

# Aspects on the breeding biology of Cory's Shearwater (*Calonectris diomedea*) in the Maltese Islands

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The population of Cory's Shearwater (*Calonectris diomedea*) in the Maltese Islands has been estimated at around 7,000 breeding pairs. The colonies are mainly found in inaccessible sheer limestone cliffs. The Cory's Shearwater has a life span of about 25 years; therefore, long-term studies are fundamental in determining the exact picture of their ecology and breeding biology. The first ringing studies were started in 1969 at a small colony on the island of Filfla through a capture – recapture programme. In 1983, a long-term study on the ecology and breeding biology was started at seventeen accessible nesting areas in colonies (ten in Malta and seven in Gozo) and over 155 nests were annually monitored. Over 2,500 Cory's Shearwaters, including both adults and chicks, have been ringed since 1965. Longevity, site-tenacity and mate fidelity, breeding success, movements and philopatry are presented. Three males ringed as adults have been retrapped after nineteen years while one female, also ringed as an adult, was retrapped after 17 years. One nest-site was used for 15 consecutive years by the same pair. Some birds were breeding at an earlier age than usual. This is due to intensive human interference, which greatly affects the normal pattern of behaviour of these colonial seabirds.

Key words: Cory's Shearwater (*Calonectris diomedea*), site tenacity, mate fidelity, breeding success, movements, philopatry, Malta, Mediterranean.

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## 1. Introduction

The main aim of this paper is to present some of the aspects of the ecology and breeding behaviour of the Cory's Shearwater (*Calonectris diomedea*) in the Maltese Islands. The results are mainly based on studies carried out over a fifteen year period, from 1983–1998.

The Maltese Islands are situated in the centre of the Mediterranean Sea, 83 km south of Cape Passero in Sicily and 334 km north of the Libyan coast, at approximately 36 ° N and 14 ° E. The archipelago consists of three inhabited islands, namely Malta, Gozo and Comino, and a number of much smaller, uninhabited islets, which are of notable ecological importance: Cominotto, Filfla, St. Paul's Islands and Fungus Rock, together with some large rocks. The total area of the whole archipelago is about 317 km<sup>2</sup> (Table 1).

Table 1: Island's size, biotope and estimated number of breeding pairs of Cory's Shearwaters. –

Island	Total Surface area	biotope	No. of pairs
Malta	245.7 km <sup>2</sup>	cliffs-boulders	2,500 – 3,000
Gozo	67.1 km <sup>2</sup>	cliffs	3,500 – 4,000
Fungus Rock	0.7 ha	cliffs	2 – 5
Comino	2.8 km <sup>2</sup>	cliffs-boulders	15 – 20
Cominotto	9.9 ha	cliffs	0
Filfla	2.0 ha	boulders	50 – 80

The total length of the coastline of all the islands is 190 km, 38 km of which consist of sheer cliffs. The seacliffs bordering the southern coasts of Malta and Gozo reach a maximum height of about 230 metres. In most areas, the cliffs are 'honey-combed' with caves, crags and fissures,

situated at various heights and offering ideal nesting sites for shearwaters. In some areas, large boulders and screes have accumulated throughout the years at the foot of cliffs as well as on ledges, increasing the availability of nesting sites. Apart from the cliffs of the two main islands, four other islands, namely Comino, Cominotto, Fungus Rock and Filfla, host one or more of the three pelagic breeding species in the Maltese Islands, namely the Cory's Shearwater, the Yelkouan Shearwater (*Puffinus yelkouan*) and the (Mediterranean) Storm-petrel (*Hydrobates pelagicus melitensis*). Fungus Rock and Filfla Island are legally protected Nature Reserves.

## 2. Material and Methods

Bird ringing in Malta started in 1965 and in the first few years Cory's Shearwaters were randomly ringed, without any specific studies in mind, mainly on Filfla islet during visits to ring Storm-petrels. Since then over 2,500 Cory's Shearwaters were ringed.

Specific studies on the ecology and breeding biology of the Cory's Shearwater were started by one of us (JJB) in 1983. This paper covering a period of 15 years up to 1998, is based on 155 accessible nests located at 17 different sites. Individual nests were numbered and both partners and consequently the young of each accessible nest were ringed. The incubating adults were also marked with a dye-spot on the forehead to eliminate unnecessary handling for identification purposes. The two main sites under regular study were the steep sea-cliffs at Hal-Far, Malta and at Gharb, Gozo. The nests are usually located in natural crags or under boulders. They are usually situated at different heights ranging from 1 to 120 metres above sea level.

The study areas were visited regularly, commencing from the last week of February to the third week of October. Individual nests were visited once a week to minimise disturbance. A special retrieving tool was used to bring out the adults and young from deep nest-sites for ringing and inspection. This tool consists of 2 m long pole with a running noose at the tip. During visits at night non-breeding birds (bachelors and/or prospectors), which are identified due to their behaviour when they land, were also marked and studied for any interactions with the breeding adults. Birds were sexed using the bill measurements' methodology of RISTOW & WINK (1980), by cloacal inspection (SERVENTY 1956) and/or by their calls (pers. obs.).

## 3. Results

### 3.1. Longevity (Table 2)

The results presented here include birds that have been ringed since 1968. In the first years the rings used were made of aluminium and these deteriorated at a much faster rate than incoloy rings, resulting in the loss of valuable data. The oldest birds recovered to date are three males, which were ringed as adults on Filfla and were retrapped several times up to nineteen years later.

Table 2: Longevity, x = year of ringing. – Langlebigkeit, x = Beringungsjahr.

	MALE	FEMALE	SEX unknown
x+10	12 (4 as chick)	9	11 (1 as chick)
x+11	6 (1 as chick)	5	6
x+12	5 (3 as chick)	3	6 (1 as chick)
x+13	3 (2 as chick)	2	2
x+14	3	0	4
x+15	3	2	1
x+16	1	0	0
x+17	2	1	1
x+18	0	0	1
x+19	3	0	0

### 3.2. Age of first breeding

Males have been found to start breeding generally in their 4<sup>th</sup> and 5<sup>th</sup> year (exceptionally in their 2<sup>nd</sup>) while females in their 5<sup>th</sup> and 6<sup>th</sup> year. Two male birds were found nesting in their second year while four other birds (3 males and 1 of unknown sex) in their fourth year.

### 3.3. Site tenacity and mate fidelity (Table 3 & 4)

Table 3: Site tenacity, n ♂ = 194, n ♀ = 154. – Brutplatztreue.

Years	♂	♀
10	4	2
11	3	2
12	1	1
13	0	1
14	0	1
15	1	0
16	1	1

Table 4: Mate fidelity. – Partnertreue.

Consecutive years	Pairs
2	30
3	24
4	20
5	7
6	6
7	3
8	3
9	3
15	1

Males showed stronger nest tenacity than females. 19.4 % of 194 breeding males nested in the same nest for ten to sixteen consecutive years, while 12.3 % of 154 breeding females occupied the same nest for the same period. One male and one female were found occupying the same nests respectively for sixteen consecutive years. However extra-pair presence within the nesting chamber has also been recorded as in the following examples.

Nest 163: In 1987 male FF01071 and female FF00897 were occupying nest 163. On two different nights a new male FF00327 was found courting FF00897. The following year the same pair was again present in the nest but on one occasion, a new female FF00712 was found incubating. In 1989, both birds were not re-trapped while another female FF01419 was found occupying the nest. The nest was later found deserted and was never used again.

Nest 165: Male FF00316 and female FF00917 were occupying nest 165 in 1989. At least on one occasion a new male FF01179 was found courting the female in the nest site. In the following year, none of the birds were re-trapped and the nest was deserted.

Nest 357: In 1994 and 1995, a pair (male FF01765 and female FF01759) occupied nest 357. In both years, they managed to raise a chick. In 1994, another male FF00833 was found copulating with FF01759 but in the following year, male FF00833 was found occupying a different nest (no. 359) located less than a metre away from nest 357.

### 3.4. Incestuous behaviour

A chick ringed in nest 225 in 1992 (male FF01776) was re-trapped in 1998 in his natal nest when six years old. He was found in the company of his parent female FF01547, which was the same bird which occupied the nest 225 in 1992. Later in the season, both male FF01776 and female FF01547 were found incubating the egg and later feeding their offspring. The old male (father of FF01776) was last re-trapped in 1996.

### 3.5. Breeding success (Table 5)

From 1983 to 1998 the average successful rate of fledging was 63.8%. The percentage of chicks which hatched but did not succeed to fledge was 11.2%, while the percentage of the eggs which were laid but did not hatch was 24%. In 1996, several established pairs were taken by man and from 155 nests under observation only 31 nests were occupied by incubating birds. Successful fledging for 1996 was only 48.3% (51% of the eggs did not hatch and 0.7% of the chicks which hatched failed to fledge). This low breeding success was also reflected in the following year. In 1998 when there was less human disturbance the breeding success rate started to increase again.

Table 5: Breeding success in Cory's Shearwater between 1983–1998. – Bruterfolg des Gelbschnabel-Sturmtauchers von 1983–1998.

Year	Sample no. of nests	Percentage per year		
		Unhatched Eggs	Unfledged chicks	Successful fledging
1983	41	27.0	5.0	68.0
1984	36	8.5	8.5	83.0
1985	52	23.0	8.0	69.0
1986	55	22.0	9.0	69.0
1987	61	31.0	13.0	56.0
1988	58	28.0	5.0	67.0
1989	57	26.0	2.0	72.0
1990	52	31.0	6.0	63.0
1991	39	20.5	15.0	64.5
1992	47	25.5	4.0	70.5
1993	35	17.0	9.0	74.0
1994	59	34.5	4.5	61.0
1995	69	16.0	21.7	62.3
1996	31	51.0	0.7	48.3
1997	26	11.5	50.0	38.5
1998	38	21.0	18.4	55.2
Mean	47.2	24.59	11.23	63.83

### 3.6. Philopatry

During the study period (1983–1998) 594 chicks were ringed. 44 (7.4%) of these have been re-trapped in later years as adults. Males have been found to be highly philopatric. Three males were found breeding in their natal nest, seven others were breeding between 1 to 3 m away while six others were breeding at a distance of 6 to 15 m. Females also make their first landfall close to their natal nest but they eventually move further away. One female ringed on the island of Malta was found breeding in a colony in Gozo, 42 km away from its natal nest.

### 3.7. Movements

Very few movements were noted to take place from one colony to another within the Maltese Islands. Seven birds which were found to have moved away from their natal colony were all females. Six of these were ringed as prospectors and one was ringed as a breeder. Distances involved varied from 200 m (1 bird), 5 km (2), 11 km (1), 13 km (1) to about 35 km (2). The only foreign recoveries are of two unsexed birds both ringed on Filfla, one in 1977 and the other in 1978. These were recovered in Sicilian (on 23 March 1979) and Tunisian waters (on 07 March 1981) respectively.

## 4. Discussion and Conclusions

The Cory's Shearwater is a long-lived, burrow-nesting, pelagic seabird which has a breeding season spanning over a period of eight months (March to October). The rest of the year is spent wandering offshore. It is a common breeding bird in the Maltese Islands, found nesting on the three main islands (Malta, Gozo and Comino) as well as on Filfla Islet and Fungus Rock (Table 1). Breeding colonies are located mainly on the south, southwesterly cliffs of Malta and Gozo. The largest concentration is at Ta'Cenc Cliffs in Gozo with 1000+ pairs. Due to heavy human disturbance,

most of the nesting sites are inaccessible and only the fringes of the colonies are accessible. Birds arrive at the colonies at the end of February. The first to arrive are usually males. The females join them a few days later. Courting takes place in late April and by the second week of May all the mated females participate in a pre-laying exodus lasting from 10–12 days (pers. obs.). Egg laying is synchronous, with peak laying dates on the 27–28 May. The incubation period lasts for fifty-five days and is equally shared by both partners. When the young hatches one of the parents broods it during the first 3–5 days. Then it is left alone and visited only at night. Fledging takes place in the first two weeks of October (SULTANA & GAUCI 1970 and 1982, CACHIA-ZAMMIT & BORG 1986–87, BORG & CACHIA-ZAMMIT 1998, BORG 1999).

Delayed breeding is a feature of the tubenoses' reproduction. No species is known to breed unless it is at least two years old. Most species of shearwaters take 5–6 years to reach breeding status (WARHAM 1990). In most petrel species males mature earlier than females and the Cory's Shearwater follows closely the same pattern (THIBAUT 1993, BORG 1999). In Crete, WINK et al. (1982) found that some birds return to the colonies at the age of five years, while on Great Selvage birds start to breed between their 8th and 11th year (JOUANIN et al. 1980). In the Maltese Islands males have been found to start breeding earlier (CACHIA-ZAMMIT & BORG 1986–87, BORG 1999). Although an overall view of the first time breeders in Malta show that most birds of both sexes start to breed at an average age of 6 years, the age of first breeding may be earlier in disturbed areas. Due to intensive human interference, which includes the taking of adult breeding birds, vacant nests and widowed partners are regularly available. Thus 'young' birds, after making their first landfall at the colony, are likely to find vacant nests or single mature birds readily. They are therefore stimulated to start breeding earlier.

When shearwaters breed successfully and raise their chick in a particular nest/colony they rarely shift to another site (Warham 1990). The Cory's Shearwater is no exception and follows the same pattern (WINK et al. 1982, SWATSCHEK et al. 1994, THIBAUT 1994, BORG 1999).

Site tenacity in Maltese birds was also investigated during the study period 1983–1998. It has been established that partners are first and foremost faithful to their nest site, and only circumstantially to each other (Table 3 and 4). It should be noted that a pair, which remained together for 15 consecutive years, was located in a secluded, almost inaccessible area. Recent observations have shown that even when paired, birds of both sexes were not entirely faithful to their partners. When the male bird is incubating the egg and a prospecting female enters the nesting chamber, the male will court and eventually copulate with the new female. This behaviour by the male may be beneficial in the future if it happens that his partner fails to turn up. Throughout the breeding season, one male may copulate with one or more females apart from his partner. On the other hand, it was found that infrequently, when the male partner is away, a paired female may also attract a bachelor male that alights in the same area in consecutive nights for copulation.

The disappearance of one or both partners from a nesting site has been mainly due to human interference. It was noted that in 98% of the cases, where a change of partners had occurred, one of the original pair had been earlier removed by humans from the nest site. The other 2% of the birds were found nesting somewhere else. Separations in Maltese birds were found to be more frequent than previously recorded by BORG & CACHIA-ZAMMIT (1998). The strong site tenacity of the species coupled with the frequent loss of one of the partners due to human interference sometimes results in incestuous behaviour. This 'abnormal' behaviour was first reported by BORG (1999), but similar cases were also noted in Corsica (C. RABOUAM & J.C. THIBAUT pers. comm.).

According to Warham (1990) the breeding success in the Procellariiformes species is relatively high when compared to other seabirds. However within a species there is always some degree of variation due to the difference in age and experience (WOOLLER et al. 1990). This variation is also related to food resources, disturbance and predation at breeding sites (SCHREIBER & SCHREIBER 1984, BORG & CACHIA-ZAMMIT 1998). The breeding success in the Maltese Islands, at

63.8 %, is relatively low. In other countries the breeding failure in Cory's Shearwater is mainly attributed to "natural" causes (MOUGIN et al 1993, BAYLE & FERNANDEZ 1992, THIBAUT 1995, RISTOW et al 1990). In Malta the relatively low breeding success is mainly due to direct human persecution, although predation by rats *Rattus* sp., cats and polecats *Mustela putorius* (the latter used for rabbit hunting) also occurs to a lesser extent (CACHIA-ZAMMIT & BORG 1986–87). In fact in 1998, when less human disturbance was in evidence in the study areas, the breeding success rate started to increase (see Table 5).

Philopatry is the return to the natal colony by the young. This behaviour was found to be part of the life cycle of the Cory's Shearwater (JOUANIN, ROUX & ZINO 1977, RISTOW et al. 1990, THIBAUT 1993, BORG 1999). Males are more philopatric than females. They never wander away from their natal colonies. After their first landing at the colony they never move any great distance from their natal nest. On the other hand, females tend to move further away (BORG 1999).

### Zusammenfassung

#### Aspekte zur Brutbiologie maltesischer Gelbschnabel-Sturmtaucher (*Calonectris diomedea*).

Die Brutpopulation des Gelbschnabel-Sturmtauchers (*Calonectris diomedea*) dürfte auf den maltesischen Inseln bei rund 7000 Paaren liegen. Die Kolonien befinden sich vor allem in unzugänglichen, steilen Kalksteinfelsen. Gelbschnabel-Sturmtaucher können ein Alter von etwa 25 Jahren erreichen; deshalb sind Langzeituntersuchungen erforderlich, um ein exaktes Bild von den ökologischen und brutbiologischen Aspekten erhalten zu können. Die Studien mit Hilfe der Beringung wurden 1969 in einer kleinen Kolonie auf der Insel Filfla im Rahmen eines Fang-Wiederfang-Programms begonnen. 1983 begann in 17 erreichbaren Nistgebieten (10 auf Malta, 7 auf Gozo) eine Langzeitstudie zur Ökologie und Brutbiologie, wobei jährlich über 155 Nester unter Kontrolle standen. Es konnten seit 1983 über 2500 Individuen (Altvögel und Nestlinge) beringt werden. In der vorliegenden Arbeit werden Befunde zum Lebensalter, zur Brutorts- und Partnertreue sowie zum Bruterfolg, über Wanderungen und Geburtsortstreue präsentiert. Drei als Altvögel beringte ♂ konnten noch 19 Jahre später wieder gefangen werden, ein als Altvogel beringtes ♀ nach 17 Jahren. In einem Fall wurde ein Nestplatz in 15 aufeinanderfolgenden Jahren jeweils vom selben Paar genutzt. Einige Vögel begannen in früherem Alter zu brüten als üblich. Dies geht auf die intensiven menschlichen Störungen zurück, die das normale Verhaltensmuster in starkem Maße beeinflussen.

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