

Zusammenfassung Nur wenig ist von der Winter-Verbreitung der Schwarzkopfmöwe *Larus melanocephalus* bekannt; dabei sind gerade die begrenzten und geographisch-sporadischen Verbreitungs-Daten dieser Art im Winter deshalb speziell interessant, weil die derzeitigen Daten der Winterpopulation nicht zu denen der globalen Brutpopulation passen. Wir untersuchten das Vorkommen und Verteilungsmuster dieser Möwenart entlang der spanischen Mittelmeerküste, einem für sie schon seit langem wichtigen Überwinterungsgebiet. Die Daten wurden 2003 in einer systematischen Erhebung an dem Kontinentalschelf

von einem Boot aus gesammelt. Daran anschließend wurde in der Golf von St. Jordi, ein bekannter hotspot dieser Spezies, genauer untersucht: das zeitliche Verteilungsmuster der Möwen sowie ihr täglicher Aktivitätsrhythmus von Juni 2005 bis September 2008. Um unsere Ergebnisse in einen größeren Zusammenhang zu setzen, wurden alle anderen verfügbaren Informationen über die Winterverbreitung dieser Art gesammelt und vergleichbar gemacht. Die Ergebnisse legen nahe, dass die spanische Mittelmeer-Winterquartier dieser Möwenart ist. In dieser Gegend betrug die durchschnittliche Population ca. 41,000 Individuen, was etwa die Hälfte der 86.311 Individuen ausmacht (50.747 - 121.875), die über alle Winterquartiere dieser Art hinweg gezählt wurden. Im örtlichen Maßstab erwies sich der Golf von St. Jordi mit im Schnitt 17,000 beobachteten Individuen und Spitzen von bis zu 45,000 im freien und offenen Überwinterungsgebiet als wichtigstes Überwinterungsgebiet für diese Spezies. Deshalb postulieren wir, dass dies eine auch im globalen Maßstab wichtige Gegend für diese Art ist. Die Tagesrhythmen ergaben sich aus den Bewegungen der Möwen von den Futterplätzen auf dem Meer, wo sie sich hauptsächlich von weggeworfenen Fischabfällen ernähren, zu den Olivenhainen und Bade- und Trink-Gelegenheiten (das Wasserreservoir von Riudecanyes) am Nachmittag und schließlich gegen Sonnenuntergang zu den Schilfröhren der Küste (Cambriils). In Anbetracht der globalen Bedeutung dieser in einem solch kleinen Areal überwinternden Population, sollten Maßnahmen zum Schutz des Riudecanyes Reservoirs und der Gebiete im Meer und auf dem Land, in denen die Vögel Nahrung aufnehmen, mit Priorität ergriffen werden. Weitere Untersuchungen sind notwendig, um die tatsächliche globale Populationsgröße der Schwarzkopfmöwen sowie die sie bedrohenden Faktoren und den aktuellen Stand ihres Schutzes festzustellen.

Historically, in winter, the species has been recorded in the Mediterranean, especially the Nile delta, the central Mediterranean (including the Ionian Sea, Sicily, Malta, Tunisia and Libya), and the Gulf of Lion and the Mediterranean coast of Iberia (Cramp and Simmonds 2004). In recent decades, due to the expansion of the species towards the NW, some areas of the European Atlantic coast have also become important as winter quarters (Pootsterlaas and Flamant 2006). However, information on winter distribution and population estimates is patchy, and the last global reviews yielded total figures well below those expected from the breeding population estimates (about 12,000–40,000 in Europe; BirdLife International 2004). This could be due to either a lack of survey effort and/or patchy survey coverage, as some of the most important wintering grounds have not been systematically surveyed for more than 20 years. Of particular concern is the Mediterranean Iberia region. Here, ca. 50,000 individuals were counted in 1985 (Carrera 1988), but, other than some local studies (Hidalgo 1992), no detailed information has since been published. The paucity of data meant that the region was not mentioned in the most recent review of European wintering populations (BirdLife International 2004). In this paper, we aim to provide updated and detailed information on the population numbers and distribution patterns of the Mediterranean Gull in Mediterranean Iberia. Particular attention was paid to the main wintering area for this gull in the region, the St. Jordi Gulf (NE Spain). A review of published and unpublished information on wintering numbers across the species' winter range was also conducted, to put our empirical survey results in a wider context. Finally, information on the foraging ecology of the Mediterranean Gulls was also collected, namely distribution patterns and foraging strategies at sea (across Mediterranean Iberia), daily activity rhythms and alternation of foraging habitats around the St. Jordi Gulf. Information on these issues for the winter period is scarce (Cramp and Simmonds 2004), but knowledge of them is critical for the conservation of the species.

Introduction

The Mediterranean Gull (*Larus melanocephalus*) is a Western Palearctic species whose breeding population

Methods

Study areas

Local scale: roost and pre-roost censuses in the St. Jordi Gulf

At the local scale, the study was focused in the north of the St. Jordi Gulf (41°03'N, 1°02'E), NE Spain (Fig.1). This area supported large numbers of Mediterranean Gulls in the 1980s (Ferrer et al.1986, Carrera 1988). During the 2005–2006, 2006–2007, 2007–2008 and 2008–2009 winters, censuses were carried out twice a month between October and 31 March at the Riudecanyes reservoir (afternoon pre-roost) and off Cambrils beach (evening roost). These sites were selected after preliminary observations on the activity rhythms of the gulls. At the medium scale, at-sea surveys across the Mediterranean Iberian shelf

Numbers of Mediterranean Gulls wintering across the Iberian Mediterranean coast were estimated by means of

systematic surveys at sea, taking advantage of the ECOMED03 cruise onboard R/V “Cornide de Saavedra” (Spanish Institute of Oceanography, IEO). This cruise covered the whole Mediterranean Iberian shelf (Fig. 1) from NE to SW, from 25 November to 18 December 2003. Systematic transects were surveyed over the continental shelf (as delimited by the 200 m isobath) and uppermost shelf slope, perpendicular to the coastline and spaced between 4 and 8 nautical miles apart, depending on the width of the shelf. In total, 1,829.5 km were surveyed (Table 1). Four areas were differentiated according to their topographic and hydrographic features (see Estrada et al. 1996, Millot and Taupier-Letage 2005): (I) Alboran Sea—Vera Gulf, (II) Alicante-Valencia, (III) Ebro delta-Columbretes islands (which encompasses the St. Jordi Gulf), and (IV) central-north Catalonia (Fig.). The Alboran Sea and the Vera Gulf are characterised by a narrow continental shelf, as well as by the direct influence of Atlantic surface waters, which lead to local areas of relatively high productivity. The continental shelf broadens in the Alicante area, where surface waters meeting Atlantic and Mediterranean waters meet around the Ibiza Sill. Around the Ebro Delta and the Columbretes Islands, the continental shelf is widest (up to 70 km), and the area is particularly productive as a combined effect of the Liguro-Provençal-Catalan slope front, the strong NW winds and the outflow from the Ebro River. In the north Catalonia area, the continental shelf becomes narrow again and indented

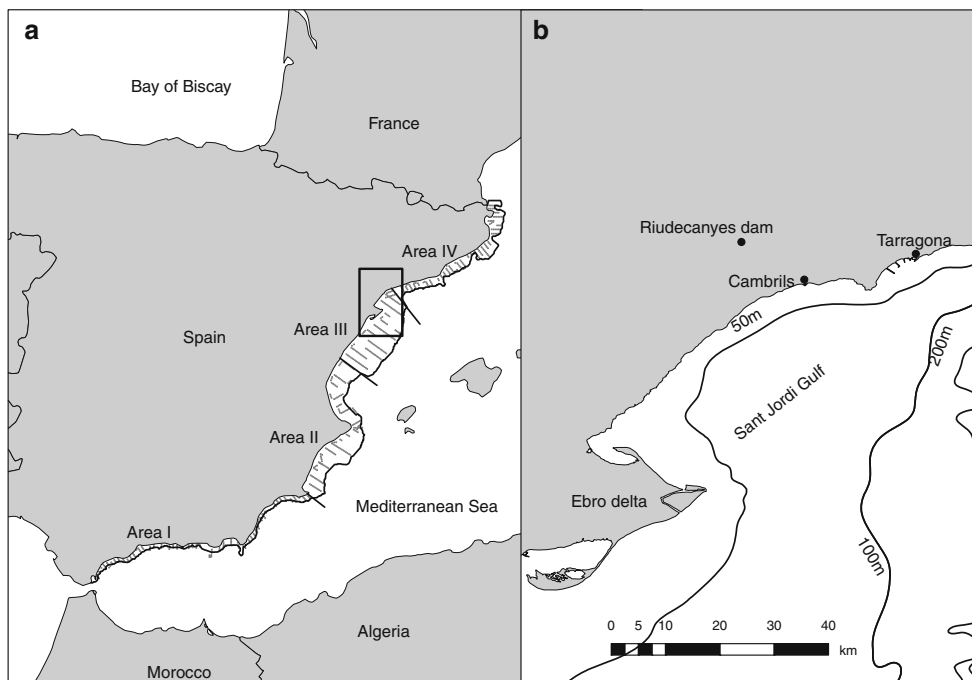


Fig. 1 Area covered by the at-sea surveys and location of the Mediterranean Gull (*Larus melanocephalus*) Cambrils roost and Riudecanyes pre-roost (b). The areas of the at-sea survey divisions, the survey bins and the 200 m depth isobath are represented in (

Table 1 Effort devoted to the at sea surveys, according to the area: (I) Alboran Sea—Vera Gulf, (II) Alicante-Valencia area, (III) Ebro delta-Columbretes islands, and (IV) central-north Catalonia

	Area I	Area II	Area III		Area IV	Total
			St. Jordi Gulf	Total		
Number of 10-min bins	161	153	45	141	134	589
Length (km)	498	476.2	139.8	440	415.3	1,829.5
Covered area (km ²)	248	218.8	54.9	163.9	199.3	830
Total area (km ²)	4,230	9,255	2,000	8,180	4,140	25,805

For the Ebro-delta Columbretes area the information is also specified for the St. Jordi Gulf

by marine canyons, with the Liguro-Provençal Catalan Global wintering population estimates front owing southwestwards along the continental slope (Salat et al. 2002, Arin et al. 2005). Survey effort for each Published and unpublished data on winter counts were of these areas is shown in the Table reviewed to update the wintering distribution patterns and

All observations were made by the same observer population size. The available information from throughout (J.M.A.) using standardized strip-transect techniques the potential wintering range of the Mediterranean Gull (Tasker et al. 1984) adapted to match the specific conditions of the study area (SEO/Birdlife 2007). A 300-m strip- (Cramp and Simmons 2004) was collected (Fig 2), from width transect band was used, at one or both sides of the (W–E) and from Macaronesia to Iran (N–SW), from Kazakhstan to Kenya (NE–SE). Minimum vessel (i.e. 600-m band) depending on the observation and maximum recorded gures during the most recent 10 conditions (visibility and wind). Snapshot counts were used mid-winters (December and January) are given and data to census ying birds (Tasker et al. 1984). All Mediterranean Gulls observed within the survey transect band were representation (see Fig 3).













recorded, and data were clumped into 10-min bins, which were georeferenced and for which a density value was obtained (birds observed/km²). In addition, all feeding Results events observed were recorded (feeding strategy and number of birds involved). Feeding strategies were categorized as follows: (1) scavenging (mainly consumption of

trawling discards); (2) direct capture of small pelagic fish; Mediterranean Gull gures at Riudecanyes (pre-roost) and and (3) capture of small pelagic fish through the interaction Cambrils seaside (roost) along the winter period are shown with sub-surface predators (cetaceans/tuna). The distance Fig. 3. Riudecanyes turned out to be important at the end to the coast and the sea depth of the sampled areas were of the season, when it held most of the birds present in the also recorded to assess topographic habitat preferences St. Jordi Gulf area. Cambrils showed a bimodal distribution, with maxima in both early (December) and late winter

sea. For each area, the number of birds present at sea was inferred from the estimated densities registered there February–March) of up to 45,000 individuals. Despite this general pattern, the gures showed high inter-annual variability, especially for maximum counts.

surface of the area. Since density data were highly variable between transect bins, and did not fit a normal distribution, 95% confidence intervals were estimated using bootstrapping (Efron and Tibshirani 1991; Quinn and Keough 2002). For our analyses, we assumed that shing activity is likely to be an important factor determining not significantly influenced by shing activity (LRT, Mediterranean Gull presence and density at sea. On this value 0.098), and therefore data from both weekdays and basis, we applied a Generalized Linear Model (GLM) weekends were analysed together to assess distribution with a negative binomial distribution, with shing activity patterns and numbers at sea. An average of 41,501 Mediterranean Gulls was estimated from the at sea surveys across the Mediterranean Iberian shelf (95% Confidence Interval 24,435–61,297; Table 2). The distribution of the

Geographical regions

-  North Atlantic, North and Baltic seas
-  Iberian Atlantic and Cantabric coasts
-  Macaronesia
-  NW African coast
-  W Mediterranean
-  Central Mediterranean and Adriatic
-  E Mediterranean
-  Black Sea
-  Inland Europe
-  Inland France and Iberia
-  NE African coast
-  SW Asia

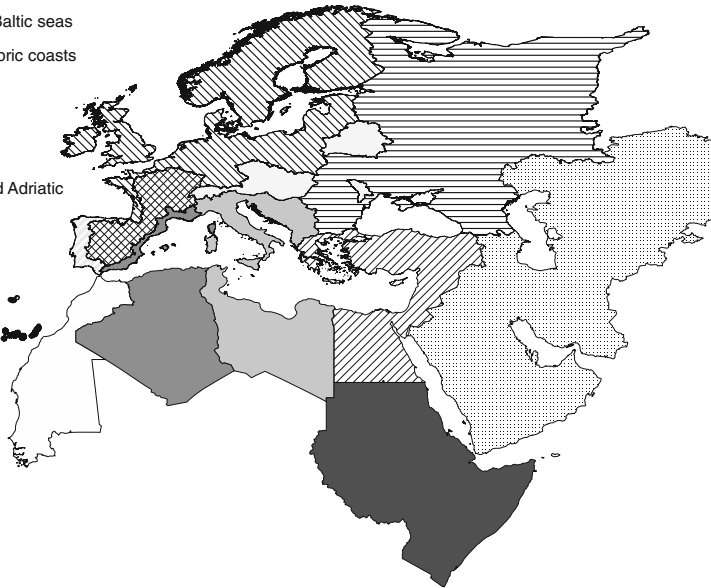


Fig. 2 Potential wintering range of the Mediterranean Gull, where an exhaustive revision work was conducted to assess winter population estimates. Data were grouped into 12 sub-regions, as detailed in the map

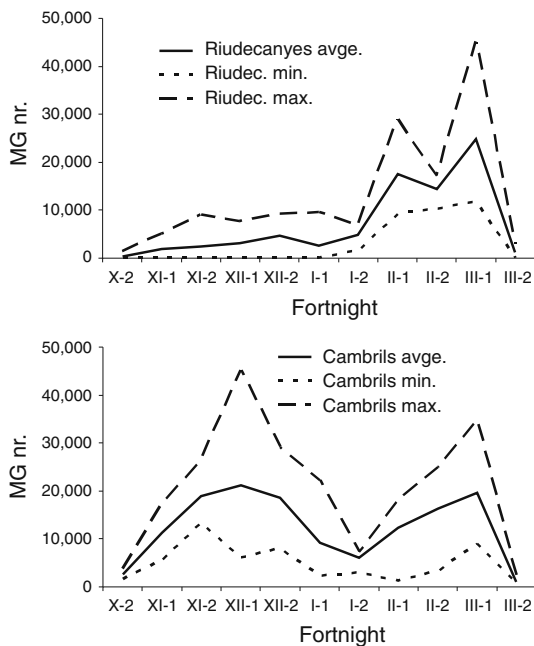


Fig. 3 Half-month number of Mediterranean Gulls at the Riudecanyes reservoir pre-roost and at the Cambrils roost during winters 2005–2006 to 2008–2009. Minimum (Min.), maximum (Max.) and average (Ave) values are shown. The fortnights are represented by the month in Roman numerals and the half of the month (1st or 2nd) in Arabic numerals

density in the Ebro delta–Columbretes area was also the highest (average densities of 3.8 birds/km²), with a maximum in the St. Jordi Gulf (8.6 birds/km²). The other areas showed relatively low densities of Mediterranean Gulls, although larger numbers were estimated in the western Alboran Sea and in central Catalonia (Table 1, Fig. 4).

Global wintering population estimation

The detailed results and data sources used in this review are detailed in Table S1 (Electronic Supplementary material). The global winter population of the Mediterranean Gull was estimated at about 86,311 individuals (range 50,747–121,875; Table 1). Data suggest that the majority (82%) of birds winter in the Mediterranean Sea, with the maximum gulls occurring in the west (primarily off the Iberian coasts, which support 48% of the global population) and decreasing towards the east. To a lesser extent, significant numbers also occur in southern Portugal (7,000–8,000 individuals) and the Atlantic coast of France (ca. 4,500 individuals). No substantial gulls were recorded in the rest of the distribution range.

Winter behaviour, activity rhythms and habitat use of the Mediterranean Gull in the NW Mediterranean

birds was highly non-random, with about 75% of the individuals concentrated in the Ebro delta–Columbretes area (31,384 individuals in average), most of them within the St. Jordi Gulf (17,192 individuals). Correspondingly, at sea, Mediterranean Gulls dispersed over the whole continental shelf (0–200 m depth), and were also present in lower densities over the continental slope (Fig. 5). This pattern was constant across the whole Mediterranean

Table 2 Estimated winter population of Mediterranean gulls across the Mediterranean Iberian shelf

Area	At sea density		At sea number of individuals		Onshore number of individuals	Source
	Mean	95% CI	Mean	95% CI		
I. Alboran Sea-Vera Gulf	0.67	0.39–1.03	2,840	1,643–4,358	?–9,000	(Clara Barcelonà 2009, Antonio Fuentes and Antonio Hernández, pers. com.)
II. Alicante-valencia	0.20	0.11–0.30	1,857	1,028–2,778	Few hundreds	(J. Ignacio Dies and Roque Belenguier, pers. com.)
III. Ebro delta-columbretes						
St. Jordi Gulf	8.60	4.41–13.57	17,192	8,815–27,143	14,600–20,900	(Vidal 2006, Vidal et al. 2007, Tirado 2009, own data)
Total	3.83	2.32–5.58	31,325	18,975–45,661	20,600–33,400	(Cramp 2004, 2007)
IV. Central-North Catalonia	1.32	0.67–2.05	5,479	2,789–8,499	3,500; 6,150	(Cramp 2004, 2007)
Total			41,501	24,435–61,297	24,100–48,550	

The results inferred from at sea survey data (mean \pm 95% Confidence Interval) are shown for each of the four areas considered and the total. For the Ebro delta–Columbretes area, the information is also specified for the St. Jordi Gulf. At-sea data are compared with mid-winter onshore censuses

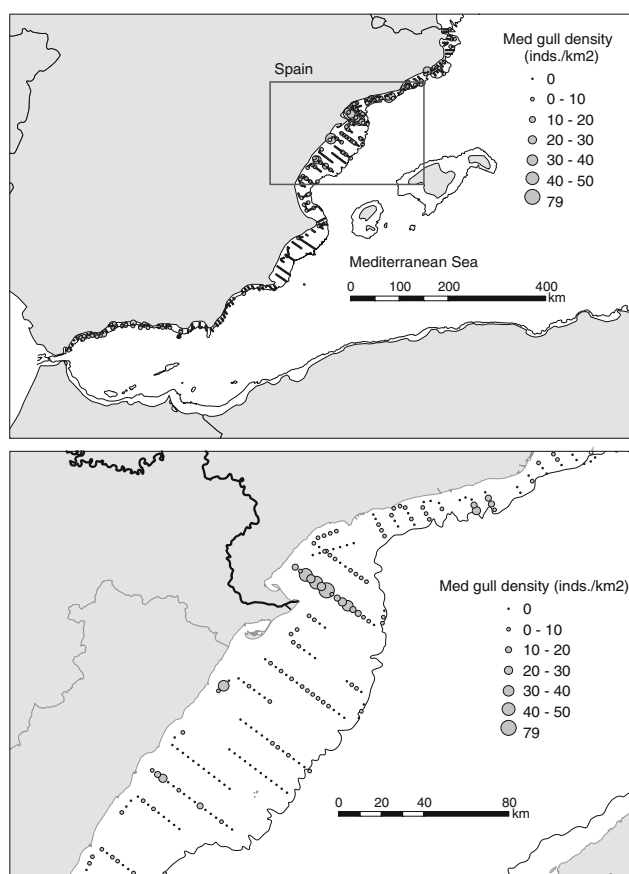


Fig. 4 Mediterranean Gull (Med gull) distribution along the Iberian Mediterranean shelf derived from 2003 winter at-sea surveys. The results for the Ebro delta sea shelf are shown in detail. The circles are proportional to the number of birds per square kilometre (inds./km²) estimated at each 10-min bin. The 200 m isobath limit is shown

Iberian shelf, even for the areas where the shelf is at its narrowest and widest. Thus, in the most important area for the species (i.e. the Ebro delta–Columbretes area) birds were frequent up to the second wintering area of importance would be the central Mediterranean, as already described by Cramp and

highest densities were recorded between 5 and 10 n.m. from the coast (Fig 5). At sea, many birds were seen associating with trawlers; e.g. feeding on shing discards was the main foraging strategy observed (78.6% of the feeding cases, involving 87.5% of the feeding individuals). The capture of small pelagic sh, either directly or in association with sub-surface predators (cetaceans and/or tuna), was less frequently observed (10.0 and 2.5% of individuals, respectively).

According to the coastal and inland observations in the St. Jordi Gulf, the Mediterranean Gulls moved up to 10 km inland to feed on fallen olives, once the shing activity ceased (strictly at 1630 hours each day). In agreement with these observations, hundreds of pellets collected in Cambrils beach and the neighbouring Tarragona harbour contained stones (from up to 25 olives per pellets). Birds then moved to Riudecanyes reservoir (pre-roost), as the census counts there showed (see Fig 4). Finally, in the late evening (dusk), they moved to roost on the sea off the town of Cambrils.

Discussion

Winter distribution

The overall review of winter counts suggest a global population of about 86,000 Mediterranean Gulls (range about 50,000–120,000). Within this context, the western Mediterranean would become the main wintering area for the species, holding an average population of ca. 46,000 individuals. These results are consistent with those from

Table 3 Minimum (Min.) and Maximum (Max.) Mediterranean Gull mid winter population estimates in the different sub-regions considered within its distribution range

Region	Min.	Max.	Average	%	Breeding population
North Atlantic, North and Baltic seas	4,882	4,952	4,917	5.7	2,120–2,583
Iberian Atlantic and Cantabric coasts	8,306	10,545	9,426	10.9	0
Macaronesia	0	0	0	0	0
NW African coast	27	691	359	0.4	0
W Mediterranean	27,930	64,792	46,361	53.7	2,230–2,303
Central Mediterranean and Adriatic	5,863	31,230	18,547	21.5	2,010–2,030
E Mediterranean	3,520	8,815	6,168	7.1	5,900–6,850
Black Sea	206	827	517	0.6	103,120–310,275
Inland Europe	0	2	1	0.0	160–402
Inland France and Iberia	13	20	17	0.0	0
NE African coast	0	0	0	0.0	0
SW Asia	0	1	1	0.0	250–250
Total	50,747	121,875	86,311	100	115,790–324,693

Average values have been used to estimate the percentage of birds wintering in each sub-region. Original data and references are shown in the Table of the Supplementary material. Breeding population in any of these regions is given according to Birdlife International (2004)

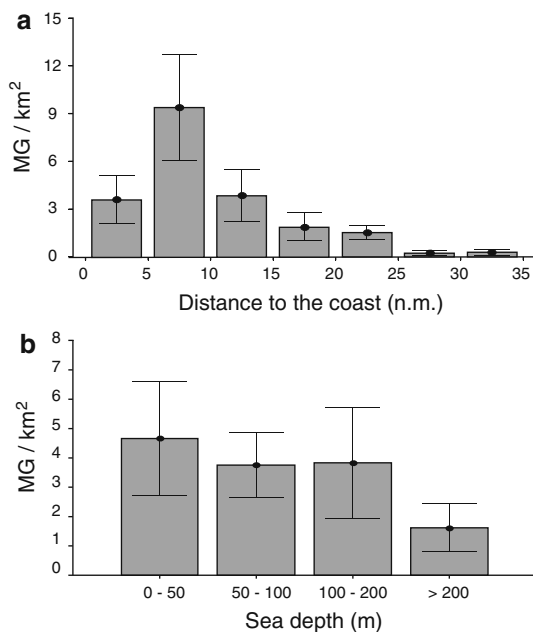


Fig. 5 Density of Mediterranean Gulls (MG/km²) depending on the distance to the coast (in nautical miles, n.m.) in Ebro delta–Columbretes sector (a) and density of Mediterranean in function of sea depth (m) in the Mediterranean Iberian shelf during the 2003 winter at-sea surveys. The results show the average value and the standard deviation

importance, the eastern Mediterranean, supports an average winter population of ca. 6,200 individuals. The wintering population in Egypt was expected to be larger (Cramp and Simmons 2004), suggesting that a change in the species' distribution has occurred. It was not possible to find information for some peripheral countries. Russia is the largest country without accurate information about the wintering numbers of the species, although apparently only small numbers of birds winter along the Black sea coasts (Yudin and Firsova 2002). Given the partially pelagic behaviour of the species in some areas during the winter (Baccetti and Smart 1999; Poot 2003), birds could go partly underestimated/unnoticed in some areas. This may be the case for the area around south Italy, Malta and Tunisia (as suggested by Baccetti and Smart 1999) or for the Iberian and Moroccan Atlantic waters. Nonetheless, our results suggest that the birds visit coastal areas on a regular (daily) basis, and therefore should be detected at some point by coastal observers. In fact, this has been reported in other areas in the Mediterranean Sea (Baccetti and Smart 1999; García-Barcelona 2009) and in the Atlantic (Poot 2003).

Mediterranean Iberia wintering population

Population estimates based on at-sea surveys showed that Simmons 2004, with an average population of ca. 18,500 Mediterranean Iberia holds most of the western Mediterranean wintering population, and therefore is the main particularly southern Portugal, are also becoming a known wintering area for the Mediterranean Gull worldwide, with an average estimated number of 41,500 individuals in November–December 2003 (i.e. almost 50% of the global population according to winter data). Results of Poot and Flamarion 2006). The fourth wintering area of

the at-sea surveys revealed that, within this region, there (Palomera et al. 2007; Bellido et al. 2008); (2) species concentrates primarily in the Ebro delta–Colum important shing ports are present (Cambrils and l'Ametlla bretes area, which is in agreement with the 1980s data from the mar, 2,000 and 2,500 mT catches/year, respectively; coastal censuses (Bermejo et al. 1986; Carrera 1988). This IDESCAT 2010); (3) a freshwater reservoir 10 km inland (Riudecanyes reservoir) provides a bathing site; and (4) largely concentrated in the north of the Ebro delta (St. Jordi farmlands with olive groves covering most (over 2,700 ha) Gulf). The remaining 25% of Mediterranean Gulls in the of the inland area (IDESCA 2010).

region were mostly concentrated in two secondary strongholds: central Catalonia, between Tarragona and winter activity rhythms and foraging ecology: Barcelona, and the western-central Albor sea. alternation of offshore and terrestrial resources

Data from at-sea surveys were compared with available onshore censuses to nd mismatches (see Table and also The present study shows alternate use of offshore and Arcos et al. 2009). The main difference was found in the inshore resources during the day by the bulk of the Med-Alboran sea, where up to 9,000 birds have been reported in the Mediterranean Gulls, with marine activity during most of the December and early January (Garca-Barcelona 2009). day, inland activity in the afternoon (the latter at least in These differences may respond either to either inter-annual the St. Jordi Gulf) and marine roosting at night. Our results or within-season differences, or also to speci c weather do not describe the behaviour of the Mediterranean Gulls in conditions that could lead to unusual local concentrations all their winter range, but are likely representative of a very of birds (resulting in peak gures from coastal counts). signi cant fraction of the global population, at least of Information in future years will be needed to assess if these those birds wintering in the Mediterranean. Indeed, during counts are truly unusual in midwinter. Until then, the sur-the day, birds occurred in high densities over the conti-vey presented here is the most comprehensive approach mental shelf and upper slope off the whole of Mediterras-assess population numbers and distribution patterns of the ean Iberia.

Mediterranean Gull along the Mediterranean Iberian shelf At sea, birds made extensive use of shing discards, as in recent decades. suggested before for the species (Arcos 2001; Arcos et al.

St. Jordi Gulf wintering population

The St. Jordi Gulf turned out to be the most important and Oro 2002) and worldwide (see review in Tasker et al. hotspot for the Mediterranean Gull within Mediterranean 2000). Inland observations and regurgitation analyses Iberia, with at-sea survey data indicating an estimated showed that the Mediterranean Gulls move inland in the gure of 17,000 individuals in early winter. Local censuses St. Jordi Gulf to feed on olives, as described previously in from the coastal observation points con rmed the signi - the same area (Ferrer et al. 1986; Carrera 1987), the cance of the area, which can reach maximums of up to Alborán sea (Garca-Barcelona 2009) and Tunis (Baccetti 45,000 birds during the migration periods. These data and Smart 1999). Although the quantitative importance of con rm the relevance of this site, already suggested by this feeding resource is still unknown, it occurs every day previous workers (Bermejo et al. 1986; Carrera 1988). The and involves the bulk of the birds scavenging off Cam-average estimated gure in the area from the at-sea cerbrils and those coming from other shing harbours. The suses in early winter (ca. 17,000 individuals) is similar toolives provide a high energetic content but also a number the highest estimate for Italy, the second most important of important compounds: polyphenols, vitamin E and country for the species in winter (Baccetti and Smart pigments such as carotenoids and anthocyanins (Roca and 1999). The differences throughout the winter, with a min- M'nguez-Mosquera 2001, 2003; Guimet et al. 2005). imum in midwinter and peaks in the early and late winter, These compounds are accepted to be positive for the are likely to be caused by a movement of birds to the south birds' health and productivity (Bloun 2004; Goñi et al. of St. Jordi Gulf, as noted by Hidalgo 1992). However, an 2007; Brenes et al. 2008; Catoni et al. 2008; Schaefer immigration of birds wintering elsewhere should also occur et al. 2008). After attending olive corps, Mediterranean since the mid-winter gures in the St. Jordi gulf roosts Gulls visit a freshwater reservoir (Riudecanyes) where (14,600–20,900; Table 2), are much lower than the maxi- they concentrate for drinking and bathing as described mumms detected then. before for the species (Isenman 1975; Paterson 1990

The cause of such a marked local concentrations is most ramp and Simmons 2004). This behaviour occurs all likely related to a number of factors (Isenman 1975; through the season but is in late winter when most. Carrera 1987; Baccetti and Smart 1999): (1) important 45,000) of the birds in the area visit the reservoir (see spawning and nursery grounds for small pelagic sh occur Fig. 3).

Conservation considerations

Results presented here confirm the apparent mismatch between breeding and wintering estimates of the Mediterranean Gull global population pointed out by Wetland International (2006). Even if some information gaps biased the winter estimation, the difference with the breeding population estimate is large enough (about 50,000–120,000 wintering vs. 360,000–960,000 breeding individuals) to suggest that the breeding population could have been overestimated. This is in agreement with Ardamatskaya (1999), who presented estimates below 60,000 breeding pairs for the northern Black Sea (including Ukraine) since the late 1980s, contrary to the official estimates of 100,000–300,000 pairs. This has important implications for the conservation of the Mediterranean Gull. For example, it indicates that information from the breeding stronghold cannot be relied upon to infer population trends, which is a key to assessing the conservation status of the species. Notably, the positive trend recorded for the newly colonised areas throughout Western Europe could give a false impression of health if this is not matched by the main population in Ukraine.

Against this background, Mediterranean Iberia gains importance for the conservation of the Mediterranean Gull. Three marine Important Bird Areas (IBAs) have been recently identified in the region for this and other species (Arcos et al. 2009), coinciding with the three hotspots identified in this paper. These sites will play a key role in the conservation of the species, and therefore deserve urgent legal protection through their designation as Special Protection Areas (SPAs) within the EC Natura 2000 framework. Of particular importance is the St. Jordi Gulf area, where the maximum recorded gure (45,000 individuals) would represent 4.5–12.5% of the official global population (BirdLife International 2004). However, if the breeding population has been overestimated, then the St. Jordi Gulf could support up to ca. 50% of the world wintering population. Riudecanyes reservoir deserves particular attention, given the high concentrations of birds at a single location (up to 45,000 individuals). This site should be identified as an IBA, and ultimately designated as a SPA. Moreover, Ramsar 5 and 6 criteria for identifying Wetlands of International Interest (Ramsar 2006) are satisfied by Riudecanyes. Thus, we argue for the designation of this as a RAMSAR area.

Threats to the Mediterranean Gull during the winter in the Iberian Mediterranean region, and particularly in the St. Jordi Gulf area, require careful assessment. Potential threats include inland habitat loss due to housing and industrial development, fishing bycatch, heavy metal accumulation and the risk of oil spills due to the high trade activity of the neighbour harbour of Tarragona (Arcos 2004; Arcos et al. 2009).

Overall, research undertaken for this paper has raised a number of questions that deserve further attention: What is the actual population size of the Mediterranean Gull? Is its conservation status really secure? Do Mediterranean gulls have similar marine behaviour through most of their wintering range? Are the daily activity rhythms described here similar to those in other wintering areas? What is the precise value of olives for the species? What is the origin of the birds wintering in Mediterranean Iberia? Do birds spend the winter in the same area, or do they change their location as the season progresses? What are the threats that the species face in the wintering grounds? These questions need to be addressed in order to improve our understanding of the ecology and distribution patterns of the species. The continuity of extensive ringing programmes, studies using remote tracking technologies and analyses using stable isotopes are likely to prove critical in this understanding, and ultimately contribute to the species' conservation.

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