Avocetta N° 16: 105-107 (1992)

Does Cory's Shearwater breed every year or is there evidence for a sabbatical?

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Abstract — A colony of Cory's Shearwater *(Calonectris d. diomedea)* was studied for several years on a rocky island off Crete. Care was taken to distinguish breeding birds, including unsuccessful breeders, from the non-breeding population. From yearly retrap data of breeding birds it is concluded that they make a breeding attempt every year and do not take a sabbatical. This result differs from the finding that the Atlantic subspecies *borealis* shows a sabbatical frequency of 7% (Mougin *et al.* 1985).

Introduction

Large southern hemisphere albatross species such as the Wandering Albatross *Diomedea exulans* have unusually long breeding periods. The time period from egg laying till fledging of the young lasts from January to December. When the time for the occupation of nest territories and pair formation before the breeding season, and for moult afterwards are included, this period is even longer. It is plausible that birds of this size do not breed continuously but only every other year. The year in between is termed a 'sabbatical' year. All larger albatrosses regularly take a sabbatical year, so that the sabbatical frequency within the population is 100% (Warham 1990). In the medium-sized Procellariiformes some of the population breed a number of years in sequence, but then are probably exhausted and take a year off. Thus a fraction of the population is regularly out for a sabbatical year (Warham 1990). Although Cory's Shearwater *Calonectris d. diomedea* is the largest representative of the Procellariiformes in the Mediterranean, it is a small to medium-sized bird (weight 400-800 g) in comparison to the albatrosses. A substantial fraction of the population can reach an age of 20 years. A report on the Atlantic subspecies *borealis* described a sabbatical frequency of 7% (Mougin *et al.* 1985). We tried to find out whether a sabbatical year is also a regular phenomenon in the Mediterranean subspecies of Cory's Shearwater.

Material and Methods

The population of 500-800 pairs studied lives off Crete on a rocky island less than 1 km in length. We spent a few weeks on the island every season for more than 15 years. Cory's Shearwater nests were located by day by looking for places with faeces and investigating the nearby crevices with a strong torch. As nests can easily be overlooked, we also searched for nests in August/September during the night when the feeding call of the chick gives evidence for nest position. Nests were marked by an inconspicuous, small black metal badge with a nest number which even in a sea-side atmosphere lasts for more than 20 years. We therefore now know more than 320 accessible nest sites.

Nests are typically 2-3 m deep in the rock, in holes and crevices, almost always one nest per entrance. We know only 8 nests under dense vegetation. This is in contrast to the situation on the Selvagem Islands where a substantial part of the population studied bred in the open (Jouanin *et al.* 1989). Distances between nests can be as small as 2 m, are typically 20 m, and in exceptional cases can be more than 50 m. Shearwaters show a high degree of nest site tenacity, but occasionally an adult shearwater breeds in the neighbouring nest site in the following year (Ristow *et al.* 1991).

The study area of 350 m x 250 m contained 207 accessible nests, 119 unaccessible nests and the number of unknown nests is estimated at about 30.

Accepted 20 December 1992

Table 1. Retrap data for breeding Cory's Shearwaters in a test area with an estimated number of 350 nests.

year	investigated nest sites	occupied nests	adults on the egg		"new" breeders		potential sabbatical	
			♂	♀	♂	♀	♂	♀
1985	111	96	87	80	-	-		
1989	179	137	122	121	90	87		
1990	176	152	132	136	37	40	1	0
1991	204	164	143	148	45	43	0	1
1992	207	162	127	142	38	27	0	1

Nests were checked during the daytime in June when shearwaters incubate their eggs. In addition to ringing the birds, we marked the incubating adult with a small white paint dot on the forehead. The paint lasts for 3-4 weeks before peeling off. So that when checking the nest again a couple of days later, the white marked bird did not need to be disturbed again. After a typical incubation spell of 6-7 days, the partner usually took over breeding duties, and was recognized by the absence of a dot and checked for ringing. Owing to the difficult topography of the island, about 40 nests could be checked per day, and after two weeks of field work the breeding population of the study area was almost completely evaluated. As hatching success is only 84% and deserted eggs may be eaten by rats, care was taken not to confuse early egg loss with non-breeding. The field work reported here was carried out in 1985 and 1989-92.

Results

In monitoring the breeding shearwaters in our study plot we tried to find out whether the birds breed every year or whether some of them take a sabbatical. An overview of our results is given in Table 1. The number of breeding birds checked is lower than the number of occupied nests because of breeding failures early in the season or because we did not succeed in capturing all the adults. The term "new" breeders refers to birds which had not been trapped before or were recorded before as known non-breeders (bachelors). In 1989 the number was high because we did not check the birds in June 1986-88, i.e. some birds died and others moved in. As a rule, we checked all breeding birds in the other years. When they were missing we did not see any of the breeding birds again in any of the subsequent years. We assume that these birds had died, so the column "new breeders" indicates the yearly population exchange.

In comparison to this data, the number of birds which might qualify for a sabbatical since they were retrapped after an intermittent year is very low (Table 1, last column). Here we list those birds whose nest was either empty the previous year or where another bird of the appropriate sex was present in the nest in the previous year and the former owner could not be found elsewhere. We do not include in this category birds where egg shells indicated an early breeding failure, or where the adults could not be trapped, but were again breeders in the following year. As shearwaters do not produce a substitute clutch, the subsequent months of non-breeding are a natural reaction to breeding failure, but do not fulfill the biological meaning of a sabbatical. Even if we accept the individuals in the last column of Table 1 as sabbaticals, a frequency always less than 1% is found. Error introduced by dispersal of ringed breeders to unchecked nests in one year and back to an accessible nest the next year would increase the apparent sabbatical frequency. Hence, 1% is an upper limit. It seems more reasonable, however, to assume that also in these few cases an undetermined natural cause of breeding failure had occurred and escaped our knowledge. We suggest therefore that the sabbatical effect does not exist in the Aegean population of Cory's Shearwater.

Discussion

When unsuccessful breeding starts are excluded, there remains no firm evidence for a sabbatical year for the Mediterranean subspecies of Cory's Shearwater. An apparent sabbatical can be the result of egg loss or of partner loss, at an advanced phase in the breeding cycle. In particular, we have no case when a pair was off on sabbatical. Among large albatrosses a pair always goes on sabbatical. A year later it is advantageous for the pair to meet again, so that pair formation and territory occupation are simplified. In species with a low value of sabbatical frequency and a large reserve population, the nest site of a pair on sabbatical is occupied in the meantime by competitors who breed in the intermittent year and claim their rights when the former owner returns. This disadvantage of the sabbatical hardly exists for the albatrosses, but is immanent for Cory's Shearwater.

Acknowledgements — We thank the Greek Ministry of Agriculture for permission to study the population of Cory's Shearwaters. We gratefully acknowledge assistance in the field by H. Dohna, H. Ludewig, T. Ristow, W. Scharlau, and S. Tempelhoff.

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