemed more logical at the time that the colony at Selvagem Grande flourished and when the population pressure must have been more significant.

6. H e r r i n g G u l l (*Larus argentatus atlantis*)

The Herring Gull is mentioned several times in the early literature on the avifauna of the Selvagens. Schmitz (1893: 143), who based his paper on information by Cabral de Noronha, the then proprietor of the islands, was the first to mention it as a breeding bird on Selvagem Grande. Ogilvie Grant (1896: 47) saw about a dozen pairs with nests: one with eggs, the others empty or with downy young. Lockley (1952: 150) observed 11 adult individuals and one juvenile and Jouanin & Roux (1964: 8) estimated the population of Selvagem Grande to comprise about 10 pairs. The estimates in the 1970's are considerably higher. Zino (1971: 215) mentioned a number of approximately 100 adult individuals, while Jouanin (1974: 19-20) saw more than a hundred birds, mostly adults, and many nests. The last-named author explicitly stated that the species had considerably increased in number since his first visit to the island in 1963 (cf. Jouanin & Roux, 1964).

It seems that recently the number of Herring Gulls is being to some extent controlled by the wardens (cf. Mougín & Stahl, 1981: 47). This is greatly to the benefit of the petrel and shearwater colonies. A

large and growing Herring Gull population would form an increasing threat to the species just mentioned.

During our visit in 1978 we neglected to make an estimate of the number of Herring Gulls but in 1980 we estimated the population at about 50-60 birds, most of which had concentrated on the northern part of the island. Here, we saw as many as 42 birds on one occasion (including only two second year juveniles). It is interesting to note that Mougin & Stahl (1981: 47) in July of the same year (i.e. one month after we had left) counted only 16 adult individuals during their 3-week stay. Jensen (1981: 6), who visited the island about half a year later (December 1980, January 1981), again estimated the population at about 25 pairs.

Den Hartog, (1981: 90) questioned whether the Herring Gull is represented in the Selvagens by a resident population or whether numbers fluctuate a great deal due to in- and outflux of wandering birds. He suggested that Herring Gulls might more or less accidentally reach the islands by following fishing vessels and subsequently stay for a shorter or longer time, especially during the reproductive period of the various petrels, when plenty of food is available in the form of eggs and juvenile birds. In times of food-shortage, supposedly in wintertime, the birds would leave in the same manner as they had come. According to the observations of Jensen it now seems clear that the Herring Gull is present on Selvagem Grande throughout the year and that also during the winter plenty of food is available in the form of migrants, Madeiran Petrels and especially Frigate Petrels which appear to return to the island at the turn of the year (cf. p. 115 & 116). The fact, however, that Jensen (l.c.) observed a flock of about 30 Herring Gulls following a ship that passed Selvagem Grande, confirms that fluctuations of the population by influx of wandering birds certainly are not imaginary.

During our visit in 1980 we found two occupied Herring Gull nests on the north side of the island, on the edge of the cliffs at Ponta do Corgo da Areia. These nests contained three and two eggs, respectively. Before we left the island all the eggs had hatched. The nest with three eggs was found on 29 May. One egg was then about to hatch. Two days later the nest was empty but we succeeded to find the chicks, which were hiding in the vicinity. In this connection it may be mentioned that Ogilvie Grant (1896: 47) noticed that a nest containing three downy young, contained only one on the following day and that he suspected the Caçarras to be the culprits. This, however, is most improbable. He apparently did not realize how soon after hatching the juveniles may leave the nest, especially when the parents sound the alarm.

The nest material of the two nests mentioned above consisted mainly of dried stalks and leaves of *Mesembryanthemum crystallinum* with some feathers and a few bones. Several old, deserted nests, that were also found, seemed mainly made up of bones and feathers of the smaller petrels. But in fact it was difficult to judge to what extent this material

really represented nest material or the remains of feeding activities, particularly as the surrounds of the nests themselves were also marked by scattered feathers and bones. One large nest found on Selvagem Pequena was built up of remains of birds — including a complete, mummified Puffin (*Fratercula arctica*) (cf. p. 134) — and man-made litter such as plastic bottles etc.

Three papers dealing with the diet of the Herring Gull on Selvagem Grande have been published (Jouanin & Roux, 1965: 25-27; Jouanin, 1974; Mougín & Stahl, 1981). These show that the species feeds mainly upon the smaller petrels, especially *Pelagodroma marina* and *Bulweria bulweri*. Mougín & Stahl found that 10 out of 117 remains of Herring Gull meals (including 23 regurgitation pellets) contained egg-shells of Cagaras. In 24 cases they found remnants of cirripeds (*Lepas* spec.) Although we did not make quantitative studies, our observations fit in well with the data presented by the afore-mentioned authors. Nest materials and regurgitation pellets definitely reveal the high price paid by the small petrels, especially *Pelagodroma marina*. We also noticed a strikingly high number of pellets containing shell fragments of cirripeds (*Lepas* spp.).

7. Common Tern (*Sterna hirundo*)

Apparently the Common Tern is not a common breeding bird in the Selvagens. It was first mentioned to breed by Schmitz (1893: 143). Ogilvie Grant (1896: 47) at the end of April 1895 observed «a good many pairs» on both Selvagem Grande and Selvagem Pequena, but he found no nests. Lockley (1952: 150), visiting Selvagem Grande in July 1939 had the same experience. It was not until 1976 that definite proof of breeding was presented by Bacallado & Oromi (: 204, fig. 5), reporting unpublished notes by Bravo, who in May 1953 observed a large number of Common Terns and found several nests on Selvagem Pequena.

During our visit in 1980 we observed one pair on the south coast of Selvagem Grande and another pair on Selvagem Pequena, but no signs of breeding were noted. On Fora, however, in the sand dunes on the southern part of the islet, we observed three pairs, apparently breeding; at close distance. We managed to locate all three nests, one containing two eggs and the others one egg each.

8/9. Roseate Tern (*Sterna dougallii*) and Sooty Tern (*Sterna fuscata*)

On Ilhéu de Fora, also in the dune area, at some distance of the three nests of the Common Tern just mentioned, we noted four individuals of a second species of tern, which none of us had ever met with. In flight the birds appeared more slender, longer tailed, and very white as compared to the Common Tern. There were no dark markings on the

primaries and only a slight brownish tinge on the upper side of the wing tip. The bill was black, slightly red at the base, and the legs reddish. The cry was hoarse and harsh, something in between that of Little and Sandwich Tern. After a careful search we managed to find two nests, each containing one egg. The nests were situated on the top of the dunes, about four metres apart and about 20 metres distant from the three nests of the Common Tern. Later on, on the basis of our field notes, we were able to identify these birds as Roseate Terns. As we succeeded to photograph one of the birds, this identification could later be checked and confirmed with the photo in hand (cf. Den Hartog, 1981: 88)³). This record appears to be the first for the Selvagens. Since, the species was again recorded by Roux (1983: 291). In the summer of 1982 this author found a small colony of Roseate Terns on Selvagem Pequena comprising 11 nests with one or two eggs each. Among this colony one pair of breeding Sooty Terns (*Sterna fuscata*) was found; the first Palearctic breeding record of that species. The Roseate Tern, in small numbers, is a summer visitor in the Madeira archipelago, but so far no breeding records have been reported from those islands (Bannerman & Bannerman, 1965: 49. It seems to be entirely absent in the Canaries (Bannerman, 1963; Bannerman & Bannerman, 1968: 451-452).

10. Kestrel (*Falco tinnunculus*)

The Kestrel has been known on the Selvagens for a long time. Already Schmitz (1893: 143) lists it as a breeding bird. Ogilvie Grant (1896: 43) who visited the islands from 23-29 April 1895, saw several pairs both on Selvagem Pequena and on Selvagem Grande, and mentions one pair that was «evidently breeding» on the latter island. His party shot one bird, a female which was later reported by Bannerman (1963: 316) to belong to the nominate, European race. Jouanin & Roux (1964: 8) mention that a few pairs breed on the islands (16-26 July). Santos Junior (1971: 68, 71, 73, 76, 78) visited the archipelago in 1970 (18-21 September) and in 1971 (17-20 September). In 1970 he saw one bird on Selvagem Pequena and two on Selvagem Grande and in 1971 one single bird on each of the islands. From 24-26 February 1976, Bacallado & Oromi (1976: 8, 202-203) observed one pair on each of the two islands. They further mention that Bravo (unpublished notes) saw a pair (presumably on Selvagem Grande) during visits in 1953 (May), 1968 (April) and 1972 (date not specified). Between 21 September and 13 October 1978, Câmara & Teixeira (1980: 3) recorded five Kestrels on Selvagem Grande, including one young bird and one found dead. Finally, Jensen (1981: 6) saw 18 Kestrels during a stay on Selvagem Grande from 4 December 1980 to 7 January 1981. It is curious that Lockley (1952), who visited

3) The picture in this paper is accompanied by a photo of a nest with two eggs, erroneously attributed to the Roseate Tern. This photo in fact shows one of the nests of the Common Tern that were found.

Selvagem Grande in 1939 (16-17 July), apparently did not see the species.

During our visits in October 1978 and May-June 1980 we observed a few Kestrels (at least two pairs) on Selvagem Grande. In 1980 there were definitely two pairs, both breeding. One pair was seen several times hovering and flying over the north-eastern slope of the island, near Ponta Espinha. The birds apparently had a nest with chicks, for we repeatedly sighted them settling on a particular spot on a steep seacliff, uttering shrill, piercing cries. The other pair was generally observed around the Pico Atalaia and on May 31 we had the good fortune to see this pair with two newly fledged young. We did not observe any Kestrels on Selvagem Pequena.

In conclusion a few Kestrels are present on the Selvagens throughout the year and it seems likely that these birds form a very small, resident breeding population. Observations by Zino (unpublished notes) of two albino Kestrels — an obvious sign of inbreeding — support this supposition. On the other hand there may occasionally be an influx of birds from elsewhere and in this connection the afore-mentioned winter observation by Jensen of no less than 18 individuals, is most suggestive.

As mentioned above, the bird obtained by Ogilvie Grant, now in the British Museum, was identified as belonging to the European race *Falco tinnunculus tinnunculus*. This would imply that the only bird ever secured on the Selvagens, happens to be a migrant, for it is difficult to imagine that the birds breeding on the Selvagens would not belong to one of the insular races resident in the nearby Canary Islands (cf. Bannerman, 1963: 54-62 — *Falco tinnunculus canariensis* and *F. t. dacotiae*) and Madeira (Bannerman & Bannerman, 1965: 23-26 — *Falco tinnunculus canariensis*), where the European race is absent as a breeding bird. However, it may be noted that the bird concerned apparently formed part of a pair, while another pair evidently was already breeding, and that the date that it was shot (the end of April) seems rather late for a spring migrant.

11. Berthelot's Pipit (*Anthus berthelotii*)

Berthelot's pipit is the only passerine bird resident in the Selvagens, even though it is — and apparently always has been — absent from Selvagem Pequena and Fora. Its further distribution only includes the Canary Islands (*Anthus bertheloti berthelotii*) and the Madeira archipelago (*A. b. madeirensis*) (Bannerman, 1963: 246; Bannerman & Bannerman, 1965: 87). The birds occurring on Selvagem Grande belong to the nominate, Canarian race. On this island we noticed that the species especially inhabits the stony plains with scattered bushes of *Sueda* on the central plateau. It was practically absent from the *Nicotiana*-groves and from sandy areas, either barren or covered with *Mesembryanthemum*. A few dozen individuals were seen during our visit in 1978 and in 1980 we estimated that there were between 60 and 100 birds present on the island.

Again, Schmitz (1893: 143) was the first to report Berthelot's pipit as a breeding bird of Selvagem Grande. Baring & Ogilvie Grant (1895: 414; cf. also Ogilvie Grant, 1896: 44) found it to be common: «These little birds were our constant companions, and one or two of them were almost always to be seen running about among the stones and iceplants.... etc.». Lockley (1952: 149) during his two-day visit in 1939 (July 16-17) saw only «three or four birds, singly», but considering that he apparently also overlooked the Kestrel (see above) it seems that he — probably due to lack of time — did not pay much attention to terrestrial birds. Disregarding Lockley's statement, previous estimates of the population of Selvagem Grande vary from 30 individuals (Câmara & Teixeira, 1980: 3) to 100-200 individuals (Santos Junior, 1971: 73).

Berthelot's Pipit usually stays very close to the ground and seems to feed mainly on ground living invertebrates. It had also been reported to eat plant seeds (cf. Bannerman, 1963: 250), but in its habitat on Selvagem Grande, the variety of the latter must be extremely poor. Its behaviour strikingly resembles that of the Grey Wagtail (cf. Ogilvie Grant, 1896: 45), not only in the way it moves, running about and suddenly stopping, but also — as we observed several times — in its way of jumping up into the air, obviously to catch flying insects,

Going through the literature, it becomes clear that surprisingly little relevant information on the population of Selvagem Grande is available. We know next to nothing about breeding, food, predators (Kestrel?, migrant raptors?) etc. No author has ever reported the finding of a nest and in fact Ogilvie Grant (1896: 44-45; cf. also Baring & Ogilvie Grant, 1895: 414-415) is the only author to have observed any actual signs that the species breeds on the island. He states: «When we arrived at Great Salvage on the 23rd of April, they had not begun to breed, and were generally met with in small companies of three or more, but on the last days of our visit we noted that they had evidently paired, and on the 29th one or two birds were seen going about with nesting-materials in their bills, so the breeding-season must have been just commencing. They apparently rear a second brood in the autumn, for several birds we shot were in freshly moulted plumage of the immature bird, with the feathers of the back, wings, and tail widely edged with buff, while in the old birds these parts were in much-worn condition».

We also did not pay much attention to this species, but taking into account Ogilvie Grant's above-cited statement, it seems curious that we did not observe feeding of young during our visit in 1980 (May 26 - June 6). A nest containing two eggs has subsequently been found by Zino on 28 March, 1983. Future research on this species is desirable.

MIGRANTS AND VAGRANTS

It is a well-known fact that oceanic islands attract passing migrants,

and during both our visits to the Selvagens a number of migrants were observed.

In October 1978 only Selvagem Grande was visited. The observations made during this two-day visit include: Short-eared Owl (*Asio flammeus*; 7 specimens), Grey Wagtail (*Motacilla cinerea*), White Wagtail (*Motacilla alba*), Black Redstart (*Phoenicurus ochruros*), Robin (*Erithacus rubecula*), Blackcap (*Sylvia atricapilla*), Song Thrush (*Turdus philomelos*), Canary (either *Serinus canarius* or the continental *S. serinus*; a small flock of 15 birds), Hawfinch (*Coccothraustes c. coccothraustes*), Chiffchaff (*Phylloscopus collybita*), and Turtle Dove (*Streptopelia turtur*) (cf. Den Hartog, 1981: 87). In addition we observed a large vulture-like bird, possibly a juvenile Egyptian Vulture (*Neophron percnopterus*) (tentative identification based on strip of 8 mm film).

In 1980, one day (May 26) was spent on Ilhéu de Fora and Selvagem Pequena. On the former islet we observed 5 Turnstones (*Arenaria interpres*), one Curlew (*Numenius arquata*), one White Wagtail, and between 10 and 15 Swallows (*Hirundo rustica*). On Selvagem Pequena we observed some 20-30 Swallows. Two mummified Puffins (*Fratercula arctica*) were found on the stony beach where they had been washed ashore. A third mummy served as nest material in an abandoned Herring Gull's nest (cf. p. 130), and a fourth specimen was picked up on June 2nd on the coast of Selvagem Grande. The age of the mummies could not be determined, but it is probable that their presence in the Selvagens is connected with a stranding recorded in December 1979 on Porto Santo (Madeira archipelago), where 22 individuals were found washed ashore (P. A. Zino, unpublished notes).

The period from May 27 to June 6 was spent on Selvagem Grande. On May 27 one Hoopoe (*Upupa epops*) which had died recently was found and one unidentified tern (*Chlidonias spec.?*) was observed flying over the Enseada das Cagarras. On the following day a few Swallows were seen, and were still present on the 29th, when we also saw two Turtle Doves and caught a glimpse of an Oriole (*Oriolus oriolus*), either a female or a young bird. On May 30 there was an influx of various migrant birds, including several species which feed mainly or exclusively on flying insects, viz. Black Swift (*Apus unicolor*), Pallid Swift (*A. pallida*), Swallow, and House Martin (*Delichon urbica*). On one occasion, on May 31, 8-10 House Martins, 3-4 Swallows and a larger number of Swifts were observed near the Enseada das Cagarras.

During the following day or two these species were seen hunting along the whole periphery of the island and occasionally over the plain on the top of the island. Soon, however, they concentrated along the southwestern coast, i.e. the lee side of the island. Obviously insects were more readily obtained here. On one occasion a House Martin was seen sitting on the ground, picking up something.

A moderate to strong NE to NW breeze blew steadily during our whole stay (cf. table 2). As on any oceanic island, flying insects are

scarce, and therefore the air-feeding birds must be expected to starve if they do not succumb to thirst, for there is no fresh water on the island except in a covered cistern.

On the 2nd of June one Short-eared Owl (*Asio flammeus*) was observed. In addition dozens of Swifts and several House Martins were seen around the Enseada das Cagarras. On the day before our departure, i.e. on June 5, about 20 House Martins were seen swirling in a very close flock at the mouth of a cave above the wardens' house. Some would occasionally cling to the cliff wall, always very close together, and on two occasions one bird was seen to cling to the back of another sitting bird. Likewise half a dozen birds would sit very close together on the rails at the houses. The birds seemed very exhausted and in bad condition, some were found dying on the ground and were collected. They were extremely emaciated.

On June 3 one Garden Warbler, (*Sylvia borin*) and one other Warbler, almost certainly a Willow Warbler (*Phylloscopus trochilus*), were seen in a *Nicotiana* shrub on the southern slope of the Pico da Atalaia. On June 5, one Whimbrel (*Numenius phaeopus*) was observed flying over the island, and on June 6th, one Redshank (*Tringa totanus*) was seen in the tidal zone at the Enseada das Cagarras.

With regard to the occurrence of the Shorteared Owl (*Asio flammeus*) on the Selvagens, it should be mentioned that Baring & Ogilvie Grant (1895: 414) and Ogilvie Grant (1896: 44) were the first to report this species from the islands (in April). They sighted three «pairs» on Selva-gem Grande and believed the species, like the Kestrel, to breed there. They further stated that plenty of food was available in the shape of mice (*Apodemus* sp.; a species undoubtedly introduced). However, these owls might just as well survive and thrive on a diet of small petrels (cf. e.g. Bannerman & Bannerman, 1965: 146; Bannerman & Bannerman, 1968: 184, 381) or even lizards (*Lacerta dugesi*) which abound everywhere. Bannerman (1963: 334) judged the birds sighted by the above-mentioned authors as «perhaps but passing migrants».

The Short-eared owl is known to breed neither on the African continent nor on the Canaries or Madeira. The southern breeding range of this owl actually lies north of the Pyrenees and the Alps (cf. e.g. Voous, 1960: 178) though breeding has been reported from Spain, Mallorca and Italy (cf. e.g. Glutz von Blotzheim & Bauer, 1980: 429-430). Furthermore the species is known as a notorious wanderer (Voous, l.c.: 158) and this matches the fact that all sightings made so far on the Selvagens (in addition to the records mentioned above, the species was also reported by Câmara & Teixeira, 1980: 2 and by Jensen, 1981: 7) have been correlated with weather conditions which also brought other migratory birds to the islands. Moreover, several authors have visited the islands for shorter or longer periods (e.g. Lockley, 1952; Bacallado & Oromi, 1980) without encountering the Short-eared Owl.

Wind direction; Wind speed in knots; Cloud cover at 6-hour intervals

Area Date	South Portugal	Selvagens	North Morocco	South Morocco
14-10-1978	X-(NW) ; x-12; 2,2,2,1	(X)-SE-(SW) ; x-12; 2,1,2,1	X ; x ; 2,2,2,2	NE-N ; 12-22; .,.,.,.
15-10-1978	X-(NW) ; x-12; 2,2,2,2	X-(SE) ; x-12; -2,2,-	X ; x ; 2,2,2,2	(X)-NE ; x-17; .,.,.,.
16-10-1978	X-(N) ; x-12; 2,1,1,1	X-(NW-SW) ; x-12; -,-,2,-	X-NE-W ; x-17; -,-,2,2	NE ; 12-17; -,-,.,.
17-10-1978	X-(N-NW) ; x-17; 1,-,2,2	N-NW ; 12-17; -,-,2,2	X-(N-NW) ; x-12; 2,1,.,.,	NE-NW ; 12-22; .,.,.,.
18-10-1978	N-(N) ; 17-22; -,-,-,-	NW-(N) ; 17-22; 1,1,1,-	X-NE-NW ; x-17; 2,2,2,2	no data
19-10-1978	(NE-N)-NW ; 12-22; -,-,-,-	(NE-N)-NW ; 12-17; 2,2,1,2	X-NE-NW ; x-17; -,-,2,2	NE-NW ; 12-17; -,-,.,.
20-10-1978	X-N ; x-17; -,-,-,-	(X)-N-NW ; x-12; 2,2,2,2	X-(N) ; x-12; -,-,-,-	NE-NW ; 17; .,.,.,.
21-10-1978	X-(NE-N) ; x-12; -,-,-,-	X-(N) ; x-12; 2,2,1,1	(X)-N ; x-12; 2,2,.,.	NE ; 12; .,.,.,.
22-10-1978	X ; x ; 2,-,-,-	X-(N) ; x-6; 2,2,2,2	X-(N) ; x-12; 2,2,2,2	N-(NE) ; 12-17; -,-,2,2
23-10-1978	X-N ; x-12; -,-,-,-	(X)-N ; x-12; -2,2,2,2	X ; x ; 2,2,2,2	N-NW ; 12; -,-,.,.
20-05-1980	(NE)-N-(NW) ; 17-27; -,-,-,-	NE-(N-NW) ; 17-27; 2,.,.,2	NE-X ; x-27; -,-,-,-	N-(NW) ; 5-10; -,-,-,-
21-05-1980	(NE)-N-(NW) ; 17-35; -,-,-,-	(NE)-N ; 22-27; -,-,-,-	(N)-X-(SW) ; x-27; -,-,-,-	X-N-NW ; x-22; -,-,-,-
22-05-1980	N-(NW) ; 17-22; -,-,-,-	NE-N ; 12-17; -,-,-,-	NW-W-(SW) ; 12-17; 2,1,2,-	(X)-NE-NW ; x-22; -,-,-,-
23-05-1980	N-(NW) ; 12-27; -,-,-,-	NE-N ; 12-22; -,-,-,-	NW-X-S ; 12-22; 2,1,.,.	N ; 12-22; -,-,2,2
24-05-1980	N ; 5-22; -,-,2,1,-	(N)-NW ; 5-17; 2,.,1,-	(W)-(NW)-X ; x-27; -,-,-,-	N-NW ; 12-22; -,-,.,.
25-05-1980	N-NW ; 12-22; -,-,-,-	N-NW ; x-22; -,-,-,-	W-NW-(X) ; x-17; 2,2,2,-	NE-N ; 12-32; -,-,2,2
26-05-1980	(NE)-NW ; 17-32; 1,-,-,-	N-(NW) ; 12-17; -,-,-,-	W-NW ; 12-17; -,-,-,-	NE-(N) ; 27-32; 2,-,-,-
27-05-1980	(V)-NW ; 6-32; 1,-,1,1	N-NW ; 12-17; 2,-,1,-	V ; 6-27; 2,-,1,1	NE-(N) ; 27; -,-,-,-
28-05-1980	NW ; 12-22; -,-,-,-	N-NW ; 17-22; -,-,-,-	N-W-S ; 12-17; 2,2,2,-	NE-(N) ; 22-32; -,-,-,-
29-05-1980	NW ; 12-17; 2,-,2,2	(NE)-N-(NW) ; 12; -,-,-,-	(NW)-X ; x-17; 2,2,2,2	(NE)-N-(NW) ; 12-27; -,-,-,-
30-05-1980	NW-SW ; 6-12; -,-,2,1,-	N-NW ; 12-17; 2,2,2,-	N-NW ; x-17; 2,2,2,-	NE-(NW) ; 17-32; -,-,-,-
31-05-1980	NW ; 6-17; 1,-,1,-	NE-(N-NW) ; 12-27; -,-,2,-	NE-NW ; 6-17; 2,2,2,-	NE-(N) ; 22-32; -,-,-,-
1-06-1980	N-(NW) ; 17-22; 2,-,-,-	NE-N ; 17-32; 1,1,1,1	(NE-NW)-X ; x-12; 2,2,2,2	NE-(N) ; 17-27; 2,-,-,-
2-06-1980	NE-(NW) ; 6-17; -,-,-,-	NE-N ; 12-17; -,-,2,2	NE-X ; x-17; 2,2,2,-	NE-N ; 12-22; -,-,1,2
3-06-1980	NE-(NW-SW) ; 17-22; -,-,-,-	N-NW ; 12; -,-,1,1	X-(NE-NW) ; x-22; 1,1,2,2	NE-NW ; 12-22; 1,-,1,1
4-06-1980	NE-NW ; 6-27; -,-,-,-	N-NW ; 12-17; -,-,-,-	(NE-NW)-X ; x-17; 2,1,2,2	NE ; 17-32; -,-,2,1,-
5-06-1980	NW ; 12-22; -,-,1,-	N-NW ; 12-22; -,-,1,2	X-V ; x-12; -,-,-,-	NE-(N) ; 17-27; -,-,2,-
6-06-1980	NW ; 22-32; -,-,-,-	NE-N ; 17-27; 1,-,2,2	X-(N-NW) ; x-22; -,-,2,2	NE ; 12-27; 1,-,1,1
7-06-1980	NW ; 22-27; -,-,-,2	(NE)-N-(NW) ; 12-22; 1,2,-,2	(X)-NW ; x-17; 1,2,-,2	NE-(N) ; 17-27; -,-,1,1,-

Table 2. — Rough general survey of three meteorological factors in four areas of the north-eastern CANCAP-region preceding (dates in italics) and during visits to the Selvagens in the autumn of 1978 and the spring in 1980.

The columns for each area read respectively: wind direction (non-prevalent winds in parentheses; X = wind absent or very weak and variable; V = wind Variable); wind speed; (X = wind absent or very weak) and cloud cover (— = cover less than 1/2; . = no data available).

Data derived from 6-hourly weather maps of the Royal Netherlands Meteorological Institute, De Bildt, Netherlands.

In conclusion, as long as definite proof is wanting (a nest with eggs or chicks), there is no reason to assume that the Short-eared Owl ever breeds on the Selvagens.

OCCURENCE OF MIGRANTS AND METEOROLOGICAL OBSERVATIONS: /EO

Câmara & Teixeira (1980) visited Selvagem Grande from 21 September — 13 October 1978, i.e. just before our first visit. They report an invasion of many Palearctic migrants after prevalent, strong easterly winds from 22-27 September, the majority of which disappeared after a change of wind direction. Six of the twelve species sighted by us, viz. Hawfinch, Robin, Black Redstart, Song thrush, Canary and Egyptian Vulture were not reported by them, and therefore we may assume that these belonged to a later invasion.

In this context it may be mentioned that, if the invasion originated from the Moroccan coast, the flock of Canaries sighted must have belonged to the continental *Serinus serinus*. However, it should be born in mind, that the insular *Serinus canarius* occurs commonly on the western Canary Islands and on Madeira, and that it is known to make at least certain local oversea movements (cf. Bannerman & Bannerman, 1965: 96; Bannerman & Bannerman, 1966: 170-171). Jensen (1981: 7) also observed five Canaries (identified as *Serinus serinus*).

During and preceeding our visit to the Selvagens in 1978 the wind speed in the whole eastern CANCAP-area was insignificant (table 2; fig. 1), hardly exceeding the force of a gentle to moderate breeze, and rather weaker than stronger when compared to average conditions (cf. Meserve, 1974). Visibility was good. The cloud cover around southern Portugal was relatively low, except from October 14-17. In north-western Morocco and around the Selvagens, on the other hand, the cloud cover seemed relatively high, though not exceptionally so. Thus, the meteorological conditions give no immediate clues to the reasons for the occurrence of the obviously disoriented migrants observed during our visit on October 21-23. The relatively high cloud cover over the Selvagens themselves probably induced these birds, viz. Hawfinch, Turtle Dove and Robin to interrupt their voyage, being observed daily in the vicinity of the houses on the south coast of the island.

Our visit in 1980 coincided with the end of spring migration. From table 2 it seems obvious that the prevalent winds in north-western Morocco cannot have caused migrant birds to deviate from their course to Europe in such a way as to reach the Selvagens Islands. The influence of cloud cover is difficult to assess. It seems more rational to focus attention on southern Morocco, where fairly strong north-easterly (i.e. off-shore) winds prevailed (stronger than usual) during and preceeding our visit. Possibly these strong winds have accounted for a fair number of spring migrants reaching the Selvagens.

Considering the general meteorological conditions in the eastern part of the CANCAP-area, it seems likely that, during spring migration, a considerable number of bird migrants will invariably be blown off their course by the prevalent, north-easterly trade winds in southern Morocco (also when these are not exceptionally strong) and reach the Canaries,

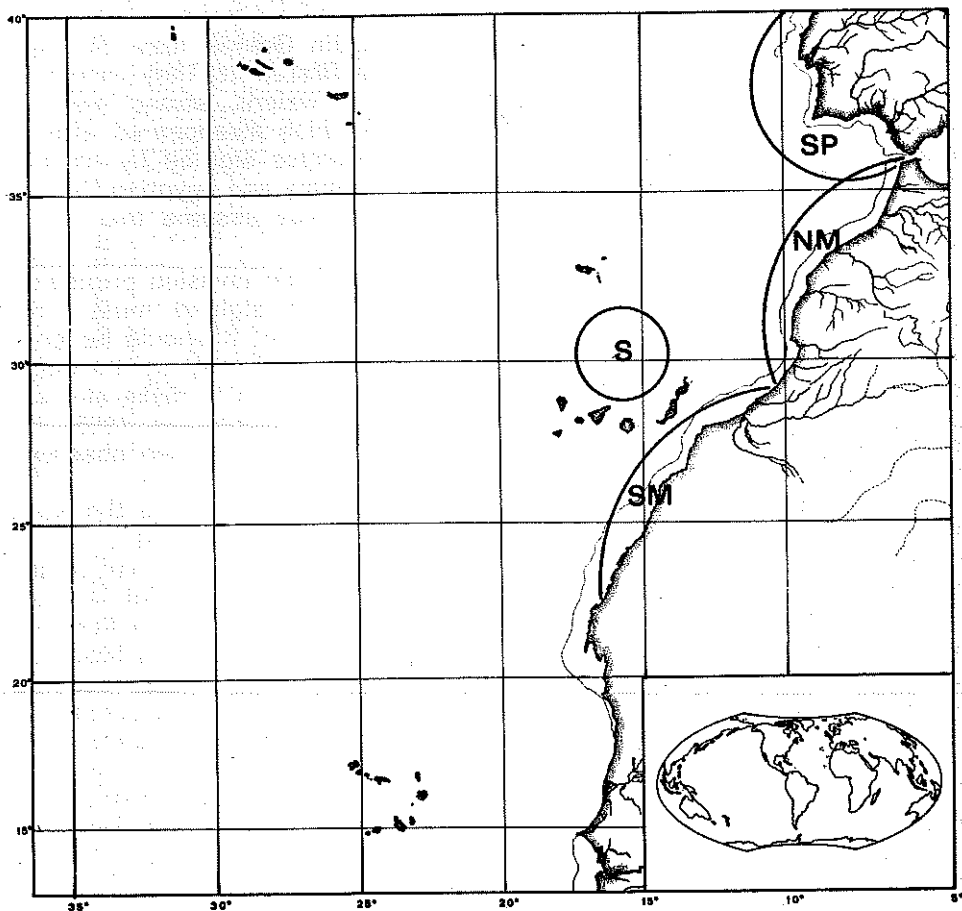


Fig. 1. — Map of the CANCAP-region. Rough meteorological data (cf. table 2) were obtained from the encircled areas. SP = South Portugal; NM = North Morocco; SM = South Morocco; S = Selvagens Islands.

the Selvagens, Madeira and even the Azores. Significant invasions of autumn migrants seem less self-evident, and may be correlated with more exceptional weather conditions.

Nonetheless, a number of migrants reaches the Selvagens every autumn, as has been established by Portuguese ringing parties operating on the islands since 1968 (Câmara & Teixeira, 1980: 1).

Bannerman & Bannerman (1968: 56) express their conviction that the Canary Islands; notably Lanzarote and Fuertaventura «are very much on some migration route between Europe and the (African) west coast». However, it is our opinion that both during spring and autumn migration, only a minority of the birds, especially song birds, which reach the islands will ever succeed in reaching the mainland again. The same must apply to ~~ever succeed in reaching the mainland again. The same must apply for~~ those birds which reached the Selvagens. Ringing studies, as those started on the Selvagens by the Portuguese «Centro de Estudos de Migrações e Protecção de Aves (CEMPA)», (Câmara & Teixeira, 1980: 1) are indispensable to get more insight in this matter.

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