

Culling Yellow-legged Gulls *Larus michahellis* benefits Audouin's Gulls *Larus audouinii* at a small and remote colony

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Capsule Culling of Yellow-legged Gulls *Larus michahellis* can have some immediate local benefits to Audouin's Gulls in small and remote colonies.

Aim To evaluate the effects of a Yellow-legged Gull culling programme conducted from 2000 to 2009 on the breeding success and abundance of syntopic Audouin's Gulls on Alborán Island, Spain.

Methods Censuses of nesting pairs and nest distribution maps for both gull species, and breeding success (well-grown chicks per pair) monitoring for Audouin's Gulls, were conducted annually from April to July, 1994–2009, with complementary data for the period 1982–1994 available in an earlier study by the first author and colleagues.

Results At the time of the peak occupation of the island Yellow-legged Gulls seemingly reduced breeding success and number of nesting pairs of Audouin's Gulls. Negative effects on the colony of Yellow-legged Gulls were observed when subjected to massive culling, which presumably favoured the breeding status of Audouin's Gulls.

Conclusion The present study demonstrates that the facultative culling of large gulls affecting syntopic species of conservation concern can have some immediate local benefits in small and remote colonies. We suggest that culling Yellow-legged Gulls in these zones could be justifiable, given the shortage of available breeding habitats for Audouin's Gulls.

Many populations of large gulls have increased and expanded their range, probably linked to the provision of discards from fishing boats and waste from land-fill sites. However, the aggressive and predatory behaviour of these birds may exert negative effects on humans and syntopic bird species. In response to this problem, many countries have developed control measures, such as culling, to remove or reduce gull populations in breeding colonies in order to reduce harmful impact on the species to be conserved, but this has shown variable success (Côté & Sutherland 1997, Harris & Wanless 1997, Kress 1997, Finney *et al.* 2001, Donehower *et al.* 2007).

Like other large gulls, the numbers of the generalist Yellow-legged Gulls *Larus michahellis* have increased dramatically and are considered by many authors to be a threat to other birds, especially syntopic Audouin's

Gulls *Larus audouinii*. Oro & Martínez-Abraín (2007) discussed the use of culling to control numbers of Yellow-legged Gulls. However, they could find no example where culling resulted in an increase in numbers of Audouin's Gulls. Nevertheless, it is important to explore the details of all the possible cases in which both species interact, considering that Audouin's Gulls are endemic and rare, occur in only a small number of colonies in the Mediterranean (Oro *et al.* 2000), and are also regarded as globally near threatened (International Union for Conservation of Nature and Natural Resources [IUCN] 2009).

Here, we present evidence of the effect of a Yellow-legged Gull culling programme of the Consejería de Medio Ambiente (Junta de Andalucía) with the aim of trying to improve the status of Audouin's Gulls in a small and isolated Audouin's Gull colony situated on Alborán Island.

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METHODS

Alborán Island (Spain), in the extreme western Mediterranean, lies 85 km from mainland Europe and 55.5 km from North Africa (35°56'24"N and 3°02'04"W). It is a small, flat, solitary island of 7.12 ha covered by low sparse vegetation (Paracuellos *et al.* 2006). The closest large colony of Yellow-legged Gulls and Audouin's Gulls lies 100 km away, in the Chafarinas Islands (Oro *et al.* 2000). Alborán has a large population of Yellow-legged Gulls that were considered a threat to the small Audouin's Gull population, and thus each year since 2000, a single visit with a team of three to six people working eight to ten hours on a single day in April or May has been made by the Consejería de Medio Ambiente of the Junta de Andalucía to poison breeding adult Yellow-legged Gulls. To achieve this, capsules with narcotics of dosages lethal to adult gulls (0.8 g of phenobarbital + 0.4 g of alpha-chloralose; for more information see Conselleria de Medi Ambient [2004]) were introduced within food deposited inside the nests of Yellow-legged Gulls. In this way, 1063 adults have been eliminated in 10 years from 2000 to 2009 (106.30 ± 94.89 sd dead gulls per year; roughly 25% of the annual population [Consejería de Medio Ambiente data]). In addition, each one of the eggs in the Yellow-legged Gull nests was pierced with a metallic needle to kill the embryo.

From April to July, 1994–2009, except for 1995, the breeding areas of the island occupied by gulls were mapped, the total numbers of adults and nests of both species were censused by direct count (with telescope and binoculars) and an *in situ* intensive search carried out by a team of workers (Bibby *et al.* 2000). Later, when the chicks of Audouin's Gulls were well grown, attempts were made to ring and count them. This information was augmented with equivalent data in Paracuellos *et al.* (2006) for the period 1982–1994. After the data were compiled, breeding success was calculated annually for the Audouin's Gulls based upon the number of well-grown chicks per breeding pair.

Given the nature of the data, a simple linear regression was used to explore the relationship between the number of nesting pairs of Yellow-legged Gulls and nesting pairs and breeding success of Audouin's Gulls in each study year. Count data were log-transformed to conform to linearity (Sokal & Rohlf 1994).

The present study was conducted independently of the culling programme, and in no case involved the destruction of eggs or specimens of Yellow-legged Gulls.

RESULTS

Starting in 1982, the Yellow-legged Gull population began to increase and expand its nesting area on Alborán Island, and occupied most of the surface area of the island in 1997 and 2000. The population of this gull increased from less than 100 pairs (10–30% of area occupied) in the 1980s, to around 400 pairs (60% area

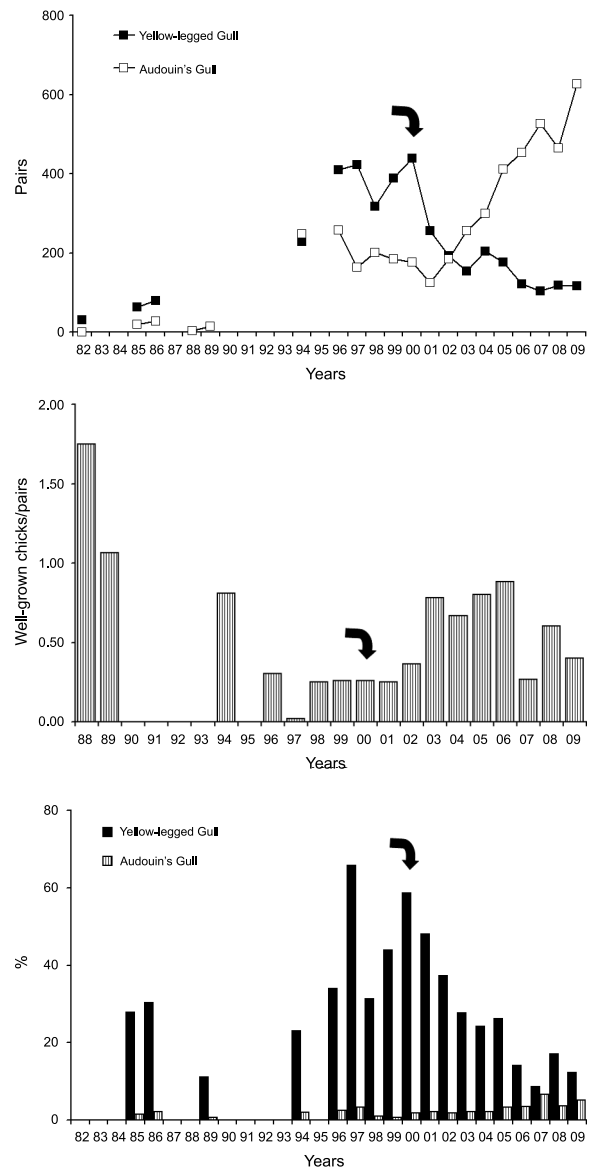


Figure 1. The breeding status of the two gull species nesting on Alborán Island from 1982 to 2009. (Top) abundance of Yellow-legged Gulls *Larus michahellis* and of Audouin's Gulls *Larus audouinii* pairs; (middle) breeding success (well-grown chicks per pair) of Audouin's Gulls; (bottom) proportion of nesting habitat (%) occupied by each of the two gull species with respect to the total surface area of the island. The arrow indicates the beginning of the general culling of Yellow-legged Gulls.

occupied) at the end of the 1990s. After the start of culling in 2000 the numbers of Yellow-legged Gulls and the extent of their colony declined substantially to around 100 pairs and less than 20% area of occupation in recent years (Fig. 1). This reduced the population and surface area of the colony by 41% and 48% respectively, from the time of maximum occupation of the island before the start of culling (1997–2000 average values: 391.75 pairs in 3.55 ha) until after the start of culling (2001–2009 average values: 160.33 pairs in 1.70 ha).

Audouin's Gulls began to increase in number after 1985 (Fig. 1), from less than 30 pairs in the 1980s to around 250 pairs in 1997. However, this species decreased from 1997 onwards to less than 200 pairs before the culling, coinciding with the maximum occupation of the island by Yellow-legged Gulls. The population changed markedly once the culling of Yellow-legged Gulls began, from 124 pairs in 2001 to 626 pairs in 2009. In this period, an increase was also observed in the area occupied by the colony, from 1–3% prior occupation to 3–6% in the last five years (Fig. 1). Thus, Audouin's Gulls increased in their population and colony surface area 205% and 200% respectively, from the time of maximum occupation by the Yellow-legged Gull before the start of culling (1997–2000 average values: 181.25 pairs in 0.12 ha) until after the start of culling (2001–2009 average values: 371.67 pairs in 0.24 ha).

The breeding success of Audouin's Gull, although high at the beginning (with up to 1.75 well-grown chicks per pair in 1988), decreased until 2001, reaching a minimum in 1997, when only three chicks fledged in the entire colony. The following year, after the start of the culling, Audouin's Gull breeding success progressively increased (Fig. 1).

The number of nesting pairs of Yellow-legged Gulls had a significantly negative impact on both the number of breeding Audouin's Gulls ($R^2 = 0.71$, $F_{1,11} = 27.14$, $P = 0.0003$) and the breeding success of Audouin's Gulls ($R^2 = 0.36$, $F_{1,11} = 6.28$, $P = 0.03$) over the period 1997–2009 (Fig. 2).

DISCUSSION

Although Oro & Martínez-Abraín (2007) reported no adverse effects of Yellow-legged Gulls on the growth rates of the populations of syntopic waterbirds, and alternative explanations could also explain the observed patterns, the evidence found in the present study strongly suggests negative impact by this species on the breeding success and nesting population of Audouin's

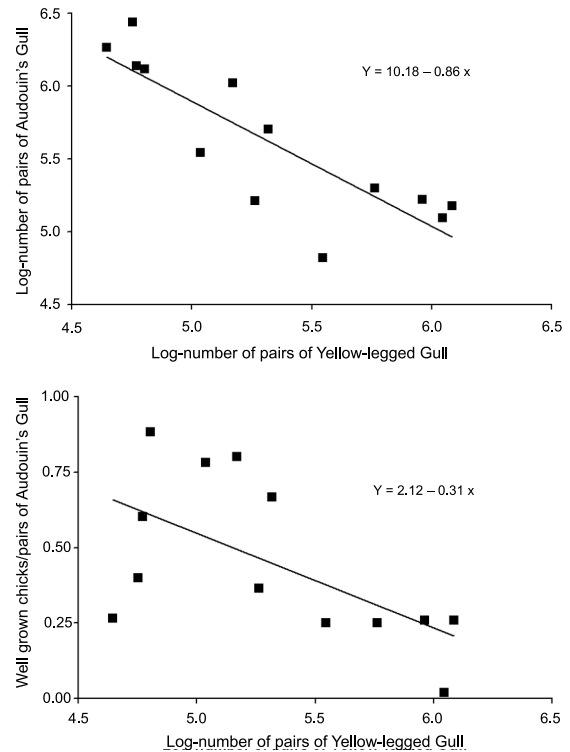


Figure 2. Relationships between the breeding rates of the two gull species nesting on Alborán Island from 1997 to 2009. (Top) relationship between the nesting population (pairs) of Yellow-legged Gulls and Audouin's Gulls; (bottom) relationship between the nesting population (pairs) of Yellow-legged Gulls and the breeding success (well-grown chicks per pair) of Audouin's Gulls.

Gull in Alborán Island. In addition, the results in Alborán suggest that culling of the local Yellow-legged Gull population had clear positive consequences for the breeding status of Audouin's Gull in the same colony, contrary to the observations of Oro & Martínez-Abraín (2007) and Sanz-Aguilar *et al.* (2009).

We hypothesize that such clear patterns are related to the geographical and spatial characteristics of our study site as well as the metapopulation dynamics of the two gull species involved. An Audouin's Gull colony located on such a small, solitary, and remote island must be more affected by pressure from Yellow-legged Gulls than colonies of greater size or which are less isolated. The spatial configuration of Alborán Island implies a low carrying capacity for its gull colonies, which may have limited or even blocked local availability of optimal alternative nesting sites for Audouin's Gull during the expansion phase of Yellow-legged Gulls. This is exacerbated by the increased contact with the larger and more aggressive Yellow-legged Gull, which preys upon Audouin's Gull

(Martínez-Abraín *et al.* 2003), and this may have occurred from 1997 onwards. These problems associated with the small size of the island are compounded by the isolation from other colonies, which hampers rescue effects at the metapopulation scale (Oro 2003). In colonies that are large and/or located near others the impact of Yellow-legged Gulls, in agreement with Oro & Martínez-Abraín (2007), would not be so evident since, even though the Yellow-legged Gulls increase their population and colonize new zones, Audouin's Gulls, given their nomadic nature, can normally find nearby available areas to relocate breeding colonies and, hence, elude Yellow-legged Gulls.

CONSERVATION IMPLICATIONS

The conservation of certain small, remote colonies of the near threatened Audouin's Gull is important at the metapopulation scale, since they constitute alternative sources of genetic variability and re-colonizers to the few main large colonies (Lambertini 1996, BirdLife International 2000, Oro 2003). If Audouin's Gulls in small colonies are endangered by the expansion of Yellow-legged Gulls, then local culling of the more abundant and widespread species seems advisable. This has particular relevance considering that the overall numbers of Audouin's Gulls are still low and densely concentrated in just one major colony (i.e. the Ebro Delta). Moreover, the foundation of new colonies has become less and less certain due to a lack of adequate sites in the Mediterranean (Oro 2003, López Ornat 2006). Yellow-legged Gull control programmes at small remote colonies could also be acceptable in terms of management, taking into account the relatively low number of gulls that need to be killed and the minor manpower and effort needed for this (with a maximum cost of six workers at ten hours per year), in comparison to what is normally entailed in intensive or specific control actions for large colonies (Bosch *et al.* 2000, Oro & Martínez-Abraín 2007, Sanz-Aguilar *et al.* 2009).

However, even in these cases involving small and remote colonies the culling programmes need to be continuous to avoid a return to the original situation, and they must be necessarily provisional until implementing the definitive management measures related to the limitation of the available food. To control Yellow-legged Gulls over the long term would require action on the root of the problem; reducing the quantity of discards from fishing boats and eliminating open-air waste dumps, which are advantageous for this generalist species (Oro & Martínez-Abraín 2007).

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