https://www.biodiversityjournal.com - Edizioni Danaus
Biodiversity Journal, 2024, 15 (2): 277–300 - **Monograph**
https://doi.org/10.31396/Biodiv.Jour.2024.15.2.277.300

Biodiversity Journal
ISSN 2039-0394 (Print Edition)
ISSN 2039-0408 (Online Edition)

Colonies of herons and other allied waterbirds breeding in Sicily, 2007-2022

Giuseppe Rannisi[1], Paolo Galasso*[2], Andrea Cusmano[3], Rosa Termine[4], Manuel Andrea Zafarana[5], Renzo Ientile[6] & Salvatore Surdo[7]

[1]LIPU ODV, Sezione di Catania, Piazza Nettuno 4, 95126 Catania, Italy
[2]Stiftung Pro Artenvielfalt®, Meisenstraße 65, 33607 Bielefeld, Germany
[3]Via Alessio Narbone 52, 90138 Palermo, Italy
[4]Laboratory of Sanitary Environmental Engineering – Section of Biology, "Kore" University of Enna, Cittadella Universitaria, 94100 Enna, Italy
[5]LIPU ODV, Delegazione di Niscemi, via Angelo Marsiano snc, 93015 Niscemi, Italy
[6]Dipartimento di Scienze Biologiche, Geologiche ed Ambientali dell'Università di Catania, Sezione Biologia Animale, Via Androne 81, 95124 Catania, Italy
[7]Department of Agriculture, Food and Forest Sciences, University of Palermo, Viale delle Scienze, 90128 Palermo, Italy
*Corresponding author, e-mail: paolo_galasso@hotmail.com

ABSTRACT

We describe the results of the first regional census of herons and other colonial waterbirds, including Great Cormorants *Phalacrocorax carbo*, Little Bitterns *Ixobrychus minutus*, Black-crowned Night Herons *Nycticorax nycticorax*, Squacco Herons *Ardeola ralloides*, Western Cattle Herons *Bubulcus ibis*, Grey Herons *Ardea cinerea*, Purple Herons *Ardea purpurea* and Little Egrets *Egretta garzetta*, carried out throughout Sicily from 2007 to 2022. We also collected data about Great Egrets *Casmerodius alba* and other waterbird species in Ardeidae colonies without any breeding evidence, as Eurasian Spoonbills *Platalea leucorodia* and Glossy Ibis *Plegadis falcinellus*. Collected data highlighted a regional widespread increase of the numbers in known colonies and nests of each species, especially of *Bubulcus ibis* that showed a sharp increase in number from 30 nests recorded for the whole region in 2007 up to 530 nests in 2022, mainly concentrated in eastern Sicily, in the province of Catania. Also *A. ralloides*, *N. nycticorax* and *E. garzetta* showed a positive trend with an increase in the number of colonized locations and nests recorded, with *A. ralloides* occupying the most of the Sicilian colonies with at least few pairs. On the other hand, *A. cinerea* showed a slight negative trend, with 45 nests recorded in 2007 and only 31 in 2022, at the end of the study; *A. purpurea* is an irregular breeder with an oscillating and unpredictable trend related to only 1–4 ascertained pairs maximum for the whole region. Despite the *P. carbo* is a regular breeding species in Sicily, it has not showed any sign of expansion in the last decade, remaining confined to a few historical locations near the Simeto River and Lentini Lake. All data here presented are related to the minimum and ascertained numbers of colonies and counted nests. Small colonies may not have been counted in some unmonitored locations, often inaccessible. It is highly recommended, in the near future, the creation of a coordinated survey network that would improve and make the census more in-depth and better standardized.

KEY WORDS

Population trend; *Ardea cinerea*; *Bubulcus ibis*; *Egretta garzetta*; *Phalacrocorax carbo.*

Received 22.01.2024; accepted 02.04.2024; published online 30.06.2024
Proceedings of 6th International Congress on Biodiversity "*Biodiversity and the new scenarios on alien species, climate, environment and energy*" - Trapani (Italy, Sicily) 2–3 September 2022

INTRODUCTION

Scant information about waterbird colonies is currently available for Sicily, and limited to restricted areas. A first attempt to outline the status of breeding herons in Sicily was made by Ciaccio & Siracusa in 1989 and, subsequently, by Ciaccio in 2004. A detailed census was carried out in Sicily in 2002, within the first national census of the Italian heronries (Fasola et al., 2007). In addition to the lack of scientific papers about this topic, the scarce use of Ornitho.it and other digital platforms by most birdwatchers and ornithologists, caused a further lack of data that could have instead shed light on the demographic trends of Sicilian herons and avifauna in general. In this paper, we aim to update the situation of the breeding populations of Eurasian Bitterns, Little Bitterns, Black-crowned Night Herons, Squacco Herons, Western Cattle Herons, Grey Herons, Purple Herons, Little Egrets and Great Cormorants in Sicily, and to compare their present status with the past censuses. We tried to summarised and analyse all the available data from previous publications (Galasso et al., 2021; Surdo et al., 2021; Zafarana et al., 2019), within the limitation that the methods adopted for the previous censuses were not a completely standardised.

MATERIAL AND METHODS

All available published information was accounted for, including some historical data of the 19th century (Benoit 1840; Doderlein, 1869–1874). The most recent species status are from the last Sicilian bird checklist (Massa et al., 2021).

A complete census was carried out for breeding Great Cormorants *Phalacrocorax carbo*, Little Bitterns *Ixobrychus minutus*, Black-crowned Night Herons *Nycticorax nycticorax***,** Squacco Herons *Ardeola ralloides*, Western Cattle Herons *Bubulcus ibis*, Grey Herons *Ardea cinerea*, Purple Herons *Ardea purpurea* and Little Egrets *Egretta garzetta* from 2007 to 2022. However, we could not monitor all the colonies each year, especially in 2009 when the census was limited to only few colonies. The count of nests was carried out from May to July, from a safe distance so as to cause as little disturbance as possible; for this reason, the data provided are estimates of the minimum number of pairs or nests that in many cases could have been more numerous. Data about unusual records of Eurasian Bittern *Botaurus stellaris* during the breeding season were collected, as well as data about Eurasian Spoonbills *Platalea leucorodia*, Glossy Ibises *Plegadis falcinellus* and Great Egrets *Casmerodius alba*. All the most important Sicilian wetlands and the potentially relevant breeding areas were investigated, including the complex of Trapani salt pans and Stagnone di Marsala (Trapani), Ponte Barca and Simeto River (Catania), Pergusa Lake (Enna), Biviere di Gela Lake and Geloi Wetland (Caltanissetta), Lentini Lake and Syracuse Salt Pans (Syracuse) and the whole complex of Sicilian south-eastern swamp lakes (Ragusa and Syracuse). At Pergusa Lake, the census of Little Bitterns in the years 2012-2021 were carried out twice per year between May and June, with the aid of the acoustic call around the perimeter of the lake from spots approximately 300 metres of distance from each other; in addition, the most difficult locations to reach were investigated using an electric motorboat. All data related to central-eastern Sicily, from 2007 to 2022, have been collected by one of the authors, Giuseppe Rannisi, during the bird census promoted by LIPU Catania. In addition to the data directly collected by authors, we also evaluated and included some records from other ornithologists and birdwatchers, as well as observations and data uploaded on online database such as Ornitho.it, Ubird, eBird, and INaturalist or social media pages such as Facebook groups.

RESULTS

We believe to have detected and monitored all of the major Sicilian colonies, with the exception of some minor mono-specific colonies with a few nests of Little Egrets (breeding on artefacts such as mills, irregularly occupied), Squacco Herons or Black-crowned Night Herons that often breed in isolated pairs in inaccessible locations. Furthermore, the results for the Purple Heron and for the Little Bittern only represent the minimum number of breeding pairs, as no aerial survey was carried out for these elusive species that mainly breed within reed beds and other halophytic vegetation.

The total number of colonies in Sicily showed a sharp increase in the last decades, from only the historical ones reported in the '80s for the province of Catania near the Simeto River (Fasola et al., 1981, Brichetti & Fasola, 1986, Ciaccio & Siracusa, 1989, Iapichino & Massa, 1989), up to 37 different colonies monitored during this study, many of them also located in middle or western Sicily, highlighting the colonisation of new sites by certain species. Some of the colonies were regularly occupied during the whole period of this study, other irregularly or occasionally (Fig. 1), like the Geloi Wetland (Caltanissetta), where the oscillation of the water levels has not allowed the establishment of stable colonies of waterbirds.

The number of nests recorded was very variable, depending on species, year and locations, from only 1 isolated nest, more frequently for Purple Herons, Squacco Herons and Black-crowned Night Herons, to more than 250 nests in the case of Western Cattle Herons and Little Egrets (Fig. 2). Likewise, the monitored colonies hosted from 1 up to 6 breeding species (Fig. 3). The major colonies were the ones located near the Simeto River that were the richest in terms of the number of nests and species, especially the colonies at Lentini Lake, Ponte Barca and near the mouth of the river (Torre Allegra, Vecchia Ansa).

More than 50% of Sicilian colonies are on swamped trees, especially on Tamarisk trees (*Tamarix africana* and *Tamarix gallica*) totally surrounded by water; subsequently, the favoured habitat is represented by reed beds with *Phragmites australis* or *Arundo donax* and other trees out of the water (Fig. 4), such as *Acacia saligna*, *Eucaliptus* sp., *Pinus* sp., *Populus* sp., and, in some cases on *Quercus virgiliana*. In the Trapani province, Little Egrets also breed in islets and on artefacts such as watermills (Surdo, 2016).

Below is a list of species covered in detail that

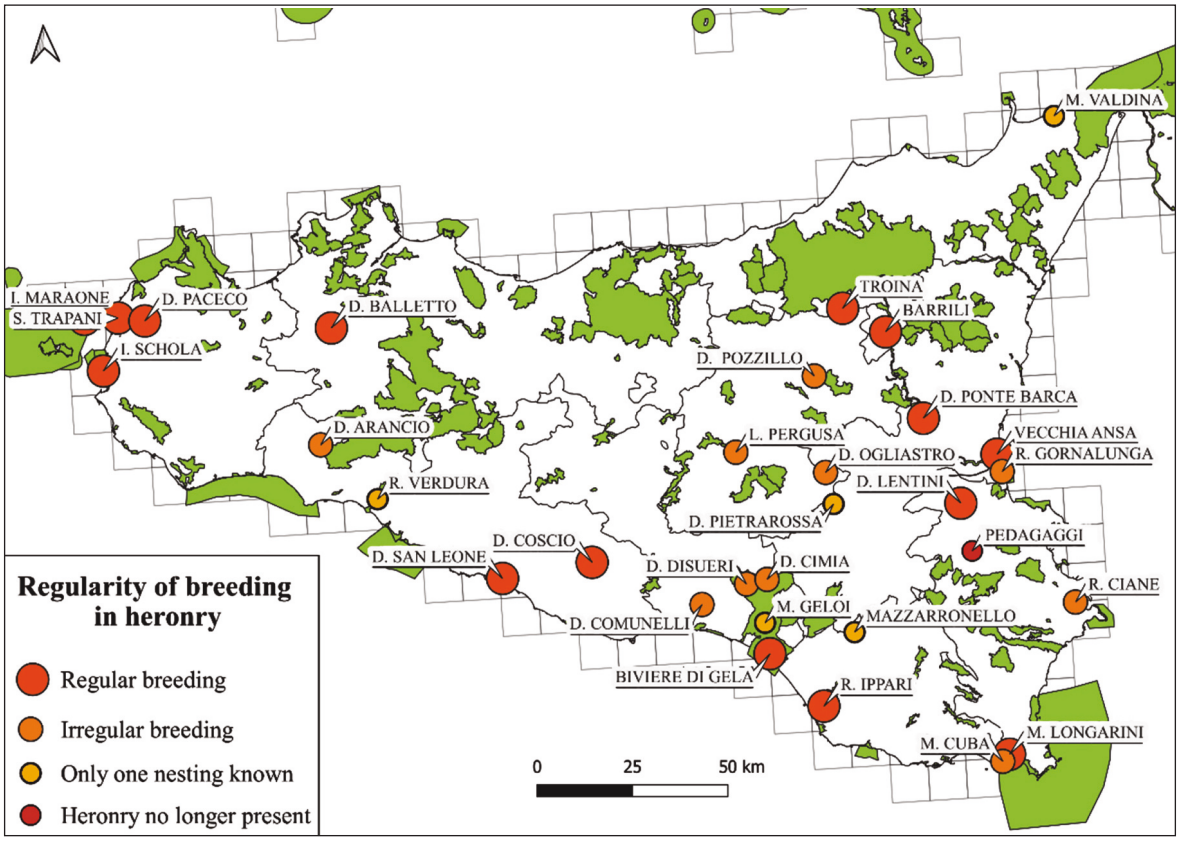

Figure 1. Map of main Sicilian colonies and their occupation over time. REGULAR BREEDING: occupied at least in 66% of the years since its discovery; IRREGULAR BREEDING: occupied less than in 66% of years during the years of the monitoring since its discovery. Labels in the maps indicate the name of the location (D = Dam; I = island; L = Lake; M = marsh; R = river; S = salts), in green, protected areas are highlighted.

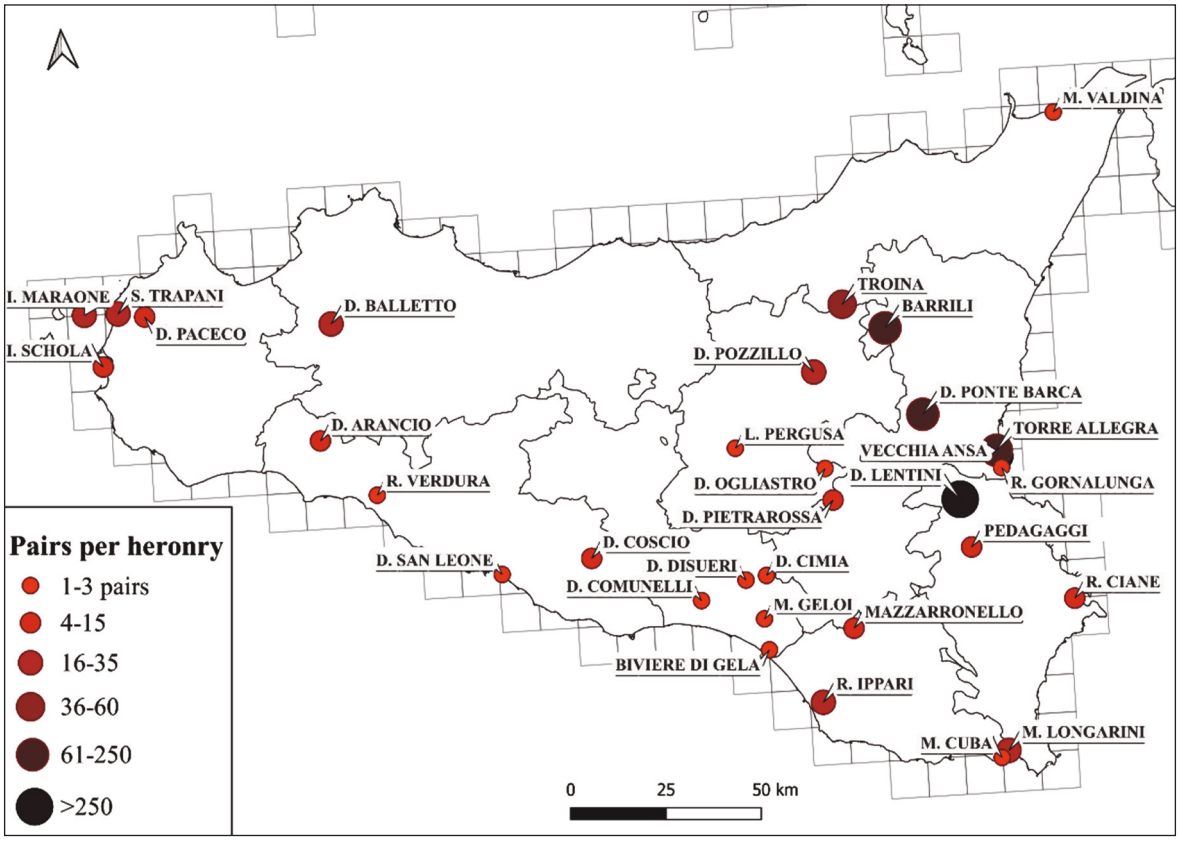

Figure 2. Map of the main Sicilian colonies in relation to the number of heron nests hosted .

includes a summary of the available previous data collected from the past years since the end of the 19th century.

Eurasian Bittern
Botaurus stellaris (Linnaeus, 1758)

PREVIOUS DATA. Reported as breeding by Benoit (1840) and as presumed breeder by Doderlein (1869–1874), but never confirmed; subsequently rejected from the list of the breeding birds of Sicily in the first related atlas (Massa, 1985). Currently considered as a scarce migrant and occasionally wintering with a stationary trend (Massa et al., 2021).

NEW DATA. Few interesting records during the breeding season without evidence of breeding: 1 adult photographed on 26.V.2018 at Ogliastro Lake, near Enna (Laspina F., *pers. comm.*); in Ponte Barca (Catania), 1 adult observed on 12.VI.2012 (Fiot J.P., *pers. comm.*), 1 on 14.VI.2015 and 1 on 24.V.2022; 1 adult in Torre Allegra (Catania) on 15.VI.2013 (Fiot J.P., *pers. comm.*); 1 adult on 12.VI.2020 in Pantano Longarini (Syracuse), where the species has become a regular wintering in the recent years (Galasso et al., 2021).

Little Bittern
Ixobrychus minutus (Linnaeus, 1766)

PREVIOUS DATA. Doderlein (1869-74) reported "thousands" individuals breeding in the wetlands near Catania and Lentini (Syracuse), the latter subsequently drained up in 1951. Krampitz (1958), reported this species as "very common" in late June at Pergusa Lake (Enna). In the three atlases of breeding birds of Sicily (Massa, 1985; Lo Valvo et al., 1993; AA.VV., 2008), the total number of occupied UTM squares remained unchanged (n=18), despite its distribution changed over the years, with no less than 150-200 pairs es-

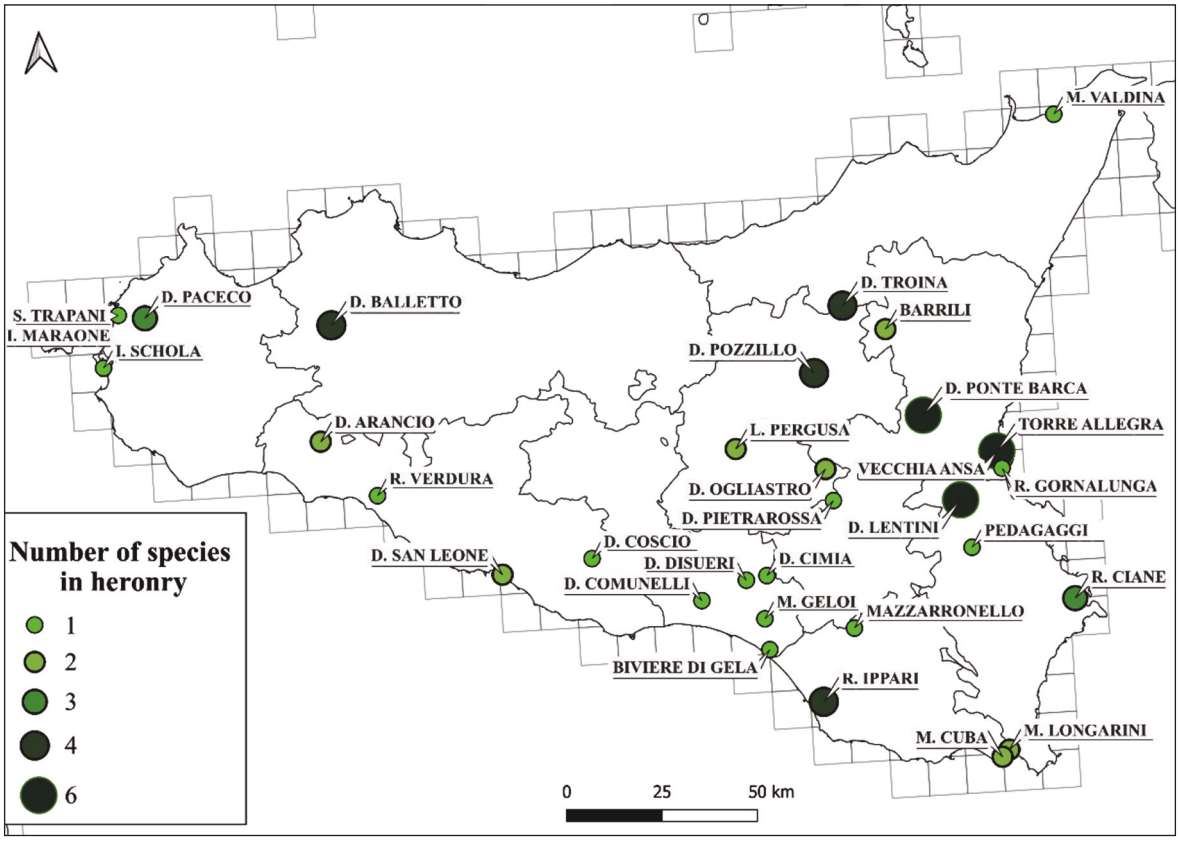

Figure 3. Map of the main Sicilian colonies in relation to the number of species hosted, with the exclusion of Little Bitterns.

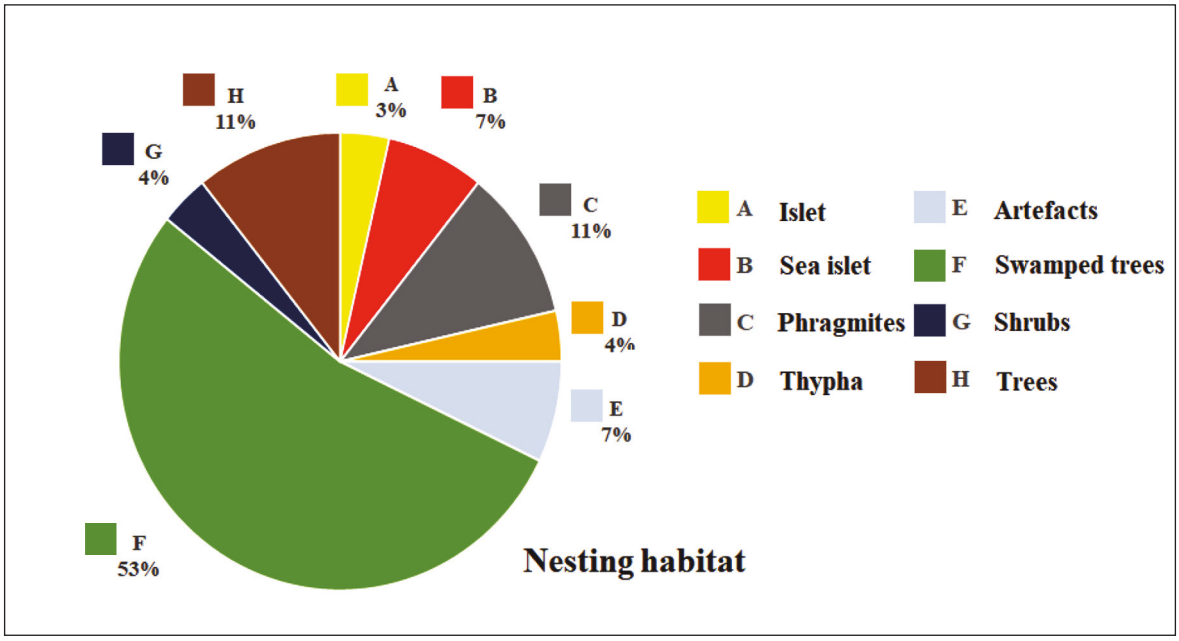

Figure 4. Pie chart of colonies nesting habitat. Habitat categories are based on Fasola et al., 1981.
Chart made on the basis of data related to 25 colonies on a total of 32.

timated by 1999 and a maximum of 150 pairs in 2004 for the whole region (Brichetti & Fracasso, 2018). The most important Sicilian breeding site was Pergusa Lake (Lo Valvo et al., 1993), where breeding ceased at the end of the '90s due to the drought. The site was colonised again in recent years because of the gradual increase in water level (Termine et al., 2008); after a first succesful breeding in 2011 (1 nest with 3 nestlings), an average of 10 nests per year was recorded from 2012 to 2020 and only 7 nests in 2021, probably due to the reduction in water level and the consequent receding of the water from the rush of reed bed (Termine, 2015; Termine R., unpublished data, 2021).

Another important historical breeding site was Lentini Lake (Ciaccio & Priolo, 1997), where the breeding population sharply decreased too, due to the reduction of the reed belt and hygrophilous vegetation. Reported as "ascertained breeder" in the last atlas of Italian breeding birds (2010–2016), only in 1 UTM Sicilian square, as "probable breeder" in 10 UTM square and as "possible breeder" in 9 squares (Lardelli et al., 2022). Currently considered as a scarce resident breeder, migrator and occasional wintering with a very declining trend (Massa et al., 2021).

NEW DATA. The Little Bittern is a very elusive species that can potentially occupy many different kind of artificial basins for breeding, including small ones (≥ 0.5 ha) reed bed belt and abundant vegetation; this makes it very difficult to do an accurate estimation of the total number of pairs. Despite this, a regular presence of several pairs was recorded during this study in the whole Sicily (Fig. 5) and especially in the wetlands of Catania's province, favoured by the presence of extensive reed beds (Simeto's mouth, Torre Allegra, Buttaceto and Juncetto channels, Pantano d'Arci, Pantano Gelsari, Pantano Lentini, Ponte Barca) until 2010. After that, the removal of the hygrophilous vegetation for the cleaning of the channels and the draining of some minor wetlands sharply reduced its nesting habitat and, consequently, the number of pairs. A range of 52–91 breeding pairs per year was

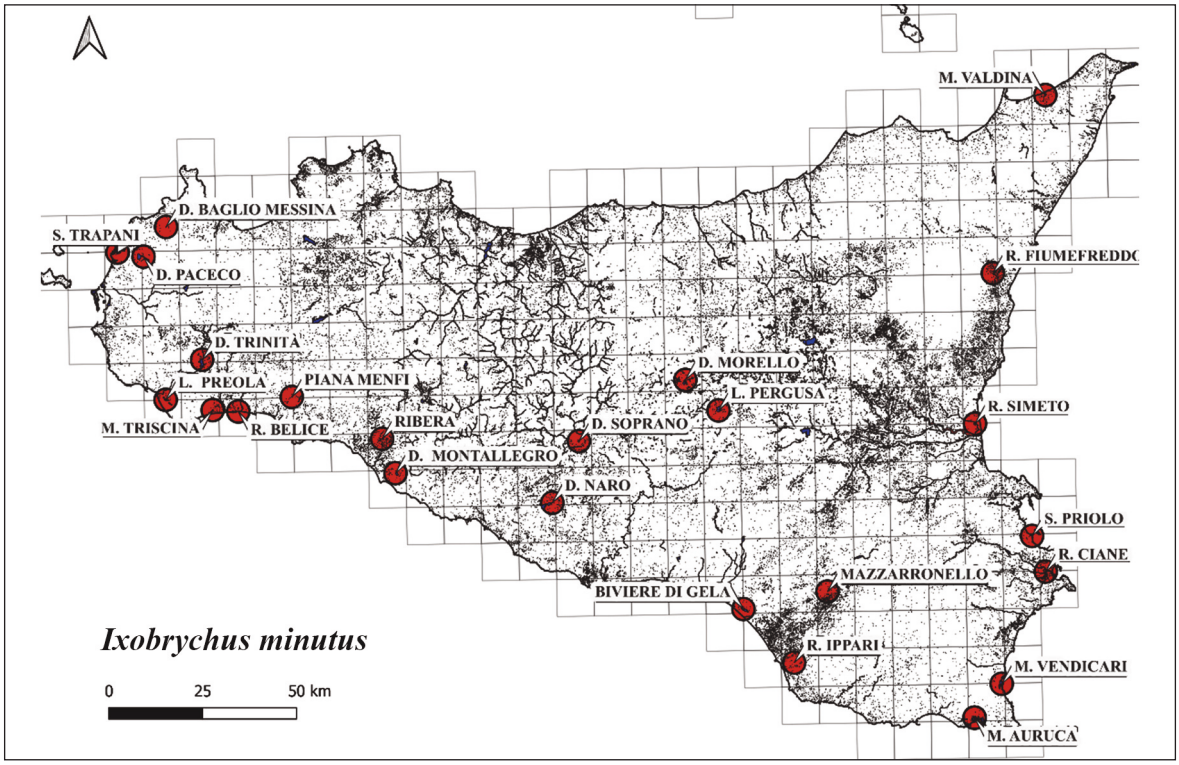

Figure 5. Distribution map of *Ixobrychus minutus* in Sicily. Red spots indicate at least one breeding pair recorded at least in one year during of this study.

Localities	Annual pairs	Localities	Annual pairs
Simeto River	8-10	Trapani Saltpans	0-1
Trinità Dam	1-3	Paceco Dam	0-1
Preola Lake	2-5	Bruno Marsh	1-2
Soprano Dam	1-2	Longarini and Cuba Marsh	4-8
Morello Dam	1-2	Auruca and Baronello Marsh	2-5
Ribera	1-2	Ippari River	1-3
Priolo Saltpans	1-2	Biviere di Gela Lake	2-3
Vendicari Marsh	1-2	Mazzarronello	2
Piana Menfi	1-2	Ciane River	1-3
Fiumefreddo River	1-2	Pergusa Lake	10-12
Triscina Marsh	1-2	Valdina Marsh	5-8
Baglio Messina Dam	1	Montallegro Dam	1-2
Belice River	2-3	Naro Dam	2-4
Total pairs counted: 52-91		**Total pairs estimated: 150-180**	

Table 1. List of locations and related annual range of Little Bitterns breeding pairs recorded during the period of this study.

recorded during the years 2007–2022 (Table 1), in 25 different UTM squares, with most abundant concentrations of pairs in the reed beds of Pergusa Lake (Enna), where 10–12 pairs per year were recorded, confirming this area as the most important breeding location for this species in Sicily. Other important areas are the Simeto River, where 8-10 pairs per year were recorded, the whole complex of Sicilian south-eastern swamp lakes with 7–15 pairs per year and the wetlands of Valdina (Messina), with 5–8 pairs per year.

Black-crowned Night Heron
Nycticorax nycticorax Linnaeus, 1758

Previous data. Doderlein (1869–1874) and Giglioli (1907) presumed the species as breeder but without further details; Massa (1985) considered its breeding formerly as "probable". First ascertained breeding in 1984 at Biviere di Gela, with 2 pairs; in 1987 the whole Sicilian population was estimated at 30–50 pairs in 5 different locations (Dimarca et al., 1996). In 1993 at least 45 nests recorded along the Simeto River (Ciaccio & Priolo, 1997). Subsequently, the species had a negative trend, with only two sites occupied in 2002 and a total of 15 pairs for the whole region: 5 at Lentini Lake and 10 along the Simeto River (Fasola et al., 2007). In 2018, the number of pairs at Simeto River increased again up to 15–20 (Zafarana et al., 2019). Likely breeding at Pergusa Lake in 2011, but without any confirmation (Termine, 2014a), where it is an uncommon migratory species (Termine et al., 2008). Only 2 UTM squares occupied in the first atlas of breeding birds of Sicily (Massa, 1985), 11 squares in the subsequent atlases (Lo Valvo et al., 1993; AA.VV., 2008) and in 3 Sicilian squares (more 1 square as probable) in the last atlas of Italian breeding birds 2010-2016 (Lardelli et al., 2022). Considered a scarce resident breeder, migrator and occasional wintering with declining trend (Massa et al., 2021).

New data. Generally irregularly breeding in some artificial water bodies and reservoirs of the inland, especially in less dry years when vegetation of *Tamarix* sp. is partially submerged and surrounded by water. The number of locations occupied has increased in the recent years, with no less than 16 different UTM square occupied (Fig. 6). Irregular breeder also in the Sicilian south-eastern swamp lakes complex during the period of the study, with only 1-3 pairs nesting on *Eucaliptus* sp. and *Acacia saligna*. An average of 4 colonies and 47 nests (σ= 24.45, years=16) per year (min. 6 nests in 2009, max 102 nests in 2013) during the period of this study mainly concentrated in the eastern and southern coast of Sicily. In total, 12 nests recorded in the whole region in 2007 and grown up to 71 in 2022, with an increase trend of +591% (r= 0.5489; p= 0.0276) as showed in Fig. 7.

Squacco Heron
Ardeola ralloides Scopoli, 1769

Previous data. Presumed to be a breeder by Doderlein (1869–1874) in the wetlands near Mondello (Palermo), drained up 30 years later, but without any definitive evidence. No more reported

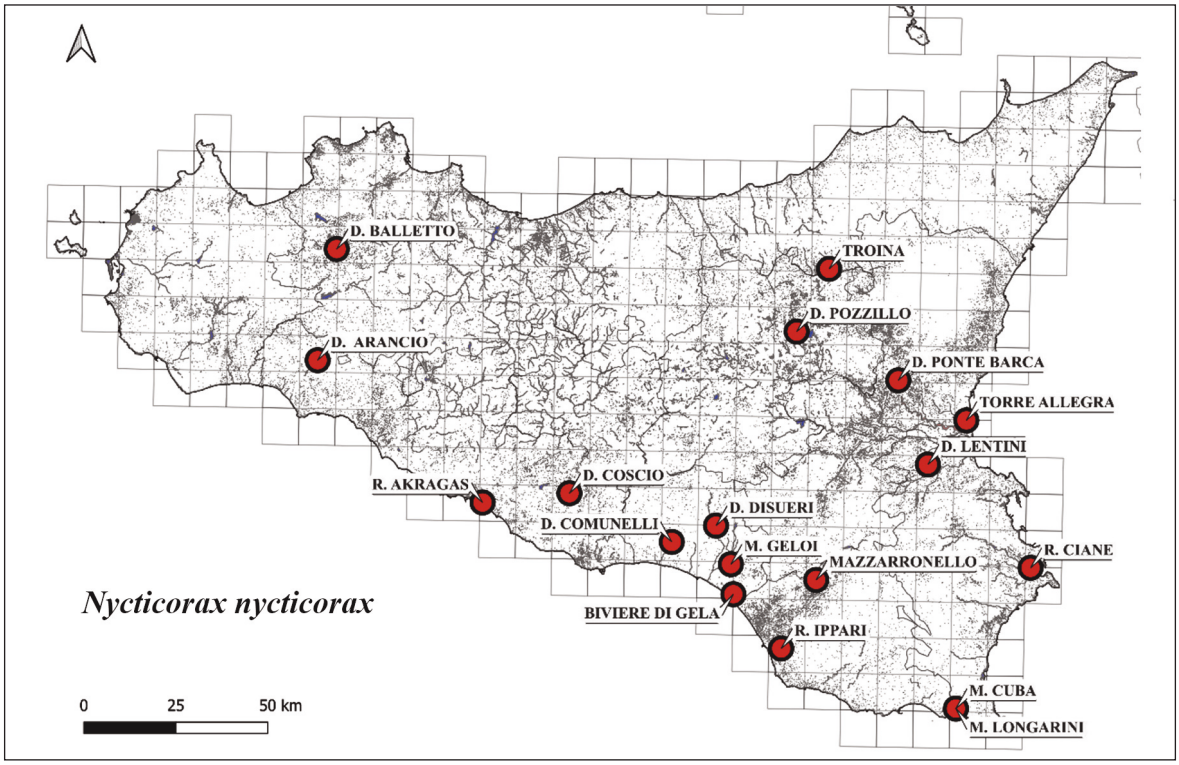

Figure 6. Distribution map of *Nycticorax nycticorax* in Sicily. Red spots indicate at least one nest recorded at least in one year of this study.

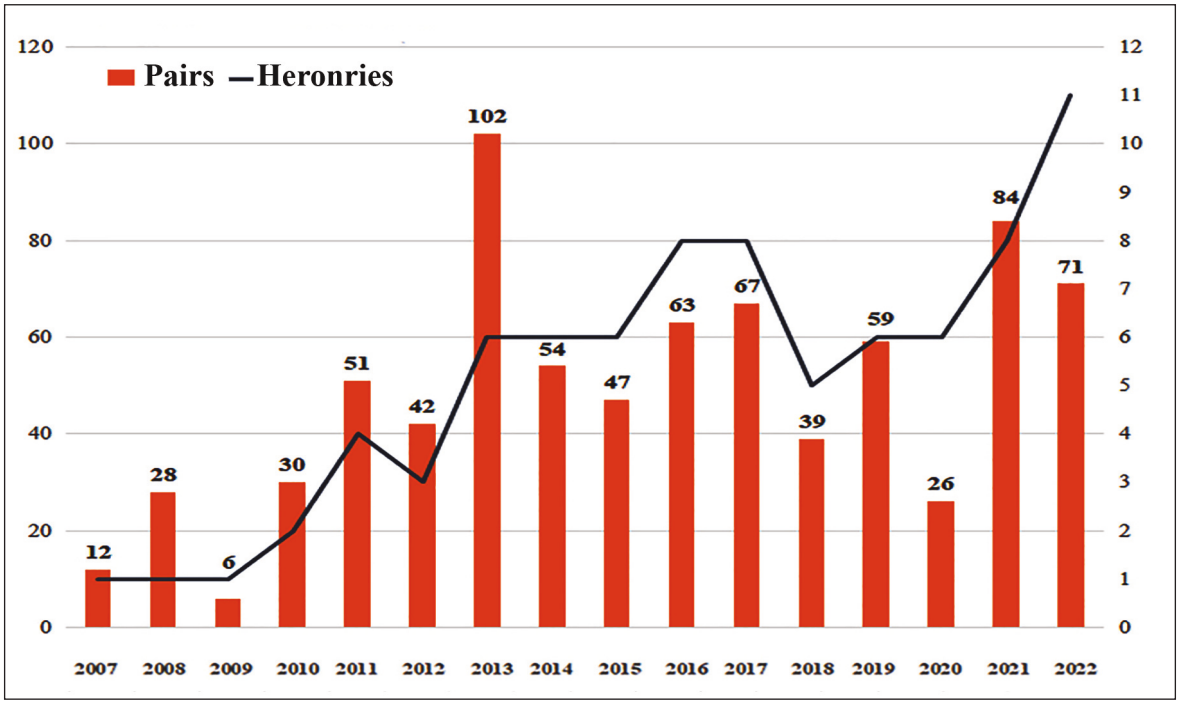

Figure 7. Population trend of *Nycticorax nycticorax* in Sicily during the period of the study: in the right ordinate the number of colonies, on the left one the number of nests recorded.

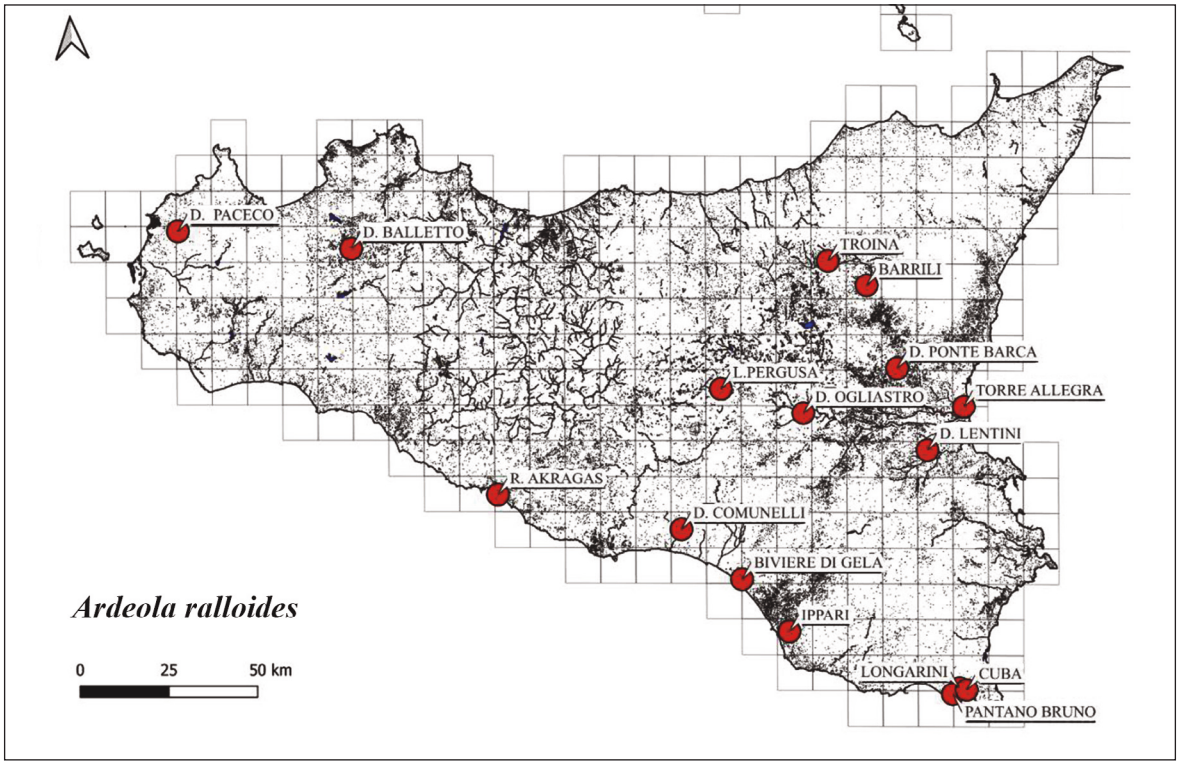

Figure 8. Distribution map of *Ardeola ralloides* in Sicily. Red spots indicate at least one nest recorded at least in one year of this study.

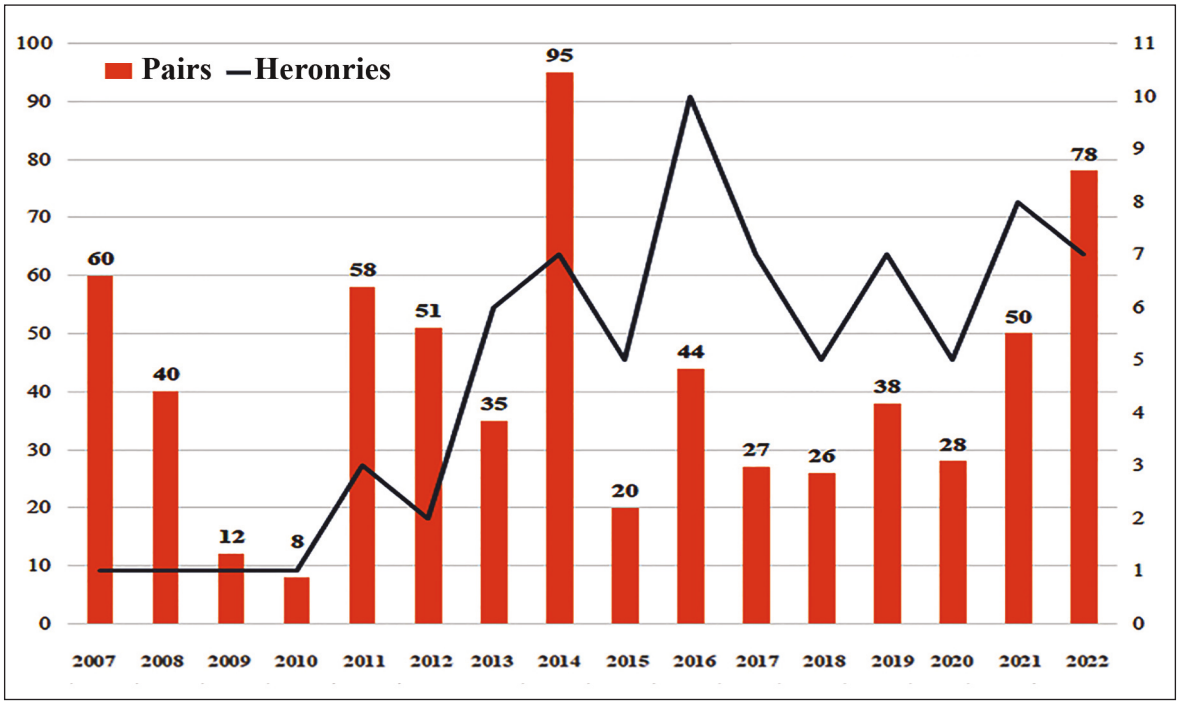

Figure 9. Population trend of *Ardeola ralloides* in Sicily during the period of this study: in the right ordinate the number of colonies, on the left one the number of nests recorded.

as a breeding species in the first atlas of breeding birds of Sicily (Massa, 1985). First confirmed breeding in 1988 at Simeto River (Ciaccio & Siracusa, 1989). In the next two atlases, is reported respectively in 5 and in 7 UTM squares (Lo Valvo et al., 1993, AA.VV., 2008), occupying irregularly other locations outside the Simeto's area in which the whole population was estimated at 65-70 pairs in 2003 (Corso, 2005) and only at 8–15 pairs in 2017 and 2018 (Zafarana et al., 2019). First ascertained breeding at Pergusa Lake in 2013 with the records of 2 juveniles at the end of July (Termine, 2015) and, subsequently, also in 2016 with 1 juvenile recorded in September (Termine R., unpublished data, 2016); at Pergusa Lake it is a regular migratory species, more common in spring (Termine et al., 2008). First breeding for the province of Trapani in 2014, at the dam of Paceco, with at least 9 juveniles from 2–3 pairs (Surdo, 2019). Reported as ascertained breeder in 5 UTM Sicilian squares (but probably only in 4 squares) in the last atlas of Italian breeding birds 2010–2016 (Lardelli et al., 2022).

Currently considered a scarce breeder and migrator, irregular wintering with a declining trend (Massa et al. 2021).

NEW DATA. Irregular breeder, often in association with Black-crowned Night Heron, both in natural habitat and in some artificial water bodies and reservoirs of the inland. The number of locations occupied has sharply increased in the recent years, with no less than 15 different UTM squares occupied (Fig. 8), but each one with only few pairs recorded. Average of 4.4 colonies and 40 nests (σ.= 21.38, years =15) per year (min. 8 nests in 2010, max 95 nests in 2014) during the period of this study, mainly concentrated in central and eastern Sicily. With 60 nests recorded in the whole region in 2007 and 66 in 2022, it showed a slight increase of +10% (r= 0.1043; p= 0.7004) as highlighted in Fig. 9.

Western Cattle Egret
Bubulcus ibis Linnaeus, 1758

PREVIOUS DATA. First ascertained Sicilian breeding in 2001 with 5 pairs recorded at "Torre Allegra", near the mouth of Simeto River (Ciaccio, 2004); subsequently, 30 pairs at the same locations in 2004 together a second colony of 7-8 pairs at Lentini Lake (Ciaccio, 2004) and at least 30 pairs in 2005 again at Lentini Lake (Fasola et al., 2007). First breeding in Trapani's province almost 10 years later, in 2014, with 11 juveniles related to 10-20 pairs in Paceco Lake, where the species regularly breed until 2018 (Surdo, 2019). Reported in the last atlas of Italian breeding birds 2010-2016 as ascertained breeder for 4 different UTM Sicilian squares and in 3 squares as probable breeder (Lardelli et al., 2022). Considered a common resident breeder, migrator and wintering with a very increasing trend (Massa et al., 2021).

NEW DATA. Species in considerable expansion, both in terms of number of pairs and, slightly, in number of sites occupied: from 2 UTM squares occupied until 2008 (AA.VV., 2008), to at least 9 squares occupied during this study (Fig. 10), mainly in the eastern part of the region, confirming Simeto River and Lentini Lake as the most important breeding areas for this species in Sicily. Average of 4 colonies (min. 1, max 7) and 342 nests (σ= 221.18, years =16) per year (min. 10 nests in 2007, max 700 nests in 2021). With a total of 10 nests recorded in the whole region in 2007 and as many as 541 in 2022, this species showed a very massive increase of +5410% (r= 0.8372; p= >0.00001) in the last fifteen years despite of the occupation of only few breeding locations (Fig. 11).

Grey Heron
Ardea cinerea Linnaeus, 1758

PREVIOUS DATA. Benoit (1840) and Zuccarello-Patti in Doderlein (1869–1874) generally reported the species as wintering and breeding in the Catania Plain, but subsequently was rejected from the list of breeding birds of Sicily in the corresponding first atlas (Massa, 1985). First ascertained breeding in 1987 at Pozzillo Lake and along the Salso River (Enna), and, the next year, also at Simeto River (Ciaccio & Siracusa, 1989). Subsequently and until 2007, only 2 breeding locations were known for the province of Catania: Simeto River and Lentini Lake, with a total of 55 pairs recorded in 2002 (Fasola et al., 2007). At Pergusa Lake, in 2008 a first breeding pair was recorded with 4 pulli (Barone et al., 2008), subsequently 5 nests in 2011 (Termine, 2014b), 1 pair with 1 pullus in 2016 and 1 pair with 2 pulli in 2019 (Termine R., unpublished data, 2019), all of them on *Tamarix* sp.; on this site it is

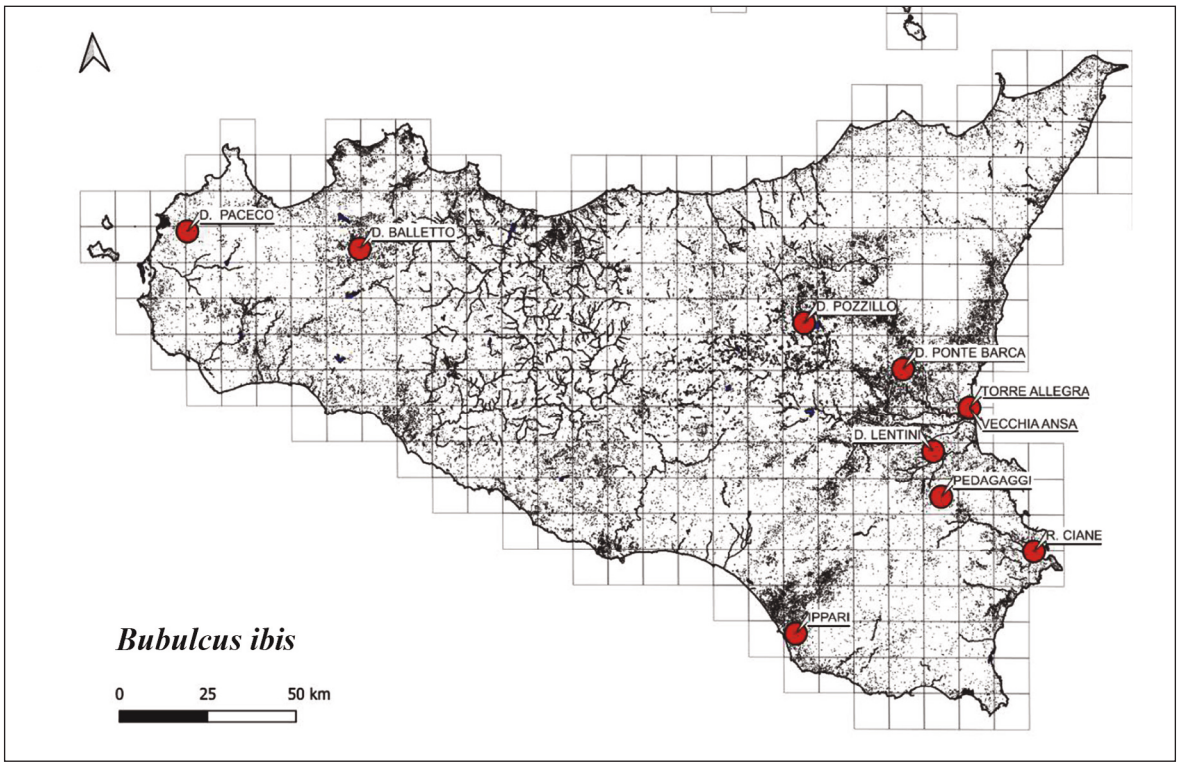

Figure 10. Distribution map of *Bubulcus ibis* in Sicily. Red spots indicate at least one nest recorded at least in one year of this study.

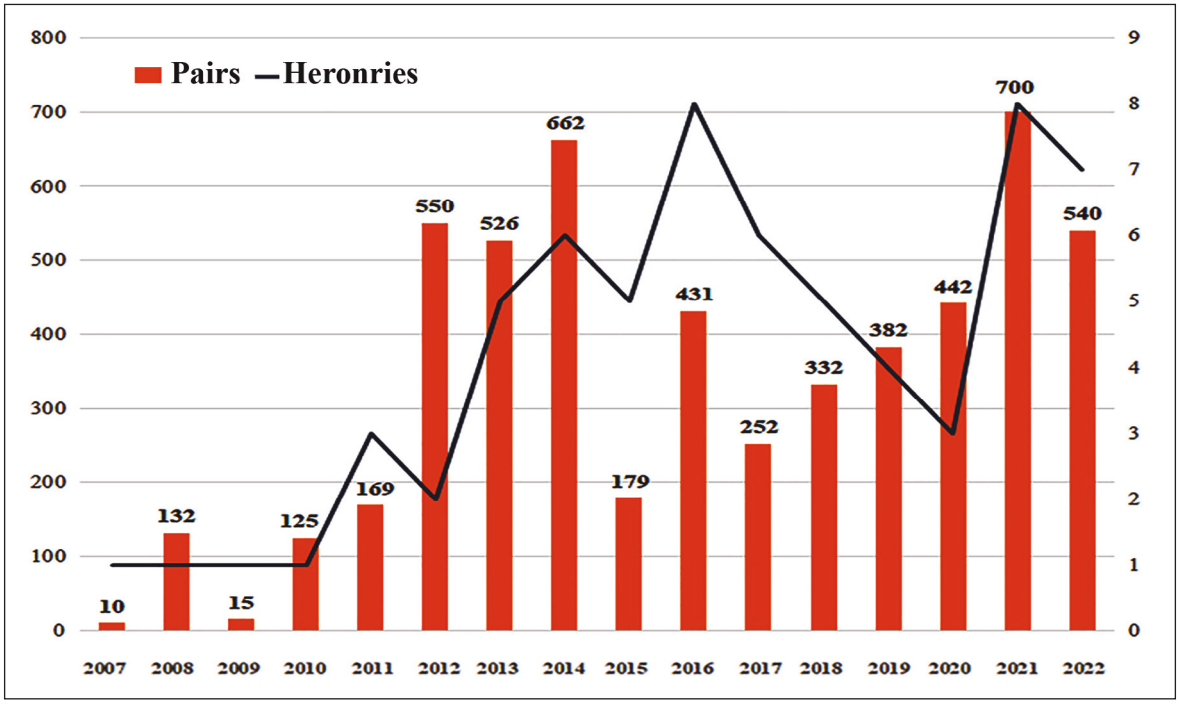

Figure 11. Population trend of *Bubulcus ibis* in Sicily during the period of this study. In the right ordinate the number of colonies, on the left ones the number of nests recorded.

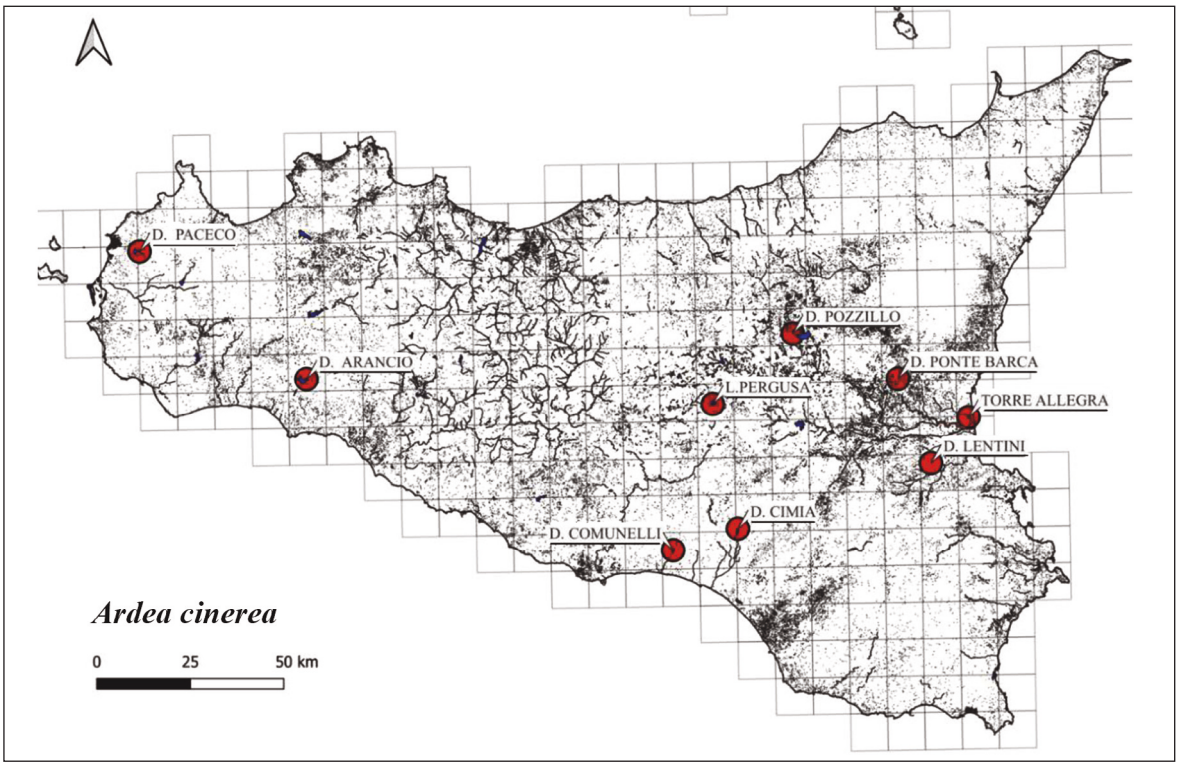

Figure 12. Distribution map of *Ardea cinerea* in Sicily. Red spots indicate at least one nest recorded at least in one year of this study.

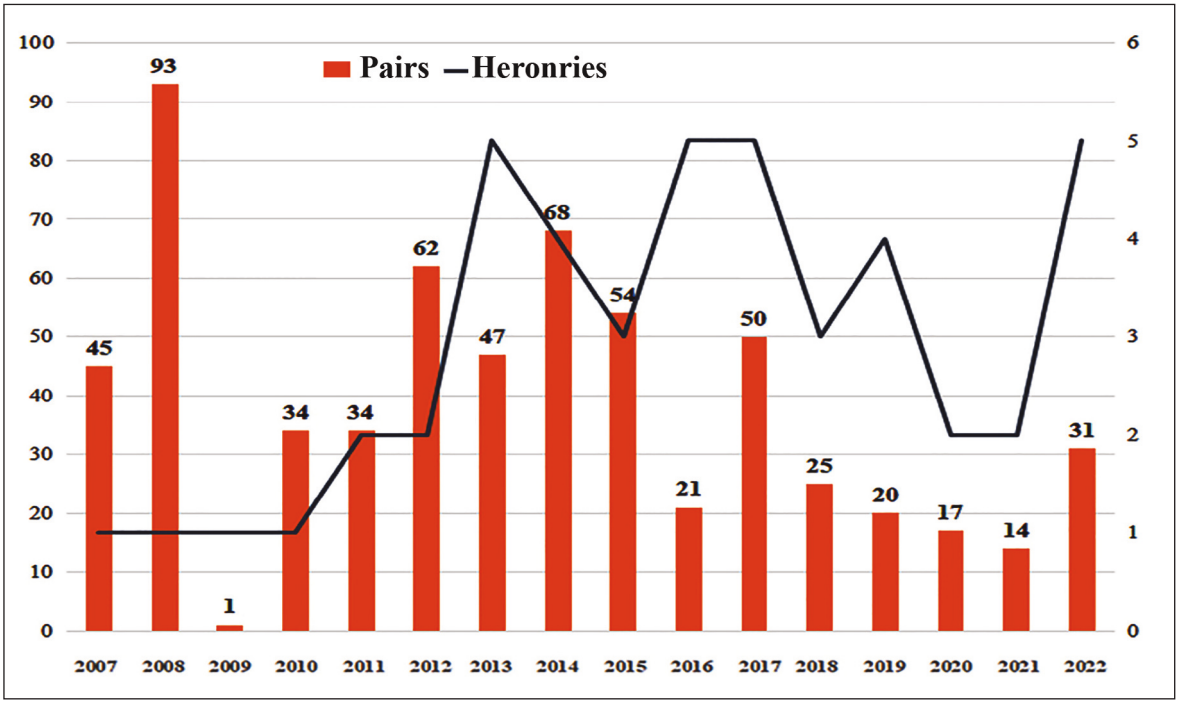

Figure 13. Population trend of *Ardea cinerea* in Sicily during the period of this study. In the right ordinate the number of colonies, on the left ones the number of nests recorded.

a regular, but sporadic, species (Termine et al., 2008). Reported for only 3 UTM squares in the second atlas of breeding birds of Sicily (Lo Valvo et al., 1993) and in 13 different squares in the last atlas (AA.VV., 2008). In most of the nesting sites, both natural and artificial, breeding is not regular. At Lentini Lake, 55 nests were counted in 2002 (Fasola et al., 2007). Reported in the last atlas of Italian breeding birds 2010-2016 as ascertained breeder for 7 different UTM Sicilian squares and in 6 squares as probable breeder (Lardelli et al., 2022). Considered a scarce breeder and a common migrator and wintering species with a stable trend (Massa et al., 2021).

NEW DATA. Irregular breeder, occupying no more than 9 UTM squares in total during the years of this study (Fig. 12), often in association with other species; average of 38.6 nests (σ.=23.4, years =16) per year (min. 1 nest in 2009, max 93 nests in 2008) mainly concentrated in central and eastern Sicily. Up to 45 nests recorded in total in 2007 and only 31 in 2022, showing a decrease of -31% (r= -0.4179; p= 0.1072) as showed in Fig. 13.

Purple Heron
Ardea purpurea Linnaeus, 1766

PREVIOUS DATA. Species listed as "common breeder" near Catania and Lentini areas by Benoit (1840), Doderlein (1869–1874) and Stresemann (1943) but subsequently rejected from the list of the breeding birds of Sicily in the first corresponding atlas (Massa, 1985). First probable breeding in 1987 at Ogliastro Lake (Ciaccio & Siracusa, 1989) and first ascertained breeding at Lentini Lake in 1993 (Lo Valvo et al., 1993). Reported as breeding only in 4 UTM squares in both of the last two atlases (Lo Valvo et al., 1993; AA.VV., 2008), related to the only two known locations of Lentini Lake and Simeto River (Fasola et al., 2007), with 1–2 pairs in 2017–2018 (Zafarana et al., 2019). Reported in only 1 UTM square (Ponte Barca) as probable breeder in last atlas of Italian breeding birds for the years 2010–2016 (Lardelli et al., 2022). Considered a scarce migrator and a rare breeder with a decrement trend (Massa et al., 2021).

NEW DATA. The species exclusively breeds in the

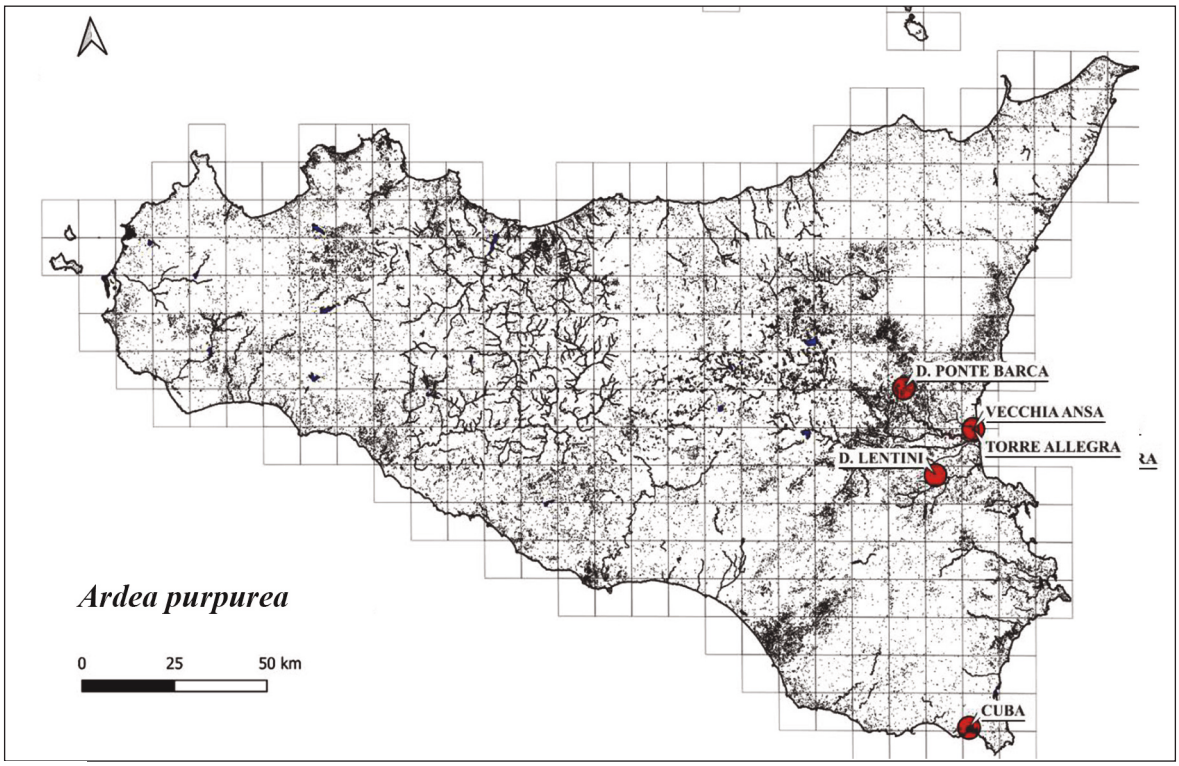

Figure 14. Distribution map of *Ardea purpurea* in Sicily. Red spots indicate at least one breeding pair recorded at least in one year of this study.

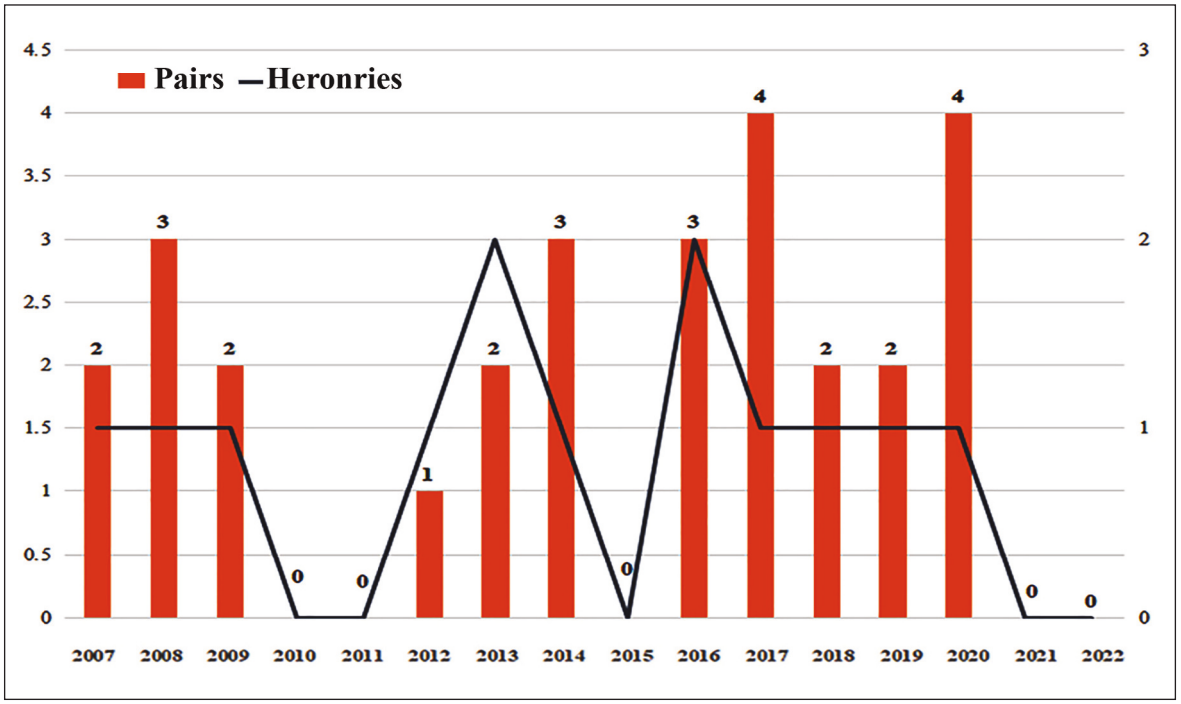

Figure 15. Population trend of *Ardea purpurea* in Sicily during the period of this study.
In the right ordinate the number of locations, on the left ones the number of pairs recorded.

eastern part of Sicily, irregularly and limited to only 4 different locations: Simeto River, Lentini Lake, Ponte Barca and, occasionally, at Pantano Cuba, Syracuse (Fig. 14). In 2020, 2 pairs in the nature reserve of Simeto River, with a distance of only 90 meters between nests; average of 0.9 colonies and 1.6 pairs (σ.=1.55, years =10) per year (min. 0 pairs in 2010, 2011, 2015, 2018, 2021 and 2022, max 5 pairs in 2008) during the period of this study. Species with a very irregular trend, as showed in the Fig. 15.

Little Egret
Egretta garzetta Linnaeus, 1766

PREVIOUS DATA. Not considered a breeding species by Benoit (1840); supposed breeding near Catania and Lentini but without any further details by Doderlein (1869–1874). Subsequently, about 10 pairs reported nesting in reed beds at Lentini Lake (Stresemann, 1943). In the first atlas of breeding birds of Sicily was considered as undetermined status and irregular breeding species (Massa, 1985). It colonised Sicily in the early 1990s (Brichetti & Fasola, 1986) and, in the last two atlases, it is reported in 4 UTM squares (Lo Valvo et al., 1998) and in 8 squares (AA.VV., 2008). Until the 2000s, only 2 locations were known where the species regularly nested, the Simeto River and Lentini Lake, with a total of 4 pairs recorded in 2002 (Fasola, 2007). Since 2010, it started to breed also in the province of Trapani, initially in the nature reserve of Saline di Trapani on islets with poor vegetation mainly represented by tree mallow (*Malva* cf. *arborea*) subsequently on artefacts such as mills (Surdo, 2016, 2018) and also on *Opuntia ficus indica* (Surdo et al., 2019). Reported nesting also on the islet of Maraone, 7.5 km away from the coast of Trapani (Surdo et al., 2021). Reported in the last atlas of Italian breeding birds 2010-2016 as ascertained breeder only in 2 UTM Sicilian squares and in 12 squares as probable breeder (Lardelli et al., 2022). Scarce breeder and common migrator and wintering with decrement trend (Massa et al., 2021).

NEW DATA. Average of 5.2 colonies and 80 nests (σ.=55.9; years =16) per year (min. 2 nests in 2009, max 211 nests in 2021), mainly concentrated in western and eastern coasts of Sicily (Fig. 16), showing a positive and increasing trend, with 50 nests recorded in 2007 and 139 in 2022, with an incre-

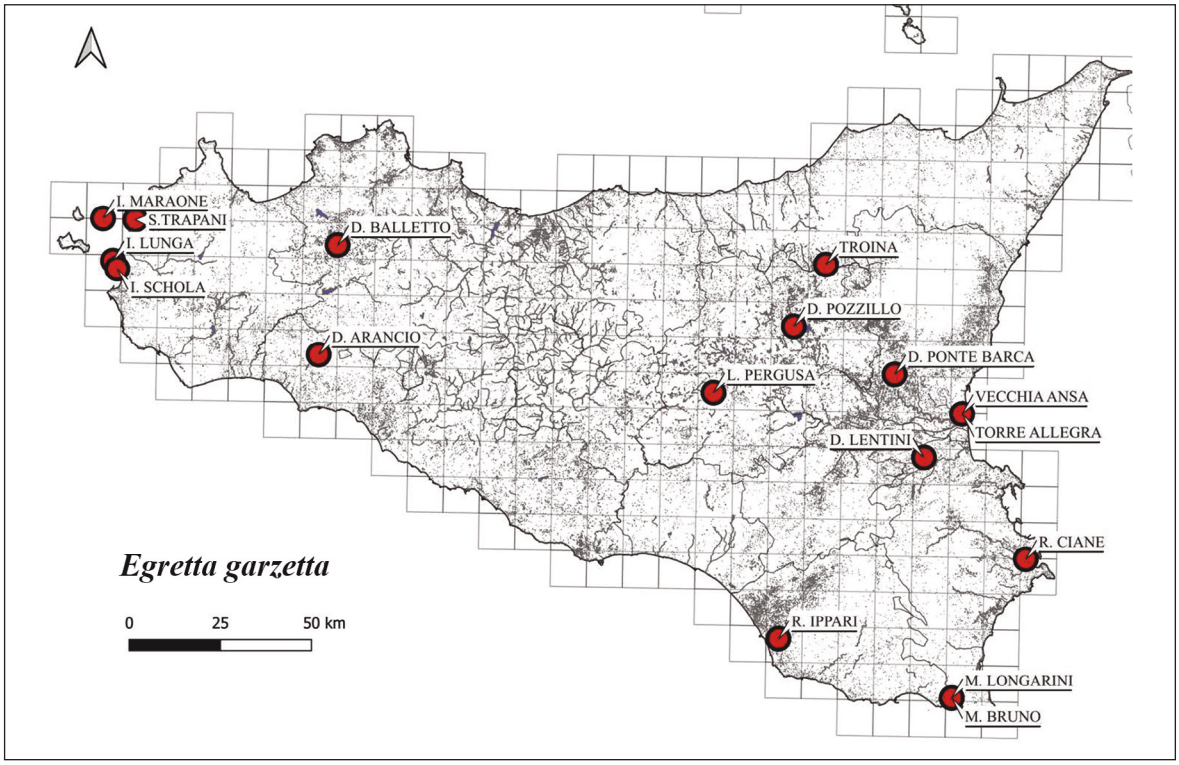

Figure 16. Distribution map of *Egretta garzetta* in Sicily. Red spots indicate at least one nest recorded at least in one year of this study.

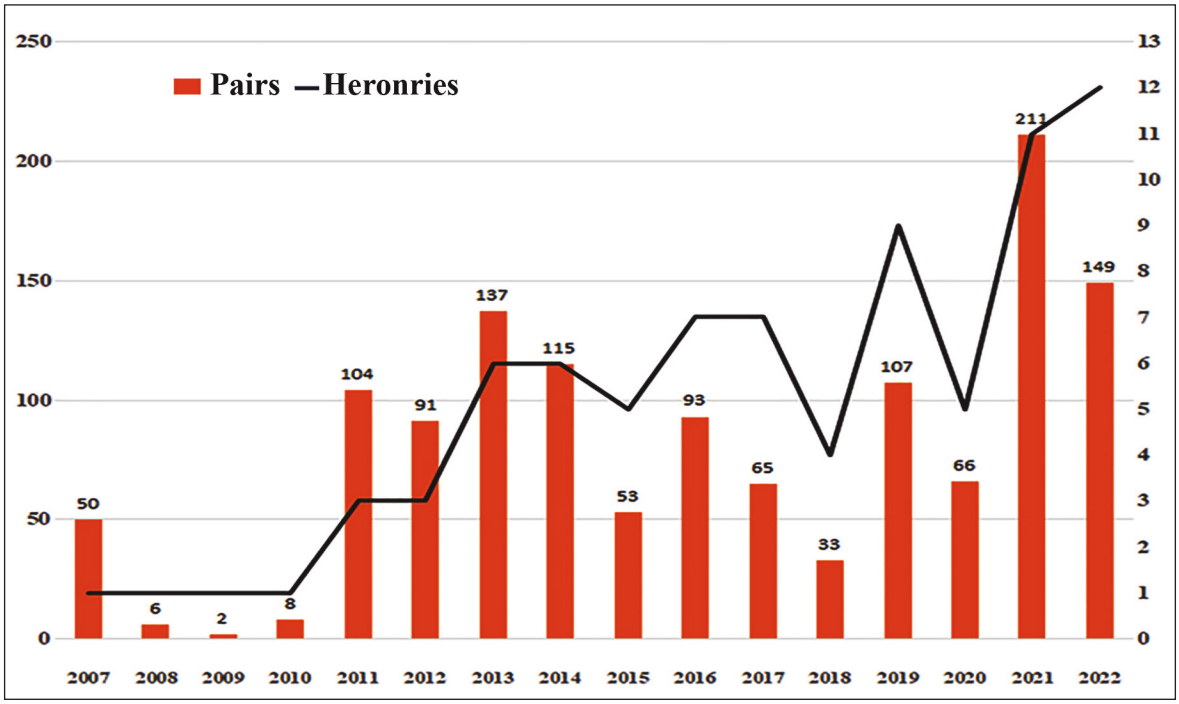

Figure 17. Population trend of *Egretta garzetta* in Sicily during the period of this study. In the right ordinate the number of colonies, on the left ones the number of nests recorded.

ment of +278% (r= 0.5977, p= 0.0144) as showed in Fig. 17.

Great Cormorant
Phalacrocorax carbo (Linnaeus, 1758)

PREVIOUS DATA. Breeding initially claimed by Benoit (1840), Doderlein (1869–1874), Giglioli (1907) and Stresemann (1943) at Lentini Lake and near Marsala (Trapani). Considered a species with an undetermined status in the first atlas of breeding birds of Sicily (Massa, 1985). The first breeding colony established in Sicily since 1990s and 2000s at Lentini Lake (Brichetti & Fracasso, 2018), and thus in only 1 UTM square, in the last two atlases (Lo Valvo et al., 1993; AA.VV., 2008). Subsequently, up to 38 pairs reported for Lentini Lake and 1 pair for Simeto River in 2011, increased up to 43 pairs at Lentini Lake and 6 pairs at Ponte Barca in 2012 (Volponi et al., 2011; Volponi & CorMoNet.it, 2013). Reported in the last atlas of Italian breeding birds (2010–2016) only in 3 UTM Sicilian squares (Lardelli et al., 2022).

Scarce breeder and common migrator and wintering with a floating trend (Massa et al., 2021).

NEW DATA. The importance of the historical breeding locations of Ponte Barca, Simeto River (Torre Allegra) and Lentini Lake were confirmed, without any evidence of expansion and occupation of new locations (Fig. 18). Average of 1.6 colonies and 45.5 nests (σ.=19.4; years =15) per year (min. 0 nests in 2009, max 96 nests in 2015) only concentrated in the just mentioned locations in eastern Sicily. With a total of 28 nests recorded in 2007 and 47 in 2022, this species shows an increase in pairs number of +68% (r= 0.3957; p= 0.1292).

Other species

For other species, in addition to the Eurasian Bittern, no any evidence of breeding was recorded, but some information and clarification are here briefly reported.

The Glossy Ibis, nested in Sicily in June 2002, at Torre Allegra with 2–3 pairs (Corso, 2005) but

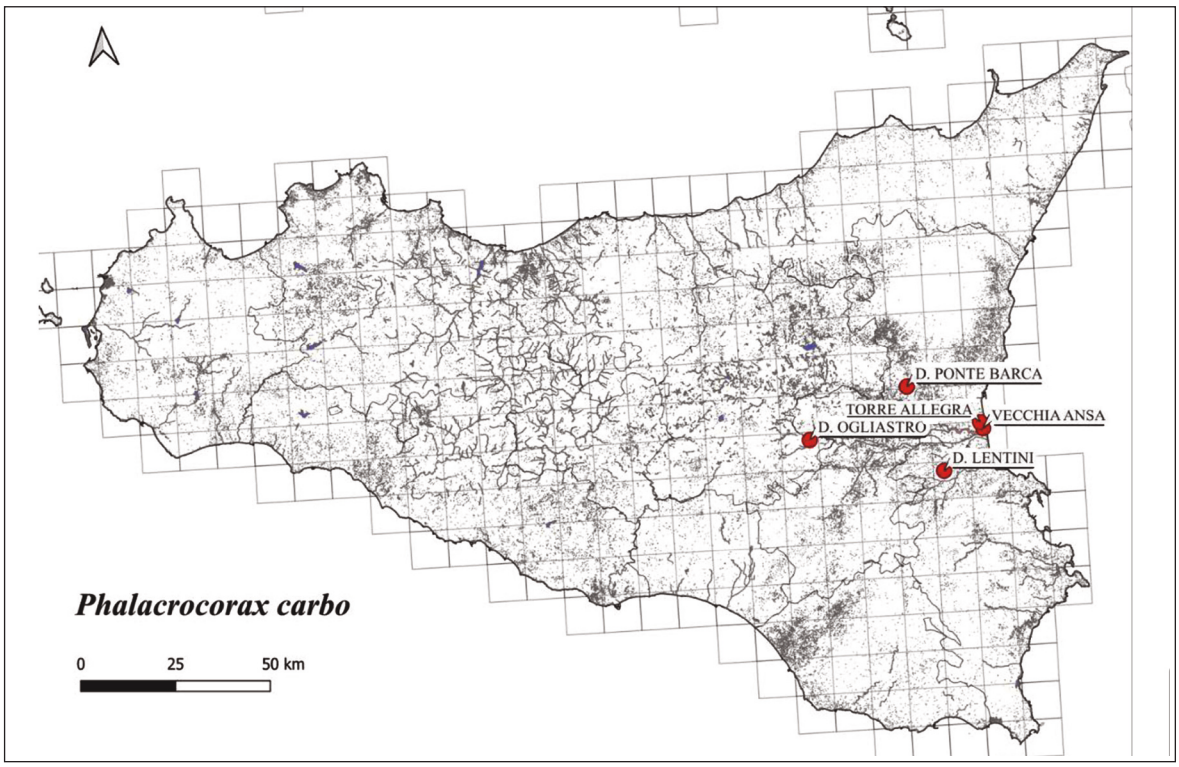

Figure 18. Distribution map of *Phalacrocorax carbo* in Sicily. Red spots indicate at least one nest recorded at least in one year of this study.

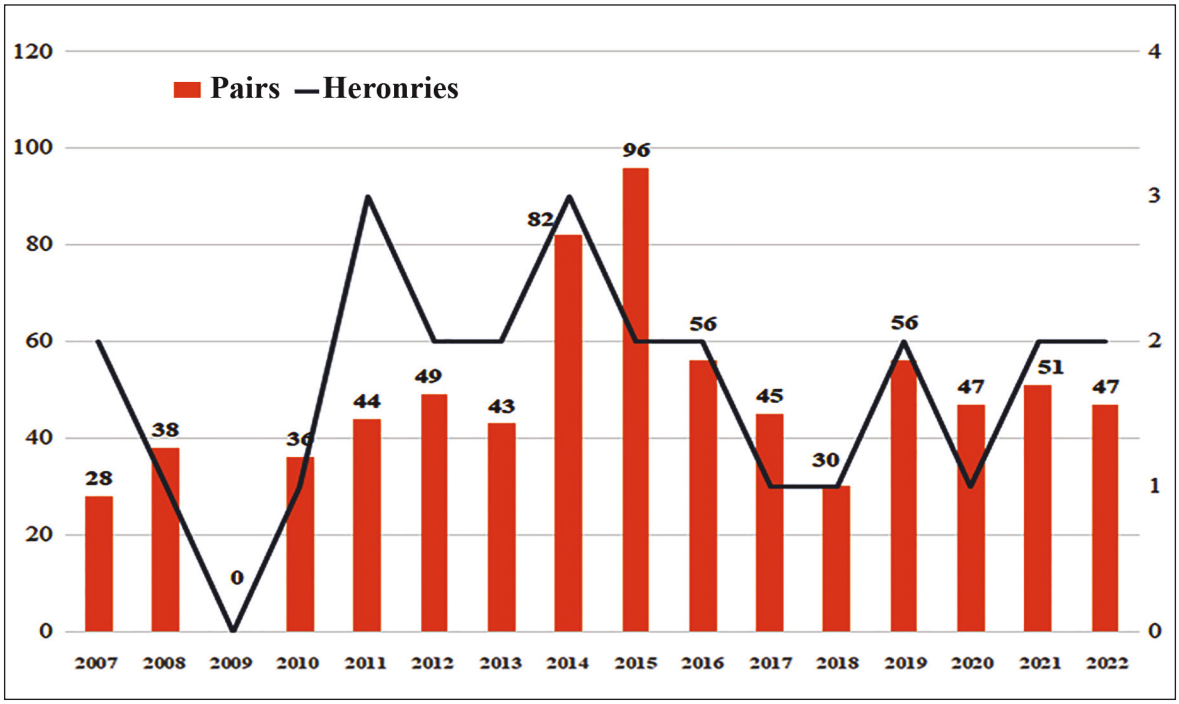

Figure 19. Population trend of *Phalacrocorax carbo* in Sicily during the period of this study. In the right ordinate the number of colonies, on the left ones the number of nests recorded.

no more in the years of this study, despite its regular presence at Ponte Barca and Lentini Lake during the breeding season. Likely, the Great Egret, reported with a breeding pair at Lentini Lake in 1996 by Brichetti & Fracasso (2018), was regularly observed in summer in few different wetlands (Pantano Longarini, Ponte Barca) but it has never again been observed as a breeder in Sicily.

The Eurasian Spoonbill is a regular summer presence too, especially where there are extensive reeds and cattail thickets, as in Ponte Barca. The Pigmy Cormorant *Microcarbo pygmeus* (Pallas, 1773), which has already colonised most of peninsular Italy, could arrive in Sicily in the near future, since it was already observed at the Simeto River during the breeding season, in IV.1994.

Most important Sicilian colonies

Here follows a short description of the main Sicilian colonies that host the higher number of pairs and species of herons and cormorant and therefore to be considered of high conservation value.

Lentini Lake. Breeding of different species of herons and cormorant started in the last decade of 1900s (Ciaccio & Priolo, 1997) with the completion of the circular water reservoir of about 1,000 ha in surface area and with a circumference of about 13 km, of which about 5 km with natural banks, and the progressive flooding of the lake bed for the time needed to soak the natural soil. The first few years were interested by the growth of an extensive reed belt of *Phragmites australis* and *Typha angustifolia*, afterwards gradually joined by *Tamarix* sp. trees that began to colonise the perimeter of the flooded area. Purple Herons and Grey Herons nested in reed beds and cattail groves. The rising water level led to the progressive flooding of the pre-existing cultivations and tamarisk belts that surrounded the wetland. The presence of dead trees at the edge of the lake also allowed all the other species to use them as support for the nests along the natural perimeter of the lake (Fig. 20). Today, the colony is located on dry vegetation, both ancient cultivated trees and swathes of flooded tamarisk. The presence of tamarisk belts is due to the periodic raising/lowering of the lake's water level. Grey Herons, Purple Herons, Squacco Herons, Black-crowned Night Herons, Little Egrets, Western Cattle Egrets and

Great Cormorants nest there. Little Bitterns used to nest in the reed bed that is now almost completely disappeared due to the fluctuation of the water level.

THREATS AND CONSERVATION ISSUES. Being the colony located in the west and north shores of the lake, an important source of disturbance during the breeding seasons are the fishermen who regularly occupy that side of the lake, sometimes too close to the colony; the lake has also been repeatedly proposed as a site for nautical competitions and, more recently, even for energy production by means of floating photovoltaic panels. In addition, a sudden change in the water levels could cause people and animals to access to the colony from the land and thus its subsequent abandonment.

Ponte Barca. The water body consists of a hydraulic crossbar that intercepts the Simeto River near the town of Paternò (Catania), forming a water reservoir of about 70 ha. The gradual formation of debris islands within the wetland area has favoured the establishment of vegetation with tamarisks (*Tamarix africana* and *Tamarix gallica*) both along the banks and on the islands that have formed in the centre of the water reservoir. Extensive reed and typhus groves are also present. The breeding colony has formed in the centre of the wetland, mainly on islands of tamarisk both on living and dead trees. Grey Herons, Little Egrets, Black-crowned Night Herons, Western Cattle Egrets, Squacco Herons and Great Cormorants nest there. The continuous fluctuation of the water level, due to a non-optimal water management of the dam system and the silting up of the water body that allow predators (dogs, foxes etc.) to reach the colonys, has caused 4 species (the Little Egret, the Black-crowned Night Heron, the Western Cattle Egret and the Squacco Heron) to move in 2015 to a nearby area colonised by a monophytic formation of *Arundo donax* (Fig. 21). Only the Grey Heron has continued to nest in tha main wetland, and since 2015 the cormorants definitely abandoned Ponte Barca. In 2021, a fire destroyed the satellite heronry but, in 2022, all of the 4 species returned to nest in Ponte Barca above the reed belt of *Arundo donax*.

THREATS AND CONSERVATION ISSUES. The main threats are represented by fires and abrupt change

Figure 20. Typical multispecies heronry in Lentini Lake (photo by G. Rannisi).

Figure 21. Little Egrets, Black-crowned Night Herons, Western Cattle Herons and Squacco Herons nesting on *Arundo donax* in the water reservoir of Ponte Barca (photo by G. Rannisi).

Figure 22. Little Egrets, Western Cattle Herons, Black-crowned Night Herons and Squacco Herons nesting on *Acacia saligna* trees in the islet of "Torre Allegra" (photo by G. Rannisi).

Figure 23.Western Cattle Herons nesting on *Quercus virgiliana* at the heronry of "Ricchigia-Barrili" (photo by G. Rannisi).

in water levels due to the non-ecological management of the hydraulic traverse, resulting in the emptying and draining of the wetland area. Disturbance by photographers who approach nests or systematically lurk a short distance away from them, may cause them to be abandoned.

Torre Allegra. A lake formed in an old abandoned sand quarry, within the Simeto River nature reserve. The breeding colony is located on an islet, in the centre of the lake, spared by the excavations; in it there is a grove of *Acacia saligna* where Western Cattle Egrets, Little Egrets, Black-crowned Night Herons, Squacco Herons, Grey Herons nest (Fig. 22) since the end of the last century and even cormorants since 2011. Close to Torre Allegra, in the lowest stretch of Simeto River, in an oxbow existing along the old course of the river before its rectification, the Purple Heron nests with few pairs on mixed reed/timber vegetation.

THREATS AND CONSERVATION ISSUES. Being the colony located inside the nature reserve of Simeto River, in a islet totally surrounded by water, the threats are fortunately very limited. That is the reason why Torre Allerga is one of the most important Sicilian colonies, regularly occupied by different species of colonial waterbirds.

Ricchigia-Barrili. Located along the upper course of the Simeto River, in the locality of the same name. It is characterised by a riparian vegetation of *Populus nigra* and *Quercus virgiliana* (Fig. 23) that skirts the river along this stretch. The heronry, where Little Egrets, Western Cattle Herons and Grey Herons nest, is located just behind the watercourse on such trees.

THREATS AND CONSERVATION ISSUES. Being the heronry located inside a private property, the disturbance by attracted photographers, and sometimes birdwatchers, to the detriment of landowners, could turn into a threat to its preservation.

Pantano Longarini. The heronry is located in the west side of the swamp lake, on *Eucaliptus camalduensis* trees higher than 20 metres and about 550 meters away from the main water body; it is a monospecific heronry of Little Egrets that hosts 15–40 pairs (Galasso et al., 2021).

THREATS AND CONSERVATION ISSUES. Since 2016, the whole Pantano Longarini swamp lake, and the nearby Pantano Cuba, were purchased by the German foundation "Stiftung Pro Artenvielfalt ®" - Foundation Pro Biodiversity, for a total, up to date, of about 420 hectares, with the only aim to convert it in a private nature reserve and protecting the biodiversity and the birds (Galasso et al., 2021). Since the purchase and the active conservation strategies applied to the area, the number of breeding pairs is increasing year by year, occasionally hosting also few pairs of Black-crowned Night Herons and Squacco Herons. Despite this, the heronry is located just few hundred metres outside of the limit of the private nature reserve and thus the main threats are from tree cutting and fires.

Saltpans of Trapani. It is a monospecific heronry of Little Egrets nesting on two islets (100 square meters each) within the "Morana" salt pan (Saline di Trapani) over the bushes of *Malva* cf. *arborea*; a small part of pairs nest directly on bare ground, in association with Yellow-legged Gulls *Larus michahellis* apparently without any form of competition and/or predation. The small size of the islets have certainly prompted the species to nest also on windmills: the first case was reported by one of the authors (Surdo, 2016). However, Little Egret's nests were found only in 3 of the approximately 80 windmills present in the nature reserve. The colonization of the saltpans area took place in 2010, but data collection began in 2013, excluding the years 2020 and 2022. The number of pairs fluctuates between 15 and 50, with the most of observations being closer to the lower end of the range.

THREATS AND CONSERVATION ISSUES. Being the heronry located inside the nature reserve of Trapani Saltpans, threats are fortunately limited.

Island of Maraone. Located in the province of Trapani, the islet of Maraone is included in the Zone A of the Integral Reserve of Protected Marine Area of the Aegadian Islands. Maraone is 7 km away from the mainland, 5.5 km from the island of Levanzo and 8.5 from Favignana. It is a monospecific heronry colonized by Little Egrets in the central part of the islet, covered by *Malva* cf. *arborea,* and which hosts 29–36 pairs (Surdo et al., 2021). A small part of pairs nest instead directly on bare ground, sometimes in association to Yellow-legged Gulls *Larus michahellis*, likely in Trapani Saltpans. The islet of Maraone was probably colonised by Little Egrets since 2013, and its nesting on a marine island represents a novelty for Sicily, despite being already known and documented for 12 heronries in Sardinia (Murgia et al., 1994).

THREATS AND CONSERVATION ISSUES. Being the heronry located inside a protected marine area, threats are fortunately very limited.

CONCLUSIONS

The more or less recent establishment in Sicily of many protected wetlands such as nature reserves, fauna protection oasis and Natura 2000 sites, as well as the protection of rivers and watercourses, has certainly favoured the formation of suitable habitats for different species of herons and colonial waterbirds. Some of these wetlands, originated as a result of the construction of dams and hydraulic crossings (e.g. Ponte Barca), are undergoing continuous silting up due to the sediments intercepted by the dams themselves, which have allowed the creation of islets with trees and shrub vegetation, some of which used by herons and cormorants for nesting. Despite this, the colonies remain susceptible to disturbance and can be impaired, even drastically, by various threat factors. The most important are represented, as already reported by other authors, by habitat transformation, fires, hunting and fishing, poaching, tree cutting and direct disturbance (Scoccianti & Tinarelli, 1999). However, one of the key aspects for conservation purposes, occupancy and reproductive success of Sicilian colonies is the management of water levels. For the near future indeed, the plans drawn up by the regional Water Management Bodies (Autorità di Bacino) for counteracting the risk of droughts provide for the emptying of sediments to restore the water reservoirs capacity before silting and water availability for the various civil, industrial and agricultural uses. This draining should be planned and conducted with the support of an ecological perspective, such as leaving islets in the centre of the water surface to maintain greater ecological diversity and to allow nesting. Another good practice would be the integrated and connected management of water withdrawals from the different artificial water reservoirs in terms of timing and modalities,

in order to keep water levels as stable as possible during the spring-summer season and avoiding to leave the nests unprotected by water. It could be done by planning and selecting the water bodies used for the withdrawals, preferring during the breeding season to focus on those those that are ecologically less significant so as to maintain stable water levels for longer in those where nesting is present.

The intensification of drought phenomena will also lead to an increase in water withdrawals with the risk of reducing or cancelling the flow of running water in watercourses, causing serious damage to aquatic ecosystems in general and to the colonies that would be more vulnerable to predators. Thus, would be essential, firstly, to comply with the regulations for maintaining the ecological flow of watercourses. Tree cutting is a serious threat that can cause the total disappearance of colonies, even those that were regularly established for years, such as the case of the heronry of Pedagaggi (Syracuse), where an established heronry of Western Cattle Herons, with no less than 10–20 pairs discovered nesting on pine trees in 2015–2016 (Di Trapani E. *pers. comm*.), completely disappeared as consequence of the tree cutting in 2018 (Laspina F., *pers. comm*.). The same effect can be caused by fires, which is why it is recommended that, within protected or otherwise managed areas, extensive firebreaks be established if the colonies are located on land. Another source of disturbance during the nesting season may be represented by birdwatchers and, especially, by bird photographers. The latter, tend to show willingness and ability to engage in illegal behaviour, as already reported in a recent study (Aas et al., 2023).

Generally, it would be desirable for the Sicilian Region's Territory and Environment Department (Assessorato Territorio e Ambiente della Regione Sicilia) to draw up specific guidelines for the protection and conservation of the colonies (as for instance the control and the right management of water levels, cutting of vegetation, monitoring activities, etc.) to be applied by the managing authorities of the individual nature reserves, parks and Natura 2000 Sites, in whose territories they fall.

Long-term datasets on animal populations are difficult to gather due to lack of commitment by researchers and to scarceness of funds necessary to sustain standardized and long-terms monitoring programs over many years. The consequence is a systemic lack of long-term data that hinders the main mission of ecology, to understand how and why animal populations fluctuate. Our monitoring program started in 2007 and is currently ongoing, thus reaching in 2023, contributing to filling this gap by carrying out a first long-term monitoring of colonial water birds (Ardeidae, Phalacrocoracidae) throughout Sicily. Despite this, it would be desirable for the future to find the way to plan and standardise censuses of colonies in order to keep monitoring their status in Sicily. A robust dataset, in addition to analysing trends, will also allow to explore a wide range of key ecological processes, such as species interactions, patterns of colony distribution, biological invasions, impact of agricultural practices on biodiversity, and influence of global changes.

ACKNOWLEDGEMENTS

We want to thank all the members of Lipu Catania who helped to collect data on the field over the years: Andrea Ciaccio, Giovanni La Grua, Dario Grimaldi, Francesco Laspina, Loredana Murabito, Angelo Scuderi and Salvatore Strano. We also thank Andrea Corso, Eduardo Di Trapani, Carmelo Iapichino and Iacopo Romano. We thank also the German foundation "Stiftung Pro Artenvielfalt – Foundation Pro Biodiversity" for financing and promoting waterbird census in the wetlands of Pantano Cuba and Longarini, south-eastern Sicily, since 2015. A special thanks to Mauro Fasola for his kindness and willingness to review this paper and for providing his valuable advice.

REFERENCES

AA.VV., 2008. Atlante della Biodiversità della Sicilia: Vertebrati terrestri. Studi & Ricerche Arpa Sicilia, Palermo, 6.

Aas, Ø., Jørgensen, F.M.O., Stensland, S. et al., 2023. Your place or mine? Exploring birdwatching tourists' behaviour disturbing birds in a nature reserve. European Journal of Wildlife Research, 69, 44. https://doi.org/10.1007/s10344-023-01678-y

Barone R., Termine R. & Massa B., 2008. Note su un bloom di *Prymnesium parvum* Carter (Haptophyta) nel lago di Pergusa e sue conseguenze sulla fauna. Il Naturalista siciliano, 32: 187–200.

Benoit L., 1840. Ornitologia Siciliana. Stamperia G. Fiumara, Messina.

Brichetti P. & Fasola M., 1986. Distribuzione geografica degli uccelli nidificanti in Italia, Corsica e Isole Maltesi. 4 - Famiglia Ardeidae (generi *Nycticorax*, *Ardeola*, *Egretta*, *Ardea*). Natura Bresciana 22: 41–102.

Brichetti P. & Grussu M., 1992. Airone guardabuoi *Bubulcus ibis*. In: Brichetti P., De Franceschi P. & Baccetti N. (Eds), Fauna d'Italia 29. Aves I. Calderini, Bologna, pp. 165–171.

Brichetti P. & Fracasso G., 2018. The Birds of Italy. Volume 1. Anatidae-Alcidae. Edizioni Belvedere, Latina (Italy), "Historia Naturae" (6).

Carpegna F., Grieco F., Grussu M., Veronesi E. & Volponi S., 1997. The Italian breeding population of Cormorant (*Phalacrocorax carbo*). Supplemento Ricerche di biologia della selvaggina, 26: 81–87.

Ciaccio A., 2004. Airone guardabuoi, *Bubulcus ibis*, e Mignattaio, *Plegadis falcinellus*, nidificanti in Sicilia. Rivista italiana di Ornitologia, 74: 150–153.

Ciaccio A. & Priolo A., 1997. Avifauna della foce del Simeto, del lago di Lentini e delle zone umide adiacenti (Sicilia, Italia). Il Naturalista siciliano, 21: 309–413.

Ciaccio A. & Siracusa M., 1989. Nidificazione di Airone cenerino, *Ardea cinerea*, e Sgarza ciuffetto, *Ardeola ralloides*, e status degli Ardeidi in Sicilia. Rivista italiana di Ornitologia, 59: 75–79.

Corso A., 2005. Avifauna di Sicilia. Palermo. L'Epos, 324 pp.

Dimarca A., Giudice E. & Longo A., 1986. Nuove nidificazioni di uccelli al Biviere di Gela. Il Naturalista siciliano, 10: 15–19.

Doderlein P., 1869-74. Avifauna del Modenese e della Sicilia. Giornale di Scienze Naturali ed Economiche di Palermo, 5: 137–195; 6: 187–236; 7: 9–72; 8: 40–124; 9: 28–93; 10: 35–71, 133–148.

Fasola M., Albanese G., ASOER, Boano G., Boncompagni E., Bressan U., Brunelli M., Ciaccio A., Floris G., Grussu M., Guglielmi R., Guzzon C., Mezzavilla F., Paesani G., Sacchetti A., Sanna M., Scarton F., Scoccianti C., Utmar P., Vaschetti G. & Velatta F., 2007. Le Garzaie In Italia, 2002. Avocetta, 31: 5–46.

Fasola M., Barbieri F., Prigioni C. & Bogliani G., 1981. Le garzaie in Italia, 1981. Avocetta, 5: 107–141.

Galasso P., Cappuzzello C., Gambino E., Torre G., Galasso G. & Patti N., 2021. Avifauna of "Sicilian southeast swamp lakes" and surroundings areas (Ragusa and Syracuse, Sicily) with commented records of interest. Biodiversity Journal, 12: 441–462. https://doi.org/10.31396/Biodiv.Jour.2021.12.2.441.462

Giglioli H.E., 1907. Secondo resoconto dei risultati dell'Inchiesta Ornitologica in Italia. Avifauna Italica. Tip. S. Giuseppe, Firenze.

Krampitz H.E., 1958. Weiteres uber die Brutvogel Siziliens. Journal of Ornithology, 99: 39–58.

Iapichino C. & Massa B., 1989. The Birds of Sicily. British Ornithologists'Union. Check-list n°11, London.

Lardelli R., Bogliani G., Brichetti P., Caprio E., Celada C., Conca G., Fraticelli F., Gustin M., Janni O., Predrini P., Puglisi L. Rubolini D., Ruggieri L. Spina F., Tinarelli R., Calvi G., Brambilla M. (a cura di), 2022. Atlante degli uccelli nidificanti in Italia. Edizioni Belvedere (Latina), Historia Naturae (11), 704 pp.

Lo Valvo M., Massa B. & Sarà M. (red.), 1993. Uccelli e paesaggio in Sicilia alle soglie del terzo millennio. Il Naturalista siciliano, 17 (suppl.): 1–373.

Massa B. (red.), 1985. Atlas Faunae Siciliae. Aves. Il Naturalista siciliano, 9 (n° speciale): 1–274.

Massa B., Ientile R., Aradis A. & Surdo S., 2021. One hundred and fifty years of ornithology in Sicily, with an unknown manuscript by Joseph Whitaker. Biodiversity Journal, 12: 27–89. https://doi.org/10.31396/Biodiv.Jour.2021.12.1.27.89

Murgia C., Demurtas A., Tatti D. & Sgarangella R., 1994. Primi dati su una colonia di garzetta, *Egretta garzetta*, in un'isola della Sardegna Nordorientale. Rivista italiana di Ornitologia, 63: 215–216.

Scoccianti C. & Tinarelli R., 1999. Le Garzaie in Toscana – Status e prospettive di conservazione. Serie Scientifica N. 6. WWF Italia. Vieri editrice "il mio Amico".

Stresemann E., 1943. Die Brutvogel des Sees von Lentini, Sizilien. Orn. Monabster, 51: 116–122.

Surdo S., 2016. New colony of Little egrets *Egretta garzetta* at Trapani saltpans. Avocetta, 40: 83–84.

Surdo S., 2018. Check-List degli uccelli della R.N.O. "Saline di Trapani e Paceco" con lista commentata dei non Passeriformes. Il Naturalista siciliano, 42: 57–109.

Surdo S., 2019. Sulla distribuzione di alcuni uccelli nidificanti in provincia di Trapani (Sicilia). Il Naturalista siciliano, 43: 191–201.

Surdo S., Cusmano A., Massa B. & Cusimano C., 2019. 6 Little egret *Egretta garzetta* in Bazzi G. Bird News Avocetta, 43: 171. https://doi.org/10.30456/AVO.2019207

Surdo S., Sparacio I., Dentici A. & Viviano R., 2021. Little Egret *Egretta garzetta* (Linnaeus, 1766) (Pelecaniformes Ardeidae) and Eurasian crag martin *Ptyonoprogne rupestris* (Scopoli, 1769) (Passeriformes Hirundidae), two new breeding species for the Egadi Islands (W-Sicily, Italy). Biodiversity Journal, 12: 629–633. https://doi.org/10.31396/Biodiv.Jour.2021.12.3.629.633

Termine R., Canale E. D., Ientile R., Cuti N., Di Grande C. S. & Massa B., 2008. Vertebrati della Riserva Naturale Speciale e Sito d'Importanza Comunitaria Lago di Pergusa. IL Naturalista siciliano, 32: 105–186.

Termine R., 2014a. *Statu quo* della fauna protetta -uccelli, rettili e anfibi- 30 giugno 2014. Università degli Studi di Enna "Kore", Provincia Regionale di Enna.

Termine R., 2014b. Nidificazione di Pollo sultano *Porphyrio porphyrio* (Linnaeus, 1758) nella Riserva Naturale Speciale del lago di Pergusa, Enna. In: Tinarelli R., Andreotti A., Baccetti N., Melega L., Roscelli F., Serra L., Zenatello M. (a cura di), Atti XVI Convegno Italiano di Ornitologia. Cervia (RA), 22–25 settembre 2011. Scritti, Studi e Ricerche di Storia Naturale della Repubblica di San Marino, pp. 618–619.

Termine R., 2015. R.N.S. Lago di Pergusa. Continuità esecuzione del Programma di Ricerca sulle componenti ambientali (abiotiche e biotiche) attraverso elaborazioni scientifiche, monitoraggio e rilevazioni parametriche della stazione meteorologica computerizzata. Rapporto finale 2013–2015. Università degli Studi di Enna "Kore", Provincia Regionale di Enna.

Volponi S., Beraudo P.L., Basso M., Caula B., Cosolo M., Emiliani E., Gagliardi A., Gola L., Panzarin L., Sponiza S., Tinarelli R., Albanese G., Bacchi E., Bartolini A., Brunelli M., Calvario E., Carini R., Carotenuto L., Ciaccio A., Fasola M., Gelati A., Grattini N., Ientile R., La Grua G., Mancini V., Pezzo F., Puglisi L., Re A., Sarrocco S., Trainito E. & Zini C., 2011. Censimento nazionale delle colonie di Cormorano *Phalacrocorax carbo sinensis*: Anno 2011. In: Tinarelli R., Andreotti A., Baccetti N., Melega L., Roscelli F., Serra L., Zenatello M. (a cura di), Atti XVI Convegno Italiano di Ornitologia. Scritti, Studi e Ricerche di Storia Naturale della Repubblica di San Marino, pp. 483–485.

Volponi S. & CorMoNet.it, 2013. Status of the breeding population of Great Cormorants in Italy in 2012. In: Bregnballe T., Lynch J., Parz-Gollner R., Marion L., Volponi S., Paquet J-Y. & van Eerden M.R. (Eds.) 2013, National reports from the 2012 breeding census of Great Cormorants *Phalacrocorax carbo* in parts of the Western Palearctic. IUCN-Wetlands International Cormorant Research Group Report. Technical Report from DCE - Danish Centre for Environment and Energy, Aarhus University. No. 22, pp. 59–64.

Zafarana M.A., Ientile R., Linares A., Messina A. & Massa B., 2019. Oasi del Simeto: recente trend di sette specie acquatiche. Atti del XX Convegno Italiano di Ornitologia, Napoli, 26–29 settembre 2019, p. 128.