

## Protection of Cory's Shearwater *Calonectris diomedea* by limitation of a population of Feral Rabbits *Oryctolagus* on the Frioul Archipelago (Marseilles, France)

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### Introduction

Human introduction of domestic and anthropophilic mammals has caused considerable damage to island ecosystems throughout the world (Merton 1978, Croxall *et al.* 1984, Chapuis *et al.* 1991). Birds, especially seabirds, have suffered the impact of these introductions mainly because of predation: numerous examples of population declines, local extinctions and some total extinctions of species are documented (Dilks 1979, Moors and Atkinson 1984).

In the Mediterranean a decline in Procellariiform colonies has been noted on some islands: this is usually imputed to feral cats *Felis catus* or Black Rats *Rattus rattus* (Cheylan 1985, Fernandez 1988, Daycard and Thibault 1990).

However the action of some species of mammals on sea bird colonies can be indirect: Fernandez (1989 and 1991) has shown that the illicit introduction of rabbits *Oryctolagus* in 1984 on to the Frioul Archipelago off Marseilles (Figure 1) was immediately followed in 1985 by a reduction of Cory's Shearwater *Calonectris diomedea* chick production (Figure 2b) and in 1986 by a decrease in the number of breeding pairs (Figure 2a). The Frioul Archipelago rabbits are hybrids between wild *Oryctolagus cuniculus* and domestic rabbits *Oryctolagus cuniculus* var. *domesticus*. Both species compete for the same breeding sites: rabbits either usurped or destroyed 18% of shearwater nesting cavities and were responsible for the destruction of c. 1% of eggs and the death of 1-2% of chicks. They also disturb the adult birds at the beginning of the breeding period which may presumably inhibit the nesting of a certain number of pairs.

To try to lower the pressure that the rabbit population exerts on the shearwater colony,

reduction of the number of rabbits has been carried out every year since 1987. The aim of this paper is to give the results of this, both in the rabbit and the shearwater.

### Study area

The Frioul Archipelago is situated in the Mediterranean, in the bay of Marseilles, its northerly point being only 1.8 km from the continental coastline (Figure 1). It consists of two islands, Ratonneau to the North and Pomègues to the South, and of an islet, Tiboulén de Ratonneau, to the West. The two islands were linked by a dyke during the 19th Century and cover a total surface area of 145 ha. Protected by this dam a marina and a tourist housing estate, named "Port-Frioul", were developed during the 1970s. With the exception of a few naval enclosures the Frioul Archipelago belongs to the City of Marseilles. The urbanized zone covers 12 ha, the rest is in "natural" state, characterized by outcrops of limestone, very little soil and a sparse and deteriorated vegetation, remnant of the typical plant community of the rocky coast of the Marseilles area.

Cory's Shearwater on Frioul Archipelago has been monitored by one of us (O.F.) since 1972, and all nests have been found since 1979. The birds were ringed as part of a personal programme with the *Centre de Recherches sur la Biologie des Population d'Oiseaux*. Maximum figures since 1979 were 73 pairs on Pomègues, 7 on Ratonneau and 5 on Tiboulén de Ratonneau (Figure 1).

Rabbits are only found on Pomègues Island. The rabbit population is hard to estimate because it is very unsteady, its size depending on different external parameters (rainfall and plant growth;

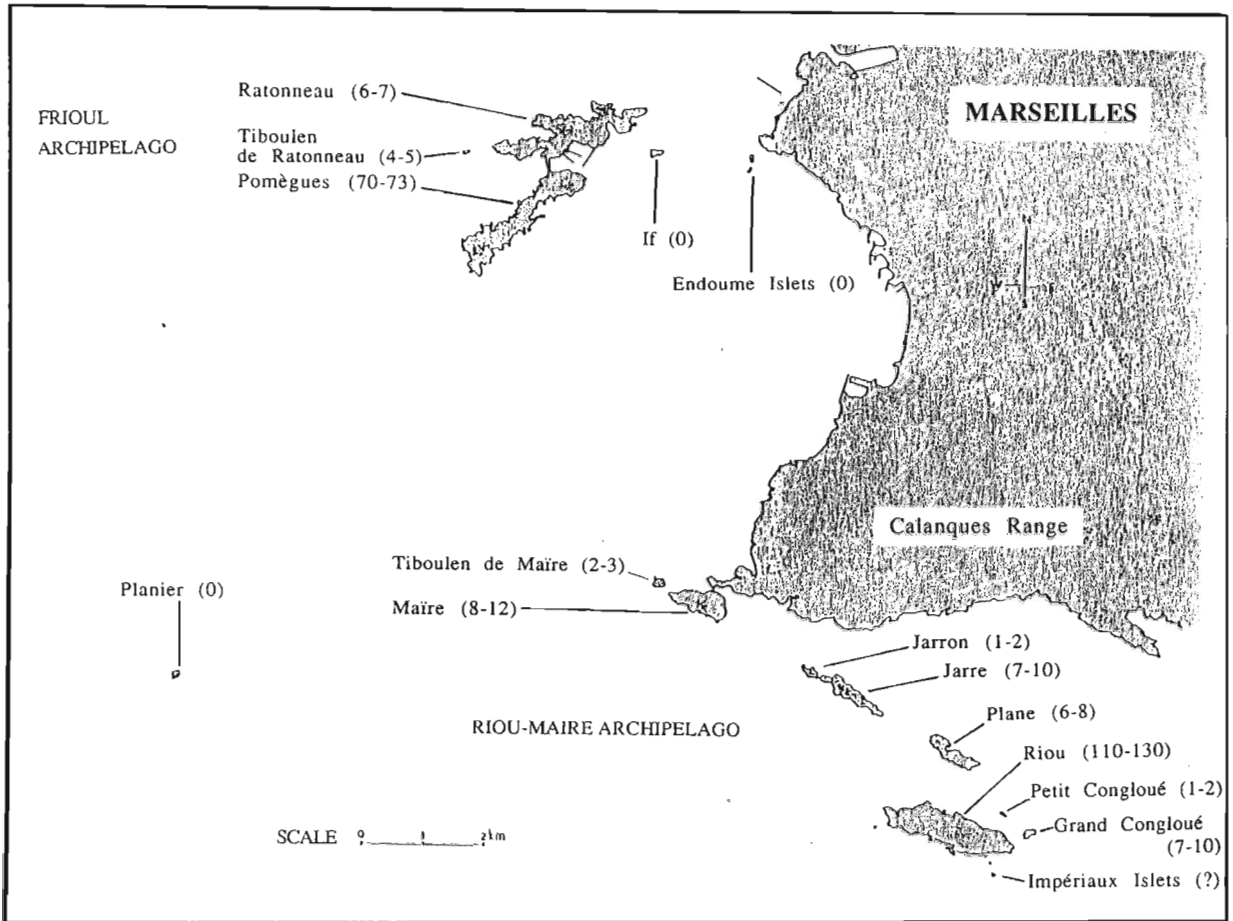


Figure 1. Distribution of Cory's Shearwater on the islands off Marseilles (France) before 1984 (after Fernandez 1991).

myxomatosis). A reasonable estimation is c. 150-200 individuals in November.

### Methods

As owner of Frioul the City of Marseilles was called on in 1986 by the *Association Régionale pour la Protection des Oiseaux et de la Nature* to find a solution for the ecological imbalance caused by the presence of rabbits.

Different methods were experimented with to withdraw a maximum number of rabbits: with nets and hunting dogs *Canis familiaris* (1987-88), with Ferrets *Mustela putorius* var. *furo* (1989) and shooting after ferreting (since 1990). These operations took place while the shearwaters were absent, *i.e.* between November and March. Depending on weather conditions they lasted between 3 and 11 days and required the contribution of a daily average of 5-6 volunteer hunters.

### Results

424 feral rabbits were withdrawn from Pomègues Island in 6 campaigns (from winter 1986-87 to 1991-92) (Figure 2c): 160 were captured alive and 264 killed. This represents an average of 70.7 rabbits/year and 1.8 rabbits/day/hunter. Important variations in the success of the operations were noted from year to year but these are not related to the effective size of the population. The landscape features (steep slopes, cracked limestone) are an explanation for the impossibility of reducing the number of rabbits in a substantial and long-lasting way by traditional hunting methods.

273 Cory's Shearwater chicks were fledged out of 321 monitored nests between 1979 and 1984 on Frioul: a yearly average of 45.5 chicks for 53.5 breeding pairs. All nests were monitored every year between 1985 and 1992 (*i.e.* after the introduction of rabbits on Pomègues Island): 246 chicks were fledged out of 406 nests (yearly average of 30.7 chicks for 50.7 pairs) (Figure 2b).

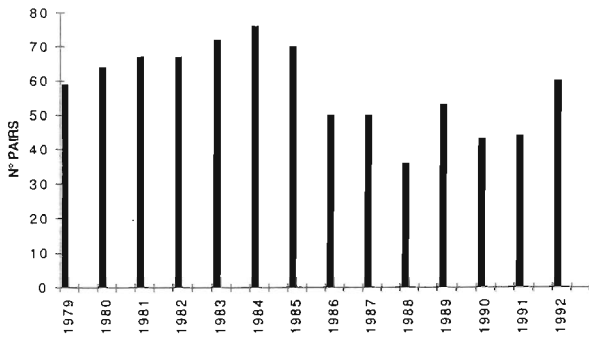


Figure 2a.

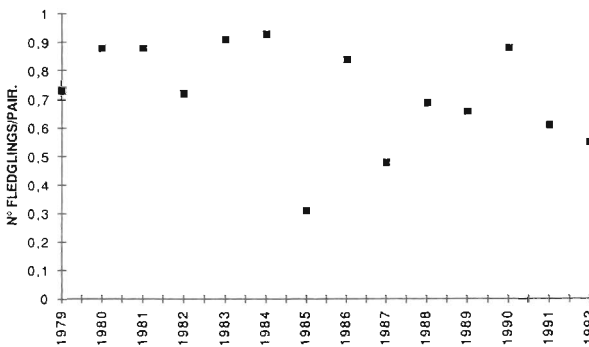


Figure 2b.

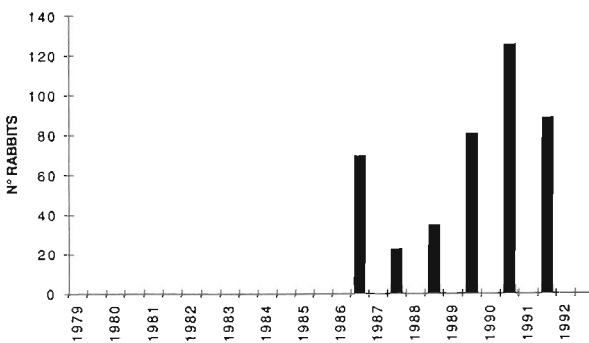


Figure 2c.

Figure 2. Number of breeding pairs of Cory's Shearwater (a), number of fledglings per pair of Cory's Shearwater (b) and number of feral rabbits withdrawn (c): Frioul Archipelago (Marseilles, France).

The decrease in the number of breeding pairs between these two periods is c. 25%. The number of young that leave the colony each year has diminished c. 33%. Before the introduction of the rabbit Cory's Shearwater was increasing on Frioul (c. 30% in 6 years) and its breeding success was stable (annual average:  $0.84 \pm 0.08$  fledgling/pair). The global decline of the shearwater colony that

occurred afterwards conceals important variations from one year to another (annual average:  $50.7\% \pm 9.9$  breeding pairs and average annual breeding success:  $0.63 \pm 0.15$  fledgling/pair).

### Discussion

The Calanques Range stretches to the South of the City of Marseilles from West to East. Off the steep coasts of these hills is found the Riou-Maire Archipelago which consists of 5 major islands, all uninhabited (Figure 1).

Together with the Frioul Archipelago these islands are a sanctuary for seabirds. Four species breed on them: Yellow-legged Gulls *Larus cachinnans*, Storm Petrels *Hydrobates pelagicus*, Mediterranean Shearwaters *Puffinus yelkouan* and Cory's Shearwater (Guyot *et al.* 1985). On the Frioul Archipelago there is no evidence for the presence of the Storm Petrel and the number of Mediterranean Shearwaters is reduced to 1-2 pairs. Before the decline of the Frioul colony the Cory's Shearwater population of the two archipelagos numbered between 220 and 260 pairs. The only other breeding population on the Mediterranean coast of continental France is found in the Hyères Archipelago, c. 75 km East-South-East of Marseilles: it is estimated at between 195 and 245 pairs (Guyot *et al.* 1985). Thus the island off Marseilles shelter between 50 and 55% of all Cory's Shearwaters nesting on the Provence coast (c. 18% on Frioul and c. 34% on Riou-Maire).

All the islands off Marseilles are of great importance for the conservation of seabirds, and especially the Procellariiforms, in the North-Western Mediterranean. Strict measures should be taken to protect the shearwaters and petrels that breed on these islands. This cannot be done without active management to reduce the ecological imbalances due to human interference. Rabbits, for example, have not only been introduced on to Pomègues but also on to the Riou-Maire Archipelago (Cheylan 1984). This applies not only to the conservation of sea bird colonies but also to the whole insular ecosystem which is more or less heavily damaged, depending on the islands (the most degraded being Ratonneau because of the permanent human occupation and, to a lesser extent, Pomègues).

The campaigns of rabbit control on Pomègues Island are the first such steps undertaken. Though they have not prevented the decrease of Shearwaters they have contributed to limit this decline. Without human intervention it is possible that shearwaters would have been eliminated from these islands by the rapid increase of the rabbit population. The withdrawals that are carried out each year are not able to eradicate these mammals but keep them from

exploding demographically. Had things taken their course "naturally" Cory's Shearwater would probably have disappeared from Frioul and its breeding population on the Provence coast would have been reduced by 18%.

Although imperfect the regulation of the feral rabbit population will continue on Frioul. For the near future ferreting and shooting will continue to be used, but more efficient solutions are being sought. Poisoning has been tested on rabbits on different islands around the world (Imboden 1987, Chapuis *et al.* 1991 *and pers. comm.*) and could prove to be the right method for the islands off Marseilles.

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