Largest colony of Audouin's Gull (*Larus audouinii*) in the Adriatic Sea and the increasing value of Apulia for the Central/Eastern Mediterranean population

Cristiano Liuzzi[1*], Paola Pino d'Astore[2], Cosimo Gaspare Giannuzzi[3], Antonio Camarda[4], Nicola Baccetti[5]

Abstract: Audouin's Gull colonized Apulia region, SE Italy, around 1990. Regular surveys were performed since 2016, revealing an increase in the number of breeding sites and population size. The top value was reached in 2020, when a new colony, representing the most important settlement in the Adriatic Sea as well as in the entire eastern basin of the Mediterranean has been discovered near Brindisi. This settlement hosted a maximum of 222 breeding pairs. In 2020-2022, when the coverage was complete, the Apulian population of Audouin's Gull fluctuated between 339 and 617 breeding pairs and occupied a total of five islands, with an overall production of 703 fledglings. Details are provided in order to enhance the designation of new or enlarged Natura2000 sites.

Key-words: Audouin's Gull, breeding population, colony sites, seabird monitoring, Adriatic Sea, Mediterranean Sea

Riassunto - La più grande colonia di gabbiano corso (*Larus audouinii*) del Mar Adriatico e il crescente valore della Puglia per la popolazione del Mediterraneo centro-orientale.

Il gabbiano corso si è insediato in Puglia, nel sud-est d'Italia, intorno al 1990. Dal 2016 sono state effettuate indagini regolari, rilevando un aumento nel numero di siti riproduttivi e nella dimensione della popolazione. Il valore massimo è stato raggiunto nel 2020, quando nei pressi di Brindisi è stata scoperta una nuova colonia, che attualmente rappresenta l'insediamento più importante dell'Adriatico e dell'intero bacino orientale del Mediterraneo. Questo insediamento ha ospitato un massimo di 222 coppie nidificanti. Nel 2020-2022, periodo nel quale tutti i siti sono stati monitorati, la popolazione pugliese di gabbiano corso è oscillata tra 339 e 617 coppie nidificanti, occupando complessivamente cinque isole, e portando all'involo 703 giovani. Vengono forniti inoltre dettagli per favorire la designazione di nuovi siti Natura2000 o l'ampliamento dei siti esistenti.

Key-words: gabbiano corso, popolazione nidificante, siti di nidificazione, monitoraggio uccelli marini, Mare Adriatico, Mediterraneo.

[1] Centro Studi de Romita APS, Via Polignano 36, 70014 Conversano (Bari), Italia.
[2] Centro Fauna Selvatica della Provincia di Brindisi-Santa Teresa S.p.A., Via Ciciriello s.n., 72100 Brindisi, Italia.
[3] Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente (ARPA), Direzione Scientifica U.O.C. Servizio Ambiente Naturale Centro Regionale del Mare, Corso Trieste 27, 70126 Bari, Italia.
[4] Dipartimento di Medicina Veterinaria, Università degli Studi di Bari "Aldo Moro", Strada Provinciale 62 per Casamassima km 3, 70010 Valenzano (Bari), Italia.
[5] Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Via Cà Fornacetta 9, 40064 Ozzano Emilia (Bologna), Italia.

* Corresponding author: cristiano.liuzzi@gmail.com

Received for publication: 26 February 2023
Accepted for publication: 30 March 2023
Online publication: 21 November 2023

INTRODUCTION

The Audouin's Gull *Larus audouinii* is the only endemic larid species of the Mediterranean Sea, with a population concentrated in the western basin and mainly in Spain. This country alone hosts c. 80% of the global numbers (Bécares *et al.* 2016, Carboneras & Oro, 2020). The species' breeding range extends from Morocco and Portugal through the Mediterranean, east to Cyprus and Turkey, including the Balearic Islands, Corsica, Sardinia and Sicily (BirdLife International, 2023). In Italy it is mainly widespread in Sardinia and Tuscany, while scattered colonies are present on the Central Tyrrhenian coast. More recently, the Ionian coasts of Sicily and Apulia have been occupied (Ientile *et al*., 2016; Nardelli *et al.*, 2015; Serra *et al.*, 2001, Zenatello, 2022). The species is currently considered as "vulnerable" in the Global Red List, with a decreasing population trend (BirdLife International, 2020).

Historical data on the Audouin's Gull were totally lacking in Apulia, when the first observations were made around 1990 (Cataldini & Scarpina, 1994; Moschetti *et al.*, 1996). A substantial increase in records was reported over the last twenty years, in all seasons including winter (Liuzzi *et al.*, 2013; Zenatello *et al.*, 2020). The observations were regular only along the Adriatic and Ionian sides of the Salento peninsula, whereas they occurred more rarely on the coast north of Bari and in the Gulf of Manfredonia. Surprisingly, the species is still un-recorded in the Tremiti Archipelago, which is the nearest territory to the only existing colony in Croatia (Lastovo islands: Crnkovic, 2012).

Audouin's Gulls have purposedly been surveyed in Apulia since 2016 (Liuzzi *et al.*, 2017). Monitoring protocols developed by Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) for the Marine Strategy

Framework Directive (MSFD) were adopted since 2020. The surveys started from the only breeding site previously known in the region i.e. Sant'Andrea island near Gallipoli, on the Ionian coast, which had been used by increasing numbers since at least 1992 (Cataldini & Scarpina, 1994; Marzano *et al.*, 2003; Serra *et al.*, 2001). A new alternative/complementary breeding site was discovered in 2017 next to the latter colony, on Campo island, and a few pairs settled in 2016 on the Adriatic coast at Eremita rock (Liuzzi *et al.* 2017).

STUDY AREA

The location of all monitored breeding sites of Audouin's Gull is shown in Fig. 1. These include:

A) Sant'Andrea island (40.0510°N, 17.9521°E), Gallipoli (Lecce province): 48 hectares large, it lays c. 1 nautical mile off Gallipoli harbour. Totally flat and surrounded by a rocky belt, it is covered by salt-steppes dominated by *Arthocnemum perenne* and a brackish lagoon of c. 3 hectares. No buildings are present except an automated lighthouse. The island falls within the Regional Natural Park "Isola di Sant'Andrea - Litorale di Punta Pizzo", as well as in SPA IT9150015 "Litorale Gallipoli e Isola S. Andrea". The main threat to the site is the impact of nautical tourism in April to July. In 2020 and 2021 the Audouin's Gull has occupied the northernmost part of the island i.e. the only one unused for breeding by ubiquitous Yellow-legged Gulls *Larus michahellis* (average estimate 1000-1200 pairs). Monitoring has been carried out with the collaboration of Capitaneria di Porto di Gallipoli on May 29th, June 8th and July 10th 2020; on May 14th, June 3rd to 30th and July 14th 2021; on April 30th, June 10th to 21st and July 6th to 13th 2022. The observations were carried out by telescope from vantage points on the island, as well as from the sea.

B) Campo island (40.0534°N, 17.9690°E), Gallipoli (Lecce province): a small rocky islet of c. 1 hectare, scarcely vegetated, c. 200 m far from Gallipoli harbour and 1300 m from Sant'Andrea island. The site was recently included in the SPA "Litorale Gallipoli e Isola S. Andrea", expanded thanks to a specific deliberation by Regione Puglia (DGR n. 505, 2020). Close enough to the mainland to allow being monitored by telescope, it has been visited by boat just once in 2020 after the chicks had fledged. Checked on April 24th, May 8th to 29th, June 8th and July 10th 2020. No breeding in 2021 and 2022 (visits: May 14th and June 3rd 2021, as well as on April 30th and June 10th 2022). Ten to 14 breeding pairs of Yellow-legged Gulls were present.

C) Eremita rock (40.9942°N, 17.2359°E), Polignano a mare (Bari province): a steep, rocky farallon 20 m high above sea level, facing the cliffs occupied by the southern outskirts of the city of Polignano a mare and only 45 m far from land. The relatively flat top (116 by 37 m large) is covered by scattered halophitic vegetation. The site was

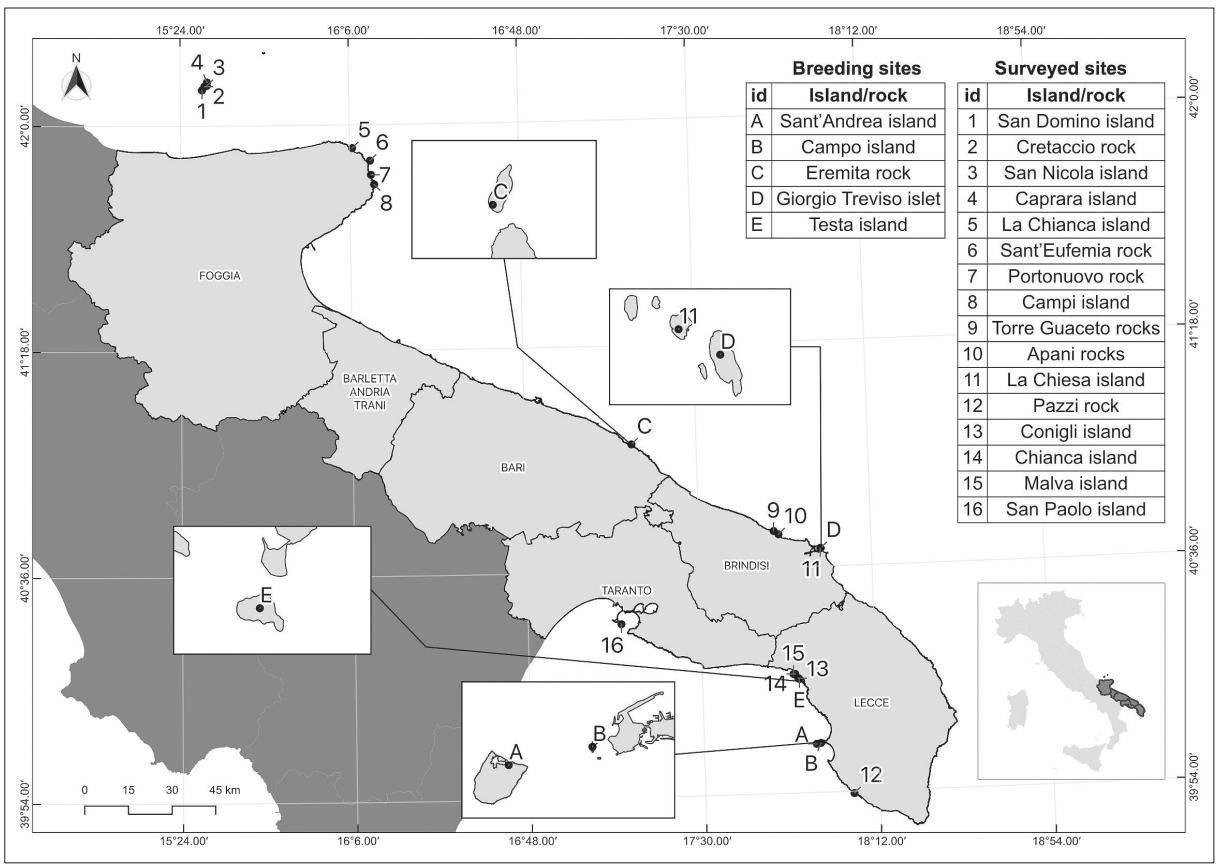

Fig. 1 - Location of breeding sites (A-E) and of the others monitored islands (1-16). / Localizzazione dei siti riproduttivi in ordine cronologico di scoperta (A-E) e delle altre isole monitorate (1-16).

initially un-protected, but it has been promptly designated as a SPA as soon as Audouin's Gull breeding was proven and continuously monitored in the 2020 breeding season with visits on ten dates (April 17th, 24th, 27th; May 16th, 27th; June 9th, 18th, 30th; July 6th, 9th) and in 2021 on May 4th and 27th, when the species had been observed in April but no breeding took place. No breeding occurred also in 2022 (visited on April 8th and May 9th). On this islet, 13 to 16 pairs of Yellow-legged Gull regularly nested.

D) Giorgio Treviso islet, (40.6564°N, 17.9937°E) Pedagne archipelago (Brindisi province): a small archipelago at the mouth of the fjord of Brindisi harbour, facing the Adriatic Sea. Composed by five islets (Sant'Andrea, Pedagna Grande, Giorgio Treviso, La Chiesa, Traversa: the former being artificially connected to land) and Monacello rock. The colony almost entirely occupies Giorgio Treviso islet, sized 0.23 hectares (c. 185 by 60 metres), totally flat and partly rocky. It is covered by halophytic vegetation, with dense clumps of *Arthrocnemum fruticosum* and, in the innermost part, *Suaeda fruticosa*, *Lavatera arborea* and *Allium commutatum* (P. Medagli, pers. comm.). No protection measures are in place but all the islands fall in a military area inaccessible to the public (Brigata Marina San Marco of the Italian Military Navy). Therefore, all monitoring operations required a special authorization, as they must be carried out on site. In fact, monitoring from the mainland has proved to be of little use (distance 800 metres). The observations were usually carried out by passing at close range on a zodiac and descending only for particular reasons (colour-ringing of chicks, counting and checking nests after fledging, etc). The colony was discovered in late June 2020, just in time to perform two late visits (June 30th, July 16th), whereas in 2021 the surveys took place on April 30th, June 22nd, July 6th and 20th. In 2022, the colony was visited on April 5th and 21st, on May 21st and June 22nd. The Yellow-legged Gull was present with just 5-11 pairs that seem to represent no threat for Audouin's Gull.

E) Testa island (40.2536°N, 17.8901°E), Porto Cesareo (Lecce province): only 0.53 hectares large and surrounded by several other islets. The substrate is for one third sandy and two thirds rocky, hosting typical dune habitats. The islet lies at the mouth of Porto Cesareo lagoon, 400 m from the city centre, within a natural reserve (Riserva Naturale Regionale Orientata "Palude del Conte e Duna Costiera") and the SAC "Porto Cesareo" (code IT9150028). Nevertheless, the site is disturbed by traffic of pleasure boats and anchoring. Bird monitoring took place in 2021, on May 14th and in 2022 on April 30th, May 6th and June 22nd, either by observations from the nearest mainland or approaching by boat. No Yellow-legged Gulls breed on Testa and the surrounding islets.

A total of 16 additional islands, potentially suitable for breeding Audouin's Gull, was visited in at least one of the breeding seasons 2020 to 2022 with negative results as for the presence of pairs (Tab. 1, Fig. 1).

Tab. 1 - Apulian islands surveyed in at least one of the breeding seasons (2020 to 2022) and hosting no Audouin's Gull breeding pairs. Only islands potentially suitable for breeding are listed. The observation of non-breeders is indicated in the last column (Yes/No). / Isole pugliesi censite in almeno una delle stagioni riproduttive (dal 2020 al 2022) e che non ospitano coppie nidificanti di Gabbiano corso. Sono elencate solo le isole potenzialmente idonee alla riproduzione. L'osservazione di individui non nidificanti è indicata nell'ultima colonna (Yes/No).

Island/rock	**Coordinates**	**Year/s**	**Species observed**
1. San Domino island, Tremiti (Foggia province)	42.1112°N, 15.4903°E	2020, 2021, 2022	N
2. Cretaccio rock, Tremiti (Foggia province)	42.1225°N, 15.5002°E	2020, 2021, 2022	N
3. San Nicola island, Tremiti (Foggia province)	42.1250°N, 15.5104°E	2020, 2021, 2022	N
4. Caprara island, Tremiti (Foggia province)	42.1354°N, 15.5111°E	2020, 2021, 2022	N
5. La Chianca island, Vieste (Foggia province)	41.9282°N, 16.1109°E	2022	N
6. Sant'Eufemia rock, Vieste (Foggia province)	41.8886°N, 16.1842°E	2022	N
7. Portonuovo rock, Vieste (Foggia province)	41.8447°N, 16.1874°E	2022	N
8. Campi island, Vieste (Foggia province)	41.8148°N, 16.2000°E	2022	N
9. Torre Guaceto rocks, Brindisi	40.7136°N, 17.8051°E	2021, 2022	Y
10. Apani rocks, Brindisi	40.7032°N, 17.8244°E	2020, 2021, 2022	Y
11. La Chiesa island, Pedagne, Brindisi	40.6571°N, 17.9923°E	2020, 2021, 2022	N
12. Pazzi rock, Ugento (Lecce province)	39.8948°N, 18.0964°E	2022	N
13.Conigli island, Porto Cesareo (Lecce province)	40.2560°N, 17.8855°E	2021, 2022	Y
14. Chianca island , Porto Cesareo (Lecce province)	40.2695°N, 17.8739°E	2021, 2022	Y
15. Malva island, Porto Cesareo (Lecce province)	40.2695°N, 17.8670°E	2021, 2022	Y
16. San Paolo island, Cheradi archipelago, Taranto	40.4387°N, 17.1770°E	2020, 2021, 2022	Y

METHODS

The standard set of breeding parameters adopted by the Italian Ministry of the Environment for the MSFD was recorded from the distance, these being the number (no.) of adults and subadults present in the colony, max. no. adults in alarm ('flush count' in Mitchell *et al.*, 2004), no. adults incubating or attending a nest, no. adults checked for rings, no. visible chicks and fledglings, no. ringed fledglings re-observed. Complete nest counts and no. dead chicks were always verified after the end of the breeding season; colour-ringing of chicks took place only in 2021 at Brindisi and in 2022 at Gallipoli. The visible prey remains were collected for future analysis. Ring reading by telescope or camera (100-400 mm lenses) took place from the boat or from a distant vantage point. The colonies were surveyed avoiding the hottest hours. When feasible, they were photographed in order to obtain comparative counts.

RESULTS

A-B) Sant'Andrea and Campo islands

Year 2020 - On the first survey from the mainland (April 24th), a large colony was present on Campo island, with c. 300 ads (at least 145 incubating). After two weeks (May 8th), only 56 adults were incubating (67 overall). The site was gradually deserted, with 26 pairs left on May 29th and 16 on June 8th. The juvenile production at fledging was of 26 (July 10th). Nearest Sant'Andrea was first checked from boat on May 29th, revealing c. 180 incubating adults. On June 8th, 120 pairs were estimated. The juvenile production at fledging was of 98 (July 10th). Nests counted: 243 in total (Tab. 2).

Year 2021 - Campo island was not occupied on May 14th, while Sant'Andrea hosted c. 350 adults (at least 200 incubating). On later dates (June 3rd and 30th), Campo was again not in use, while at Sant'Andrea 200-293 pairs attending nests were confirmed. Fledged juveniles amounted to 190 on July 14th. Nests counted: 293 in total.

Year 2022 - Campo island held no colony again. On Sant'Andrea, c. 300 adults were present on April 30th (225 incubating). The colony was located in a different part of the islands, next to the lighthouse. On 10th and 21st June, a gradual decrease to 110-120 pairs was observed, and 26 chicks were colour-ringed on the latter date. Fledged juveniles amounted to 50 on July 6th.

C) Eremita rock

Year 2020 - Seven pairs were apparently breeding, four of them with success (one pair with 3 chicks, 3 pairs with one). The rock was climbed on July 30th, after all birds had left. By counting the nest remains, it was possible to reveal a seventh pair, invisible from land. Two unhatched eggs were present.

Years 2021 and 2022 - In 2021, colony abandoned by early May (4th); in April the species had been observed on the 16th and 17th. The site has not been used at all in 2022.

D) Giorgio Treviso islet

Year 2020 - The colony was discovered in late June. The first survey was performed from a boat on June 30th, when 142 ads. and 110 fledglings were present. The simultaneous presence of many adults in the fish harbour, suggested that numbers at nest were probably not repre-

Tab. 2 - Colony size and breeding parameters in Apulia (2020-2022). No. breeding pairs refers to the max. number of incubating adults counted from the distance or to actual counts of the empty nests after breeding (for details, see text). The reproductive success was calculated by dividing the number of birds fledged by the number of pairs. / Dimensioni delle colonie e parametri riproduttivi in Puglia (2020-2022). Il numero di coppie riproduttive fa riferimento al numero max. di adulti in incubazione, conteggiato a distanza o al conteggio effettivo dei nidi vuoti effettuato dopo la riproduzione (per i dettagli, vedere il testo). Il successo riproduttivo è stato calcolato dividendo il numero di giovani involati per il numero di coppie di nidificanti.

	2020			2021			2022		
Site	No. breeding pairs	No. fledged juvs.	breeding success	No. breeding pairs	No. fledged juvs.	breeding success	No. breeding pairs	No. fledged juvs.	breeding success
A) Sant'Andrea island	243	98	0.40	293	190	0.64	225	50	0.22
B) Campo island	145	26	0.18	0	0	0	0	0	0
C) Eremita rock	7	6	0.85	0	0	0	0	0	0
D) Giorgio Treviso islet	222	178	0.80	168	150	0.89	110	4	0.03
E) Testa island	0	0	0	0	0	0	4	1	0.25
Apulia	**617**	**308**	**0.49**	**461**	**340**	**0.73**	**339**	**55**	**0.16**

sentative of the colony size. A closer inspection on July 16th revealed 272 adults, 2 sub-adults and 178 fledged juveniles (capable of flight). Nest count: 222 in total; 6 dead chicks and 12 un-hatched/broken eggs.

Year 2021 - Site monitored from the mainland since mid-March, with closer observations from a boat on April 30th and July 6th, and access to the colony on June 22nd and July 20th. Max. adults 280, counted on July 6th. Total of fledged juveniles 150, 34 of which were colour-ringed. The empty nests on July 20th amounted to 168; 35 chick carcasses (90% less than 10 days old), one dead adult, 46 un-hatched/broken eggs.

Year 2022 - Site monitored from the mainland on April 5th and 21st; boat surveys on May 21st and June 21st (disembarking only on the latter date). A range of 70-80 pairs was estimated, with a maximum of 128 adults on April 21st. During the survey of June 21st an almost complete breeding failure was recorded, most probably due to direct anthropic disturbance: 110 nests containing 229 eggs and 16 dead chicks of 1-3 days of age had been abandoned (i.e. it can be supposed that anthropic disturbance had occurred about three weeks before). A heavy mortality in adults was also observed on the colony site and at least five carcasses tangled in nylon fish-lines were collected (up to three inds. on the same long thread). Nest cups in this and other colonies were normally built with *Posidonia* leaves and other vegetation collected from the island (e.g. *Allium*); only in 2022 and only in this site was it observed that many of them (13 cases) partly included nylon fishing lines and ropes in the structure and three were exclusively built with this material (Fig. 2).

E) Testa island

Year 2022 - This island, as well as the adjacent ones nos. 13, 14 and 15 in Tab. 1, are only 23 km away from Sant'Andrea and Campo islands. For this reason, these sites have since a long time been regularly visited by the adults. Only in 2022 was it possible to confirm breeding on the Testa island. On April 29th, four pairs with nests were counted; three other nests were empty. Finally, on June 22nd, a single fledged juvenile (capable of flight) was observed.

PRESENCE OF MARKED INDIVIDUALS

Only 1.4% of the observed breeding adults had been marked in the year of hatching with an extant colour-ring. Birds wearing a metal ring only were not considered here. On the main Ionian colonies (A-B), all seven ringed adults were of local origin (Sant'Andrea, hatched 2001-2009, Tab. 3). Conversely, on the new Adriatic colonies (C-D), beside the only Apulian site where birds had been ringed in the past (Sant'Andrea), also Croatia and Spain were represented by one bird each.

Fig. 2 - Nest made mainly with nylon fishing lines and ropes; Giorgio Treviso islet (2022). / Nido realizzato prevalentemente con lenze da pesca e corde di nylon; isola Giorgio Treviso (2022). (Photo: /Foto: Cristiano Liuzzi).

Tab. 3 - Number and origin of colour-ringed adults and sample sizes at each site (max. number of inds. checked on both legs per year). Asterisks show the case of Yellow 'CN' of Croatian origin, breeding at two different Apulian colonies (2020: Eremita rock; 2021: Giorgio Treviso islet) and wearing also a GPS tag (Jurinovic *et al.*, 2019). / Numero e origine degli adulti con anelli colorati e dimensione del campione per ciascun sito (numero massimo annuo di individui controllati su entrambe le zampe). Gli asterischi indicano il caso di un individuo con anello giallo 'CN' di origine croata che ha nidificato in due diverse colonie pugliesi (2020: Scoglio dell'Eremita; 2021: isolotto Giorgio Treviso), individuo con un tag GPS (Jurinovic *et al*., 2019).

Observation colony	Max. no. ads./subads. checked	No. colour-rings	Ringing site and years
A) Sant'Andrea island	2020: 161 2021: 220 2022: 180	2 3 2	Sant'Andrea island, Italy (7 inds.): 2001 and 2009
B) Campo island	2020: 140	2	Sant'Andrea island , Italy (2 inds.): 2001 and 2009
C) Eremita rock	2020: 13	1	Lastovo island, Croatia: 2017*
D) Giorgio Treviso islet	2020: 274 2021: 78 2022: 70	3 2 1	Sant'Andrea island, Italy (2 inds.): 2009; Salines de Sant Antoni (Tarragona, Spain): 2015; Lastovo island (Croatia): 2017*

DISCUSSION

Audouin's Gull historically bred on a disjunct global range, with the bulk of the population distributed in the West Mediterranean basin, no further east than Tuscany and Tunisia, and a small number of colonies in the eastern basin, across the Aegean and Levant seas (De Juana & Varela, 1993).

The gap between these two sectors started to be filled in 1992 by the Sant'Andrea colony on the Ionian coast of Apulia, followed by the occupation of the Adriatic Sea: first with 6-7 pairs in southern Dalmatia in the late 1990ies (Rubinic & Vrezec, 2000), increased to 45-60 in recent years (BirdLife International 2023; Crnkovic, 2012; Jurinovic *et al.*, 2019), and then with a small settlement also on the Italian side (Eremita rock) since 2016 (Liuzzi *et al.*, 2017). The population in the eastern Mediterranean basin (excluding the Adriatic) is currently composed by 350-500 pairs in Greece, with a decreasing trend (Fric *et al*, 2012; D. Portolou, *pers. comm*.) and 62-118 in Türkiye and Cyprus (BirdLife International, 2023).

On a regional level, Apulia reached the top of population size in 2020, when 617 pairs were present, with a substantial contribution by the new Adriatic colony formed at Giorgio Treviso islet near Brindisi (37,1%). With respect to the rest of Italy, Apulia as a whole hosted 44,3% in 2020 and 32,4% in 2021 (ISPRA database, with one missing value in 2020 for Sicily).

The settlement of a large colony on Giorgio Treviso islet, reported here, represents a remarkable event not only for being the largest in the Adriatic and East Mediterranean, but also for the standards of the rest of Italy. Thanks to its relatively high breeding success (up to 0.89 in 2021, highest value in three years for all four Apulian colonies), as many as 332 juveniles have fledged heresince the colony first settled, despite a failure in the last season probably due to human disturbance. There is little doubt that the year of discovery was indeed the year of first occupancy, as GPS-tagged breeders from nearest colonies (either Lastovo in Croatia or Sant'Andrea in Apulia) never prospected Giorgio Treviso in previous years, whereas they regularly did and even bred on the tiny Eremita colony, 74 km further north (N. Baccetti, L. Jurinovic, *pers. comm.*). A sharp population increase or sudden settlement can only be explained by a high recruitment rate of individuals from other colonies (Oro & Ruxton, 2001). The small number of colour-marked birds from Croatia and the old age of most Apulian rings (last cohort ringed in 2009), however, do not shed any light on the precise source. A mass translocation from Sant'Andrea and Campo islands seems most likely, as they were not monitored in 2019, but held more than 500 pairs in 2017 and 2018 (C. Liuzzi, unpubl.).

Hosting nearly half of the national population in a strategic position at the edge of the eastern Mediterranean gives Apulian breeders a particular role for conservation. This is especially true in these years, since Audouin's Gull has been up-listed again to Vulnerable in the global IUCN red list and a further contraction between 20 % and 29% can be expected (BirdLife International, 2020). The West Mediterranean population has declined rapidly since 2010, as a result of the reduction in fishing-related activities (Calado *et al*., 2018, García-Tarrason *et al.,* 2015) and due to the presence of predators in the main breeding sites (Payo-Payo *et al.,* 2018).

Although the presence of the species has been favoured in the past by fishing activities (Oro 1999; Oro *et al.*, 1996), the resulting waste including fishing lines represents at the same time a lethal threat, as observed from the severe mortality in 2022 on Giorgio Treviso colony. All four Apulian colonies, except the latter, fall inside SPAs specifically designated by the regional authority and according to the recommendation of the national action plan (Serra *et al.*, 2001). Islands on the Ionian coast are also protected by the regional parks/

MPAs of Gallipoli and Porto Cesareo. The Eremita rock was designated as a SPA in 2017, nine months after the colony has been discovered (Liuzzi *et al.*, 2017). Further, a 681,3 sq km large marine SPA has been instituted in 2022, according to the foraging area of GPS-tagged Audouin's Gulls of Sant'Andrea colony and including the three breeding sites of Sant'Andrea, Campo and Testa islands. Adequate protection will hopefully be enforced also at Brindisi, for the new Giorgio Treviso breeding site.

Acknowledgements

This work was carried out using data collected within the framework of the 2021-2023 agreement between the Italian Ministry of the Environment and Energy Security (MASE), the National Institute for Environmental Protection and Research (ISPRA) and the Regional Environmental Agencies of Calabria, Liguria and Emilia-Romagna, for the implementation of the EU Marine Strategy Framework Directive (MSFD-2008/56/CE).

We are indebted to Direzione Marittima Capitaneria di Porto of Bari and Capitaneria di Porto of Gallipoli, and particularly to Lieutenant Commander Francesco Martina, as well as to Brigata San Marco of the Italian Military Navy, for having authorized and/or accompanied us to survey Apulian Audouin's Gull colonies. Eng Caterina Di Bitonto and Dr. Maria Fiore (Regione Puglia – Servizio Parchi e Tutela della Bioviversità) had a supportive role from the regional autority. Thanks are due to the presidents of Provincia di Brindisi, Riccardo Rossi and Antonio Matarrelli; to Giuseppe Marchionna, CEO of Santa Teresa Ltd (Centro Fauna Selvatica della Provincia di Brindisi); to Jonian Dolphin Conservation, particularly Carmelo Fanizza and Stefano Bellomo, for support during surveys on the Cheradi Islands. Adriano De Faveri (ISPRA) was instrumental for the chick ringing operations. Many thanks to Tommaso Capodiferro for the support throughout the study. Marco Zenatello, Fabio Mastropasqua, Egidio Fulco, Simone Todisco, Alessandro Caiulo, Mauro Masiello, Donato De Castro, Enrico Ancora, Luka Jurinovic, Marco D'Errico and Marco Bernardini, kindly offered valuable support to field activities and/or exchange of information. An anonymous referee usefully commented on an earlier draft of the manuscript.

REFERENCES

Bécares J.; Arcos J. M. & Oro D., 2016 – Migración y ecología espacial de la gaviota de Audouin en el Mediterráneo occidental y noroeste africano. Monografía n.º 1 del programa Migra. *SEO/BirdLife*, Madrid.

BirdLife International, 2020 – *Larus audouinii*. The IUCN Red List of Threatened Species 2020: e. T22694313 A183584708. <https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22694313A183584708.en>

BirdLife International, 2023 – Species factsheet: *Larus audouinii*. <https://www.birdlife.org/news/2021/11/05/seabird-of-the-month-audouins-gull-larus-audouinii/> (Downloaded on 21/01/2023).

Calado J. G., Matos D. M., Ramos J. A., Moniz F., Ceia F. R., Granadeiro J. P. & Paiva V. H., 2018 – Seasonal and annual differences in the foraging ecology of two gull species breeding in sympatry and their use of fishery discards. *Journal of Avian Biology*, 49 (1), e01463.

Carboneras C. & Oro D., 2020 – *Larus audouinii* - Audouin's Gull. In: European Breeding Bird Atlas 2: Distribution, Abundance and Change. Keller V., Herrando S., Vorisek P., Franch M., Kipson M., Milanesi P., Martì D., Anton M., Klvanova A., Kalyakin M.V., Bauer H-G., Foppen R.P.B. (eds.). *European Bird Census Council & Lynx Edicions*, Barcelona: 373.

Cataldini G. & Scarpina L., 1994 – Nidificazione di Gabbiano corso, *Larus audouinii*, sull'Isola S. Andrea, Gallipoli, Puglia. *Rivista Italiana di Ornitologia*, 63: 217-219.

Crnkovic R., 2012 – Present situation of the population of seabirds (*Calonectris diomedea, Puffinus yelkouan, Phalacrocorax aristotelis desmarestii, Larus audouinii, Larus michahellis* and *Sterna hirundo*) breeding in Lastovsko otocje nature park, Croatia. In: Ecology and Conservation of Mediterranean Seabirds and other bird species under the Barcelona Convention. Proceedingsn of the 13th Medmaravis Pan-Mediterranean Symposium. Alghero (Sardinia) 14-17 Oct. 2011. Yésou P., Baccetti N. & Sultana J. (eds.). *Medmaravis*, Alghero: 221-222.

De Juana E. & Varela J.M., 1993 – La poblacion mundial reproductora de la gaviota de Audouin (*Larus audouini*). In: Estatus y conservación de aves marinas. Actas del II Simposio Aves marinas del Mediterráneo, Calviá 21-26 de Mar. de 1989. Aguilar J. S., Monbailliu X. & Paterson A. M. (eds.). *Sociedad Espanola de Ornitologia*, Madrid: 71-85.

Fric J., Portolou D., Manolopoulos A. & Kastritis T., 2012 – Important Areas for Seabirds in Greece. LIFE07NAT/GR/000285. *Hellenic Ornithological Society* (*HOS/BirdLife Greece*), Athens.

García-Tarrasón M., Bécares J., Bateman S., Arcos J. M., Jover L. & Sanpera C., 2015 – Sex-specific foraging behavior in response to fishing activities in a threatened seabird. *Ecology and Evolution*, 5 (12): 2348-2358. <https://doi.org/10.1002%2Fece3.1492>

Ientile R., Linares A. & Brogna F., 2016 – First breeding colony of Audouin's Gull *Larus audouinii* in Sicily, characteristics and its origin. *Avocetta*, 40 (2): 71-76.

Jurinović L., Zec M., Dumbović Mazal V. & Kralj J., 2019 – Explorative GPS-tracking of foraging movements by Audouin's Gulls reveals no association with fishing vessels in Croatia. *Ardea*, 107 (2): 213-221. <https://doi.org/10.5253/arde.v107i2.a8>

Liuzzi C., Mastropasqua F. & Todisco S., 2013 – Avifauna pugliese… 130 anni dopo. *Ed. Favia*, Bari.

Liuzzi C., Todisco S., Mastropasqua F. & Capodiferro T., 2017 – Nuova colonia di Gabbiano corso *Ichthyaetus audouinii* in Puglia. *Alula*, XXIV (1-2): 71-75.

Marzano G., Mallia E. & Lai O. R., 2003 – Growth and limiting factors of Audouin's Gull (*Larus audouinii*) colony in S. Andrea Island. *III International Symposium on Wild Fauna*, Ischia, Italy: 500-503.

Mitchell I. P., Newton S. F., Ratcliffe N. & Dunn T. E., 2004 – Seabird Populations of Britain and Ireland. *T. & A. D. Poyser*, London.

Moschetti G., Scebba S. & Sigismondi A., 1996 – Checklist degli Uccelli della Puglia. *Alula*, III (1-2): 23-36.

Nardelli R., Andreotti A., Bianchi E., Brambilla M., Brecciaroli B., Celada C., Dupré E., Gustin M., Longoni V., Pirrello S., Spina F., Volponi S. & Serra L., 2015 – Rapporto sull'applicazione della Direttiva 147/2009/CE in Italia: dimensione, distribuzione e trend delle popolazioni di uccelli (2008-2012). *ISPRA*, Serie Rapporti, 219/2015.

Oro D., 1999 – Trawler discards: a threat or a resource for opportunistic seabirds? In: Proceedings of the 22nd International Ornithology Congress. Adams N. J., & Slotow R. H. (eds.). *BirdLife South Africa*, Johannesburg: 717-730.

Oro D. & Ruxton G. D., 2001 – The formation and growth of seabird colonies: Audouin's gull as a case study. *Journal of Animal Ecology*, 70 (3): 527-535. <https://doi.org/10.1046/j.1365-2656.2001.00511.x>

Oro D., Jover L. & Ruiz X., 1996 – Influence of trawling activity on the breeding ecology of a threatened seabird, Audouin's gull *Larus audouinii*. *Marine Ecology Progress Series*, 139: 19-29.

Payo-Payo A., Sanz-Aguilar A., Genovart M., Bertolero A., Piccardo J., Camps D., Ruiz-Olmo J. & Oro D., 2018 – Predator arrival elicits differential dispersal, change in age structure and reproductive performance in a prey population. *Scientific Reports*, 8 (1971): 1-7. <https://doi.org/10.1038/s41598-018-20333-0>

Rubinic B. & Vrezec A., 2000 – Audouin's Gull *Larus audouinii*, a new breeding gull species in the Adriatic Sea (Croatia). *Acrocephalus*, 21 (102-103): 219-222.

Serra G., Melega L. & Baccetti N. (eds.), 2001 – Piano d'azione nazionale per il Gabbiano corso (*Larus audouinii*). *Ministero dell'Ambiente, Istituto Nazionale della Fauna Selvatica, Quaderni Conservazione della Natura*, 6.

Zenatello M., 2022 – Gabbiano corso. In: Atlante degli uccelli nidificanti in Italia. Lardelli R., Bogliani G., Brichetti P., Caprio E., Celada C., Conca G., Fraticelli F., Gustin M., Janni O., Pedrini P., Puglisi L., Rubolini D., Ruggieri L., Spina F., Tinarelli R., Calvi G., Brambilla M. (a cura di). *Edizioni Belvedere, Historia naturae*, 11: 230-231.

Zenatello M., Liuzzi C., Mastropasqua F., Luchetta A. & La Gioia G., 2020 – Gli uccelli acquatici svernanti in Puglia, 2007-2019. *Regione Puglia, Editrice Salentina*.