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Current breeding distribution and status of Audouin's gulls *Larus audouinii* in the Mediterranean

D. Oro [1], N. Baccetti [2], D. Boukhalfa [3], G. Eken [4], A. El Hili [5], V. Goutner [6], S. Karauz [7], C. Papaconstantinou [6], B. Recorbet [9] & X. Ruiz [1]

Abstract

During the 1990's, regular surveys of colonies of the Audouin's Gull *Larus audouinii* have been carried out throughout its breeding range in the Mediterranean. These have resulted in an up to date analysis of the status and distribution of the species. No breeding colony has been found outside the Mediterranean region. Although number of breeding pairs in colonies normally fluctuate from year to year, there has been a general increase in the total world population (estimated at 19,000-19,100 pairs in 1998) over the last 10 years. 65% of the world population is concentrated in only two western Mediterranean colonies, the Ebro Delta (11,700 pairs) and Chafarinas Islands, and 90% is found in Spanish colonies. An overall trend of increasing breeding numbers has also been recorded in Italy (802 pairs in 1998) and Greece, probably due to the discovery of several new colonies in the Aegean Sea (704 pairs in 1998). Numbers recorded in Algeria (160-170 pairs), Tunisia (60 pairs) and Morocco (60 pairs) are stable, whereas a slight decrease probably occurred in France (Corsica, 62-70 pairs in 1998) and Turkey (15-50 pairs). The status is poorly known in Cyprus (15-20 pairs) and Lebanon (15 pairs). Some threats to breeding Audouin's gulls have been identified. These vary between colonies, and reliable data is not always available. When present, carnivores cause large-scale desertions and are one of the most serious threats in the short term. Competition and predation by Yellow-legged Gulls *L. cachinnans* seem to be a threat in small Audouin's Gull colonies, whereas human activities are probably the main threat. Over-fishing is an important factor in the western Mediterranean and increasing tourism, with accompanying human disturbances and destruction of suitable breeding habitat, is also a threat throughout its breeding range. It

[1] Dept. Biologia Animal, Universitat de Barcelona, Diagonal 645, 08028 Barcelona, Spain.
[2] Istituto Nazionale per la Fauna Selvatica, via Ca' Fornacetta, 9, 40064 Ozzano Emilia BO, Italy.
[3] BP334, Hussein Dey 16040, Alger, Algeria.
[4] Middle East Technical University, Biology Department, 06531 Ankara, Turkey.
[5] Association «Les amis des Oiseaux», Faculté des Sciences, Campus Universitaire, 1060 Tunis, Tunisie.
[6] Dept. of Zoology, Aristotelian University of Thessaloniki, 54006 Thessaloniki, Greece.
[7] P.K. 245, 06443 Yenisehir, Ankara, Turkey.
[8] Hellenic Ornithological Society HOS, Em. Benaki 53, 106-81 Athens, Greece.
[9] Direction Regionale de l'Environnement, BP 334, 20180 Ajaccio cedex, France.

seems clear that a more rational exploitation of fishery resources would be beneficial for Audouin's gulls in the long term; however, culling Yellow-legged Gulls probably has little effect on population dynamics of Audouin's gull. Much more work is needed to identify the threats for the species especially in eastern and southern Mediterranean colonies. Although the species is nowadays modestly common, its conservation status is still endangered since its populations are geographically restricted.

Introduction

Audouin's Gull *Larus audouinii* is a medium-sized (average weight 570 gm), monogamous gull with a modal clutch size of three eggs (see details in Oro 1998). The species is an endemic seabird of the Mediterranean region, and was considered to be threatened with extinction in the late 1960's (600-800 pairs, de Juana *et al.* 1984, de Juana & Varela 1993). Today, the species is still considered endangered (Lambertini 1996), and its current threat status is Conservation Dependent (Mace & Collar 1994). However the establishment in 1981 of a new colony in the Ebro Delta (north-western Mediterranean) has dramatically increased the total number of breeding pairs (Oro 1998). Since the late 1980's, no data on the status of the species at world population level have been published (de Juana & Varela 1993, but see Lambertini 1996 and Oro 1998 for more recent data). The knowledge of the population size and distribution of the species is still essential to assess whether the increase in total numbers from the 1960's up to the late 1990's is resulting from a real demographic growth, or simply is due to more precise surveys throughout the breeding range.

During the 1990's, regular surveys of colonies of Audouin's Gull have been carried out throughout the Mediterranean. These have resulted in an up to date analysis of the species' status and distribution. Moreover, the ecology of the species has been studied intensively in recent years, especially within most of the western population. Data on some aspects of the biology of the species have also been recorded very recently in France, Italy and Greece. Here we present the current breeding distribution and status of Audouin's Gulls in the Mediterranean and a summary of the main data recorded of its ecology during the last few years.

Population size and trends

Figure 1 illustrates how much the estimates at world population level, based on published studies and our own results, have dramatically increased. Table 1 shows the estimated size of the Audouin's Gull populations in every country. The Spanish population makes up 90% of the total world population, which is estimated at 19,000-19,100 breeding pairs (1998)(see also figure 2). This represents an annual increase of 9% since the last world breeding population estimation obtained in 1989 (de Juana & Varela 1993). No breeding colony has been found outside the Mediterranean region, and no new major colony has been found within the ten countries where the species was already breeding in the 1980's (Table 1). Figure 3 shows that the location of the colonies has hardly changed since the last map distribution given by de Juana & Varela (1993). Since then, new

Country	Estimate	Year	Trend	(λ) (year)	Reference
Lebanon	15	1997	Unknown	-	J.Sultana (pers.com.)
Turkey	15-50	1998	Slight decrease	-2.7% (1974)	Present study
Greece	704	1998	Unknown	8.5% (1970)	Present study
Cyprus	15-20	1987	Unknown	-	de Juana & Varela 1993
Italy	802	1998	Increasing	1.6% (1988)	Present study
Tunisia	60	1996	Stable	0.7% (1984)	Present study
France	62-70	1996	Decreasing	-3.7% (1988)	Present study
Algeria	160-170	1998	Stable	-6.1% (1978)	Present study
Morocco	60	1997	Increasing	6.3% (1984)	Present study
Spain	17125	1997	Increasing	10.9% (1989)	Present study
Total	19000-19100			8.1% (1989)	

Table 1. Estimated size of the Audouin's Gull *Larus audouinii* breeding population for each country. Population growth rate (l) is given together with the year of the last previous estimate or census (from de Juana & Varela 1993), except when accurate information is lacking.

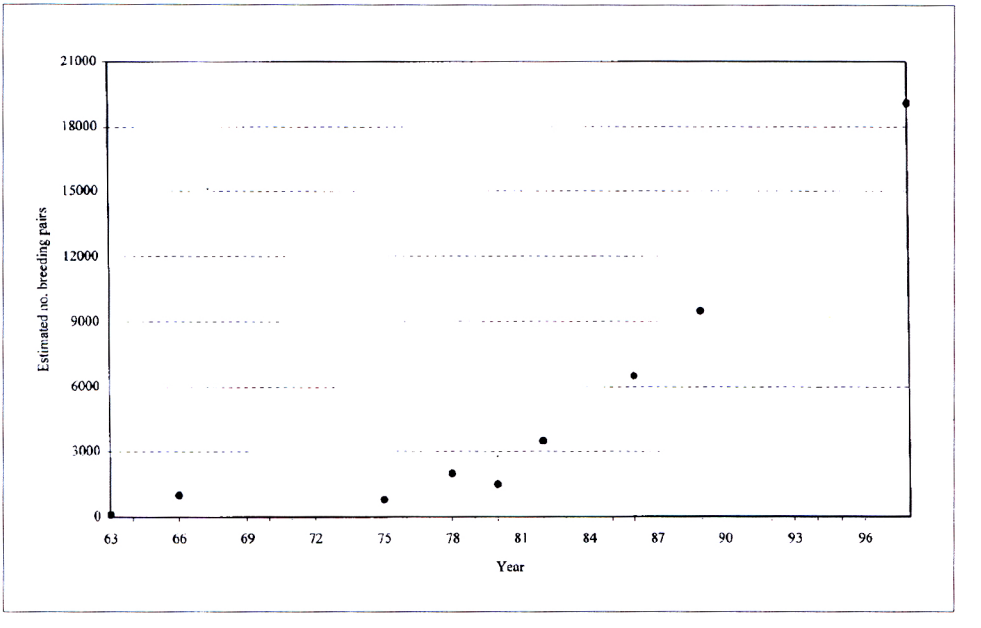

Figure 1. Estimates of the world breeding population of Audouin's Gull *Larus audouinii* (after several authors quoted in de Juana & Varela 1993, and present study).

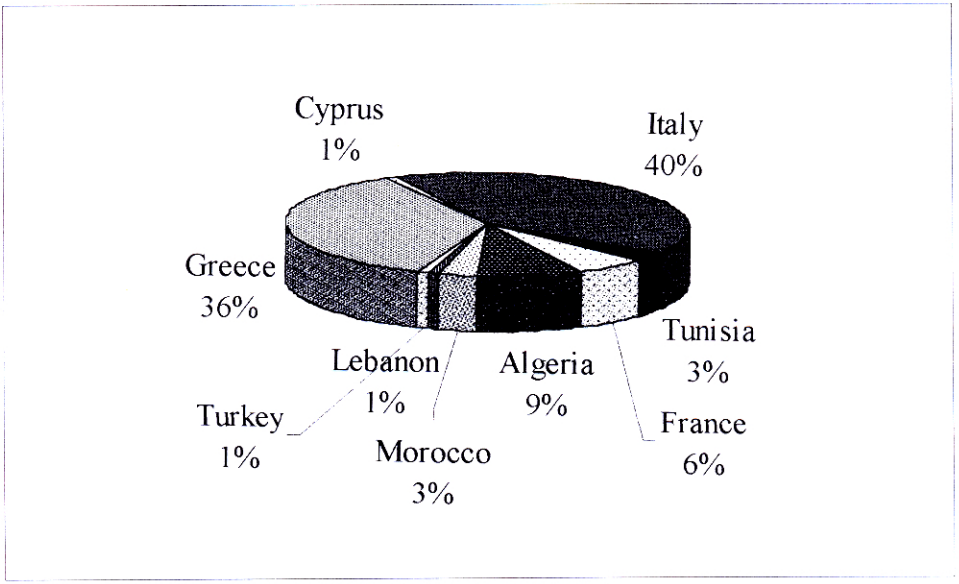

Figure 2. Population size (in %) of Audouin's Gull *Larus audouinii* apart from the Spanish population,which represents 90% of the total world population. The estimated total number of the above countries is 1900 breeding pairs (see Table 1).

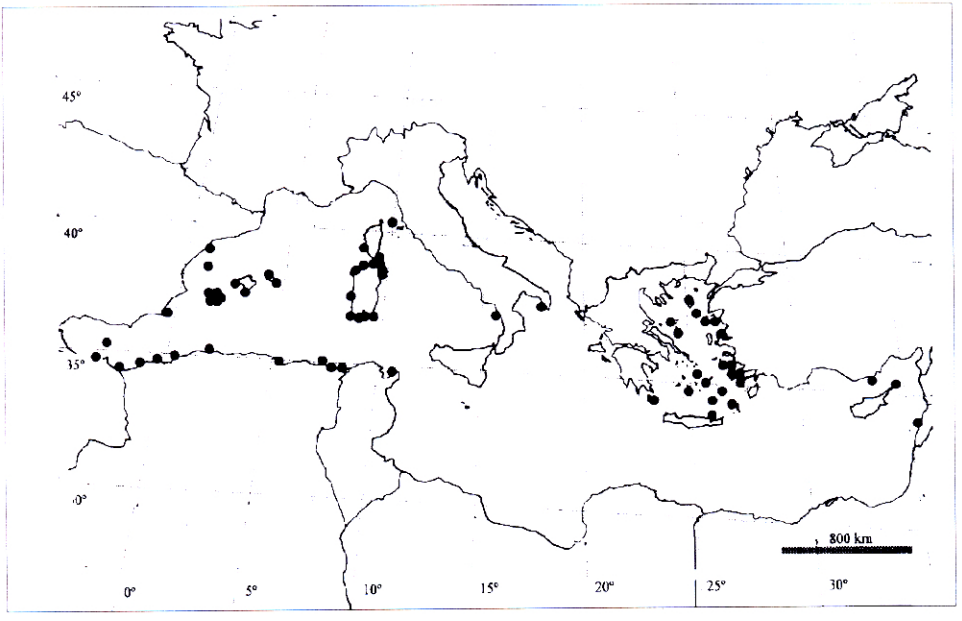

Figure 3. Map showing the distribution of the colonies of Audouin's Gull *Larus audouinii* in the Mediterranean (from de Juana & Varela 1993 and present study). Since breeding site turnover is very high in most metapopulations (see text), only colonies occupied during the most recent censuses are shown for each country.

colonies have been established in south-eastern Spain, the Balearic Archipelago, southern Italy (Calabria and Puglia) and Sardinia. Many colonies have been discovered in the Aegean Sea. Although the number of colonies is quite similar among eastern, central and western populations, 90% of the world population is concentrated in the western Mediterranean, where colony size is much larger than in the eastern and central basins. The information available for some countries (e.g. Lebanon, Cyprus) is patchy and the trend for these populations remains unknown.

a) Turkey

The Turkish breeding population has possibly decreased from the 30 breeding pairs estimated in 1974 to only 15-50 pairs in 1998, in four small colonies (Table 1). Breeding in the Karaburun Peninsula Islands was firstly confirmed in 1996 (an adult with two chicks, Eken 1997), while 3-4 pairs bred in 1998 (S. Karauz, unpubl. data). An estimate of 3-5 pairs breed at Bodrum Peninsula and Northern and Central Güllük Bay Islands (AKGT 1995, SAD & TTKD 1997). Finally, Audouin's Gulls breed at Aydincik Islands in numbers reaching the IBA criteria (Magnin & Yarar 1997). Breeding has been known there since the 1970's (Witt 1976), and these islands still hold the largest breeding population in Turkey (10 pairs in 1997, H.-H. Witt pers. comm.) even after the breeding numbers has dramatically decreased over the last decade (30 pairs in 1987, Magnin & Yarar 1997). Furthermore, breeding may be also occurring in two other sites: the Çiftlikköy and Alaçati Islands (Eken 1997), and the Datça Peninsula Islands where there are several observations of Audouin's Gull (Eken 1997).

b) Greece

No estimates had been recorded since the 1970's from Greece (de Juana & Varela 1993, but recent intensive surveys in several archipelagos have yielded the discovery of previously unknown colonies (C. Papaconstantinou & Hellenic Ornithological Society HOS, unpublished data). The monitored colonies (for four years) in the Dodecanese archipelago showed an increase and the general trend appears to be on the increase in spite of the fact that other colonies have disappeared. There are 25 known breeding sites in the Aegean Sea, all on small rocky islets. As the historical information available for most of the Aegean Sea is insufficient (de Juana & Varela 1993, Papaconstantinou & HOS unpubl. data), it is difficult to assess whether the population growth (from less than 100 pairs estimated in the 1970's to more than 700 pairs in 1998) is the result of a demographic increase or simply the result of better coverage.

c) Italy

Although the population has decreased in the Tuscan archipelago (N. Baccetti, unpubl. data), the general trend in Italy, is one of increasing, when recent estimates are compared to surveys carried out during the

last decades (550 pairs in the mid 1980's, 800 pairs in 1998). Steep changes have been recorded in population dynamics. In Sardinia there were 369 breeding pairs in 8 colonies in 1997 and 696 in 11 colonies in 1998, with an average growth rate of 44 % in the 8 colonies counted in both years, and 74 % in the largest colony. In Calabria (south-western Italy) a new small colony established in 1997 at Capo Palinuro was not present in 1998 (E. Romito, unpubl. data). A new small colony was also established in Apulia (south-eastern Italy) in 1992 (Cataldini & Scarpina 1993) and has since increased greatly (G. Marzano, unpubl. data).

d) France

Corsica holds the whole breeding population in France (around 60-100 pairs in 5-6 colonies, the largest with up to 60 pairs) The population seems to be quite stable since the last census in 1989 (Table 1).

e) Tunisia, Algeria and Morocco

The estimated breeding population (60 pairs in two colonies) in Tunisia is also stable. In Algeria, a decrease of the breeding numbers occurred between the late 1970's and the early 1990's (Table 1), although since 1993 and until 1998 the population seems to have increased slowly (1.2% of average annual growth rate) (see D. Boukhalfa, this volume). In Morocco the breeding population was estimated at 60 pairs in 1997, with an average growth rate of 6.3% since 1984.

f) Spain

Regular censuses have been carried out over the last 20 years in the main Spanish colonies (Chafarinas Islands off the Moroccan coast, Columbretes Islands, Balearic archipelago and the Ebro Delta). These censuses have shown that during the 1990's an increase occurred in the Ebro Delta as well as in the Balearic archipelago colonies (new small colonies were established there in the early 1990's, see review in Oro 1998), whereas numbers in the Chafarinas and the Columbretes Islands have been quite stable, although steep population fluctuations have been recorded (PCGA 1994, Oro 1998). A colony was re-established on Alborán Island in 1988, now increasing (from 20 pairs in 1989 to 160 in 1997). A new colony was discovered in 1989 in Grossa Island (south-eastern Spain) also increasing considerably (450 pairs in 1995, Oro 1998).

Ecology of the species

Intense scientific research carried out in the 1990's, particularly in the western Mediterranean, has yielded new information on the species (see review in Oro 1998 and references therein). It has been found that the species is more opportunistic in its feeding ecology and breeding habitat selection than previously thought.

Several studies have confirmed that Audouin's Gulls are specialist foragers taking clupeid fish mostly during the night (Oro 1995, Oro *et al.* 1997,

Mañosa 1998, Abelló & Oro 1999). They also exploit discards from trawler fisheries when this resource is highly available, probably because discarded fish represent a very predictable foraging resource in both space and time (see also Oro & Ruiz 1997). Thus, this behaviour would increase with the importance of the trawling fleet, and is probably more common in western parts of the Mediterranean where trawler fisheries are the largest.

Regarding breeding habitat selection, the habitats are diverse and not only rocky islets are selected (Cramp & Simmons 1983), but also sandy beaches such as in the Ebro Delta, harbour docks as in Corsica (Recorbet & Bonaccorsi 1995), or salinas. Actually more than 60 % of the pairs breeding in the Ebro Delta build their nest within the salinas area and a small colony is also established in salinas at San Pietro Island in Sardinia, Italy (N. Baccetti & M. Grussu, unpubl. data). It seems clear that the main factor influencing habitat selection in Audouin's Gull is the absence of terrestrial predators (mainly carnivores) and the protection of the area against the accessibility of these predators (Oro *et al.* 1999). The location of breeding sites on small rocky islets mostly without human settlements (and their associated predators such as feral dogs and cats) seems a constraint rather than a positive selection owing that in the Mediterranean only these sites appears to be safe for the gulls (Oro 1998).

On the other hand, recent data confirm that Audouin's Gulls may forage at large distances from the colony. Jacob & Courbet (1980) gave a minimum foraging distance of 25 km from an Algerian colony. Gulls breeding in the Ebro Delta may forage more than 160 km from the colony during the chick-rearing period (Arcos & Oro 1996, Mañosa 1998, Oro 1998). During incubation, Sardinian birds feed more than 50 km from their nests (Baccetti *et al.*, this volume). Thus Audouin's Gulls are very mobile feeders, also during migration (Oro & Martínez-Vilalta 1994), and that capability allows them to disperse to breed in new colonies, even over a distance of more than 800 km (Oro & Pradel 1999). However, a search for Spanish-ringed birds in the six Sardinian colonies, in 1997 and 1998, gave no positive results.

Overall, the recently published information confirm the views of Witt *et al.* (1981) that ecological conditions, especially in terms of food availability (both natural and from human fisheries), seem more suitable in western Mediterranean than those in eastern Mediterranean.

Threats at breeding sites

Several threats have been cited by Lambertini (1996). Traditionally, human disturbances (especially egg collection) and interactions with Yellow-legged Gulls have been considered the main threats. During the 1990's, some new threats have been identified, especially the role of overfishing and the accessibility of terrestrial predators to the colonies. It seems that the vulnerability of the colonies decreases with their size. Some threats, especially interactions with Yellow-legged Gulls *Larus cachinnans* or stochastic and detrimental events such as sea gales or the

occasional presence of carnivores, are more detrimental in small colonies than in larger ones (González-Solís *et al.* 1995, Oro 1996a, Oro *et al.* 1999). This is also valid for the impact of scientific research, which should not be intensive in small colonies. Some others potential threats have also been studied recently: pollutants such as organochlorine compounds or heavy metals (e.g. Pastor *et al.* 1995, Morera *et al.* 1997), internal parasites (Ruiz *et al.* 1995) and ectoparasites (Roca *et al.* 1998), although they do not seem to threaten the species at present.

Human disturbance

Direct human disturbances have been recorded in many colonies during the 1990's. In Greece, Italy and Spain they seem related to tourism since egg collection for human consumption has been abandoned, although that practice may still be carried out at unprotected sites in Algeria and Tunisia (Essetti 1994, Boukhlafa 1995). In Greece, transportation of terrestrial predators has caused colony desertion during the period 1995-1998. Habitat alteration, mainly by overgrazing linked to transportation of livestock (especially goats), may be considered a low threat in Greek and Turkish colonies, where this practice is common (C. Papaconstantinou & HOS, unpubl. data; Magnin & Yarar 1997). Regarding many colonies placed in small archipelagos (e.g. in Tunisia, Italy and Spain), human settlements such as military garrisons or penitentiaries in the main islands allow the protection of the surrounding small islets. However, only 14 % of the colonies are legally protected. Furthermore effective protection is lacking in some of the protected sites (Oro 1998). Some very important colonies in Greece, such as those in Limnos, Lesvos, Skyros and Central and South Dodecanese, are outside the proposed Natura-2000 areas and should be established as such without delay (C. Papaconstantinou & HOS, unpubl. data). Increasing tourism, combined with other human disturbances and destruction of suitable breeding habitat, is also a threat throughout the breeding range. Effective protection of the breeding sites and potentially suitable habitats should be one of the main targets for long term conservation.

Interactions with Yellow-legged Gulls and other predators

In most of their colonies, Audouin's Gulls share their breeding habitat with Yellow-legged Gulls. The effects of competition between the two species (nest site competition, kleptoparasitism, predation on adults, eggs and chicks) have been quantified in few cases (Bradley 1986, Oro & Martínez-Vilalta 1994, González-Solís *et al.* 1995). The problem of nest site occupation of the most suitable areas by Yellow-legged Gulls (which breed one month earlier on average than Audouin's Gulls) is difficult to analyse, although some culls of Yellow-legged Gulls performed at the Chafarinas Islands have suggested that competition exists (Álvarez 1992, PCGA 1994). However, culling Yellow-legged Gulls is not significantly effective even when performed over a number of years, and probably has

little effect on population dynamics of Audouin's Gull (see also Ruiz *et al.* 1998). Furthermore, these studies suggest that predation is a threat only in small colonies or sub-colonies (González-Solís *et al.* 1995). In large colonies where the ratio Audouin's Gull / Yellow-legged Gull is high, predation did not constitute a threat to Audouin's Gulls (Oro *et al.* 1996a). Yellow-legged Gulls were responsible for 35 % of the observed adult mortality at the Ebro Delta (Oro 1996b), but the overall adult mortality remained very low (see also Oro *et al.* 1999).

Nevertheless, Yellow-legged Gulls are still quite often cited as a threat for Audouin's Gulls in Turkey, Greece, Italy, Tunisia, Algeria, Corsica and Spain. Yellow-legged Gulls preying on nests of Audouin's Gulls caused the desertion of two Sardinian colonies in 1998 (N. Baccetti, unpubl. data), and Magnin & Yarar (1997) have quoted the increased number of breeding Yellow-legged Gulls as the main reason for the size decrease of the largest Audouin's Gull colony in Turkey. However scientific data is lacking for these colonies.

Hooded Crows *Corvus corone cornix* have also been identified as predators for eggs and chicks in some Greek colonies (C. Papaconstantinou & HOS, unpubl. data). Peregrine Falcons *Falco peregrinus* have also been noted preying on adults and fledglings in the Chafarinas Islands (Oro 1998), in the Ebro Delta (Oro 1996b) and in Greece (C. Papaconstantinou & HOS, unpubl. data). Whereas in the Ebro Delta Peregrines are responsible for 10 % of the observed adult mortality, in the Greek colony of Kythira a Peregrine family ate at least 38 fledglings, possibly over 50, out of the 85 chicks that hatched (C. Papaconstantinou & HOS, unpubl. data). More data is needed to assess how the predation rates by these species may influence population dynamics in these colonies.

The terrestrial predators are mainly rats and carnivores. Rats have been mentioned as a potential threat for Audouin's Gulls in many colonies (e.g. Bradley 1986, Boukhalfa 1995), but recent data from Chafarinas Islands suggest that predation of rats on eggs or chicks cannot be considered as such (Ruiz *et al.* 1996). Carnivores are probably the most important threat for Audouin's Gulls in the short term. Audouin's Gulls are very sensitive to carnivore predation by feral cats (mainly coming from human settlements such as salt pans exploitations or military garrisons) or wild carnivores such as European Badgers *Meles meles* (Oro 1998). Predation by these carnivores, even if only on eggs and chicks, triggers the dispersal of a significant proportion of breeding adults to other colonies (up to 14 %, see Oro *et al.* 1999). The simple presence of feral cats or dogs may also cause the desertion of many adults, as recorded in the Ebro Delta (Oro 1997a). Montpellier Snakes *Malpolon monspessulanus* may be common in many colonies (e.g. Tunisia, Spain, see Essetti 1993 and Oro 1998 respectively) and they may even prey on Audouin's Gull chicks, but predation rates are very low (Oro 1997b and 1998).

Fishing moratorium and fishing gears

Since the discovery that Audouin's Gulls largely exploit discards from

fishing vessels (especially from trawlers) in the western Mediterranean (e.g. Oro *et al.* 1997), it is accepted that human fisheries plays an important role in the conservation of the species (see also Lambertini 1995). Since 1991, a trawling moratorium around the Ebro Delta and Columbretes Islands colonies has been overlapping with the breeding season of Audouin's Gull and has affected negatively the species breeding and feeding ecology (Oro *et al.* 1996a and b). Moreover, interactions between Yellow-legged Gulls and Audouin's Gulls increase when discard availability decreases, since Yellow-legged Gulls also exploit that resource (Oro & Martínez-Vilalta 1994, González-Solís *et al.* 1997a and b). Consequently, the trawling moratorium is considered to be a negative factor for the conservation of Audouin's Gulls.

However, it seems that fish availability in the Mediterranean has decreased in the last few decades as a consequence of overfishing (Palomera 1992, Safina 1995), although the decrease has affected neither all the species nor all the areas (Lleonart & Recasens 1996). It thus seems clear that a more rational exploitation of fishery resources in the Mediterranean would be beneficial for the Audouin's Gull in the long term, and that a trawling moratorium, if effective, is a protective measure rather than a threat for the species (Oro 1999). Application of the fishery policies recently approved by the European Community (e.g. moratorium periods, quotas, minimum net mesh size, see for instance Furness 1992) may be essential for the conservation of the Audouin's Gull in the Mediterranean, not to speak of other seabird species.

On the other hand, direct mortality caused by fishing gears (hooks, nets, long lines) is potentially a serious threat, since it affects adult survival which is the most important parameter in the sensitivity of population growth rate (Oro *et al.* 1999). Although several authors have cited that source of mortality as a threat (de Juana *et al.* 1984, Bradley 1988, Mayol 1986, PCGA 1994), only quantitative data at the Ebro Delta have been recorded. At that colony, fishing hooks and nylon thread were responsible for 11 % of the observed adult mortality, although that rate may be underestimated since gulls may die at sea far from the colony.

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Many deserted Tuscan sites were visited in 1998 by Paolo Sposimo, within a LIFE-project devoted to this and other seabird species. Pierre-Christian Beaubrun, Joe Sultana and Hans Witt kindly provided data on some breeding sites.

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