

The first inventory of birds of prey in sicilian museum collections (Italy)

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ABSTRACT

Natural History Museums are places of scientific dissemination and informal education, and have a fundamental role in scientific research and in preserving the historical heritage of a territory and its biodiversity. The island of Sicily, thanks to its geographic position as an inter-continental bridge in the Mediterranean, presents a notable ornithological diversity, with both sedentary species and species that migrate between Africa and Europe. For this reason, and thanks to a strong hunting tradition, Sicilian collections also depict the avifaunal assemblage historically present in the region, particularly for birds of prey, the group we focus on because of its particular ecological characteristics and cultural interests. However, the partnership among museum institutions, generally and in Italy, is complex and fragmented, and thus a census of Sicilian raptors collections had not been attempted yet. This study presents data from 16 public museum institutions, reporting the presence in their collections more than 1800 specimens belonging to 64 species. This census presents a detailed estimate of the Sicilian museum patrimony regarding this charismatic group, which may constitute a starting point for future studies and contribute to the visibility, promotion and interconnection of the institutions involved.

Key words: inventory, birds, raptors collections, Sicily, Italy.

RIASSUNTO

Il primo inventario dei rapaci nelle collezioni dei musei siciliani (Italia)

I musei di storia naturale sono luoghi di educazione scientifica con un ruolo chiave per la ricerca e la conservazione del patrimonio storico e della biodiversità del territorio. La Sicilia, grazie alla sua posizione nel Mediterraneo, presenta una grande diversità ornitologica, con specie sia sedentarie che migranti. Per questo e grazie anche alla forte tradizione venatoria, le collezioni siciliane rappresentano in modo significativo l'avifauna e in particolare i rapaci. La partnership tra istituzioni museali è però complessa e frammentata, e mancava ancora un censimento delle collezioni siciliane di rapaci. Questo studio, che raccoglie dati da 16 istituzioni museali pubbliche segnalando la presenza nelle collezioni di oltre 1800 esemplari di 64 specie, offre una stima dettagliata del patrimonio museale siciliano relativamente a questo gruppo e può costituire un punto di partenza per studi futuri, contribuendo a visibilità, promozione e interconnessione delle istituzioni coinvolte.

Parole chiave: censimento, uccelli, collezioni di rapaci, Sicilia, Italia.

INTRODUCTION

Thanks to its central position in the Mediterranean Sea, the island of Sicily presents a notable ornithological diversity, comprising both sedentary species and species that use the region as a stepping stone in their migratory routes between Europe and Africa. This role as inter-continental bridge is clearly shown by bird of prey routes (Agostini & Logozzo, 1997; Corso, 2001; Agostini, 2002).

Such feature makes the Sicilian natural history museums notable as regards bird collections, particularly for avifauna occurring in the Island over the past two centuries. In addition to this, a strong local hunting tradition has over time resulted in the creation of many private collections of naturalized birds, which have in many cases later been devolved to public institutions.



Fig. 1. A photograph of the project "Diachronicles" by Giulia Parlato (see website 2) displaying a view of the diurnal raptors diorama in the Museum of Zoology "P. Doderlein". The photograph won the Carte Blanche Étudiants 2019 prize.

Birds of prey or raptors (i.e. members of the orders Accipitriformes, Falconiformes and Strigiformes) are of particular interest because of their ecological niche. They occupy important roles as predators and scavengers, providing ecological ecosystem services such as the regulation of prey species and the elimination of carrion. They can also be considered to provide cultural ecosystem services, as flagship taxa with prominent symbolic and cultural roles (Donázar et al., 2016) (fig. 1).

Several studies show that birds of prey are, at least in some contexts (Estrada & Rodríguez-Estrella, 2016), good biodiversity indicators of overall species richness of coexisting animals and plants (Burgas et al., 2014). Raptors are generally long-lived species, existing at low densities and having low population turnover rates; this, combined with their generally high trophic level, makes them particularly vulnerable to environmental fluctuations and human disturbance (Donázar et al., 2016).

McClure et al. (2018) found 18% of all raptor species to be considered threatened, while over half (52%) as having declining population trends. Several anthropogenic stressors heavily affect raptors: Real et al. (2001) find electrocution and direct persecution to be the main sources of mortality in Bonelli's Eagles (*Aquila fasciata*) (fig. 2) in Spain, while Coon et al. (1970) recorded gunshot wounds, impact and trapping injuries, electrocution and pesticide poisoning as some of the most common causes of fatality among 76 Bald Eagles, *Haliaeetus leucocephalus*; Mateo et al. (2003) quantified lead and arsenic concentrations in bones of Spanish birds of prey and found them to be particularly high in two species that mostly feed by scavenging, the Red Kite, *Milvus milvus*, and Eurasian Griffon Vulture, *Gyps fulvus*, to the point of being associated with physical symptoms of probable death by intoxication. Indeed, while many raptor species have recently recovered thanks to conservation efforts (Donázar et al., 2016), vultures remain particularly vulnerable, with the populations of several species in the Indian Subcontinent having been reduced to a fraction of their historical size in a few decades by veterinary use of the anti-inflammatory drug Di-

clofenac on the livestock on which they mostly feed (Green et al., 2004) and conservation efforts on the Critically Endangered Californian Condor, *Gymnogyps californianus*, being hampered by the effects of lead poisoning, one of the very causes of its near-extinction (Finkelstein et al., 2012).

An example of this is the case of the Griffon Vulture, *Gyps fulvus*, in Sicily. Historically present and apparently even widespread and abundant in Sicily up to the mid 1800's (Minà Palumbo, 1853; Doderlein, 1869). A suite of concurring causes – changes in agricultural practices (particularly, in the disposal of livestock carcasses), the local extinction of wild ungulates (red, fallow and roe deer and wild boar), poisoning by consumption of poisoned fox and direct poaching – brought it into decline, until it eventually disappeared from the island in the 1960s. However, starting in 1998, a reintroduction project using founder individuals sourced from rehabilitation centers in the Spanish Pyrenees (Lo Valvo & Scalisi, 2004) has had moderate success, with the population now standing at some tens of individuals and with some successful nesting attempts having occurred since.

Natural History Museums are important places for scientific dissemination and environmental education, constituting an interface between the common citizen and the scientific world; however, they also have an important but often neglected role in scientific research and as historical legacy of a geographical area and its past landscape.

The current overall situation of Natural History Museums in Italy is dramatic, making up a fragmented reality in which a multitude of small institutions cope with a scarcity of funds by focusing on events and sometimes forgoing research and study activities (Andreone et al., 2014; Andreone et al., 2015). The situation is exacerbated in regions like Sicily where private funds are particularly scarce.

Animal collections have traditionally been the basis of taxonomy and comparative anatomy studies; more recently, they have provided study material for research on evolutionary topics (Holmes et al., 2016) and environmental processes (Lo Brutto, 2017), or the revision of taxa (Mannino et al., 2015) and the accumulation of contaminants in tissues as a reflection of toxin levels in ecosystems (Movalli et al., 2017). In consideration of that, an inventory of all the collections in Sicily would be necessary, though difficult to achieve. Therefore collecting data by taxon has been chosen as the easiest way to proceed.

The aim of this work is to undertake a first regional-scale inventory of collections of birds of prey (Accipitriformes, Falconiformes and Strigiformes) in Sicilian public institutions – universities and regional museums, schools, research centers – in order to provide an estimate of the extent of Sicilian collections and to place them in the historical period of collection of the specimens.

A more general objective is to create a network of museum structures to further promote their visibility and promotion, in line with other European projects aiming to better the collaboration between various museums (Movalli et al., 2019; see website 1).

THE CENSUS COLLECTIONS

The collections considered in this study belong to the following institutions:

- Museo Regionale di Storia Naturale e Mostra Permanente del Carretto Siciliano, Terrasini (PA) – MRSNT;
- Museo Civico di Scienze Naturali "Angelo Priolo", Randazzo (CT) – MSNRAN;
- Museo di Zoologia "P. Doderlein" dell'Università degli Studi di Palermo, Palermo – MZPA;
- Museo Ornitologico "F.lli Azzara", Chiaramonte Gulfi (RG) – MOCG;
- Museo Ornitologico di Mazara del Vallo, Mazara del Vallo (TP) – MOMV;
- Museo di Zoologia e Casa delle Farfalle dell'Università degli Studi di Catania, Catania – MZU-NICT;
- Museo Ambientalistico Madonita, Polizzi Generosa (PA) – MAM;
- Siti Ente Parco dei Nebrodi: Museo della Fauna, Mistretta and Alcara Li Fusi (ME) – MEPN;
- Museo Naturalistico "F. Minà Palumbo", Castelbuono (PA) – MNMP;



Fig. 2. Specimen of Bonelli's Eagles at the Museo Civico di Scienze Naturali "Angelo Priolo", Randazzo (CT).

- Collezione Cutgana, Università degli Studi di Catania, Catania – CUNICT;
- Museo della Fauna dell'Università degli Studi di Messina, Messina – MFUNIME;
- Museo Civico del Comune di Niscemi, Niscemi (CL) – MCNIS;
- Collezione Istituto Statale Gemmellaro, Catania – IGCT;
- Museo di Storia Naturale dell'Istituto Parlatore, Palermo – MSNP;
- Istituto Zooprofilattico Sperimentale della Sicilia "A. Mirri", Palermo – IZSS;
- Istituto Comprensivo "Giovanni XXIII - Piazzì", Palermo – IPPA;
- Museo di Scienze Naturali del Liceo Classico "Empedocle", Agrigento – MTAG;
- Museo Agroforestale "San Matteo", Erice (TP) – MAF.

Only whole naturalized specimens, either as skins or posed, were included in the census, excluding partial specimens (e.g. isolated wings), anatomical preparations, eggs, etc.

This inventory doesn't include the more-or-less minor collections of the following public institutions: Museo Mandralisca, Cefalù; Museo di Castellana Sicula; Museo Civico di Comiso; Istituto Maria Adelaide, Palermo; Museo Cambria of the Università degli Studi di Messina, as access to these was not allowed.

An unknown number of private collections, some of them extensive, also exists in Sicily; many or most of them are not yet properly declared, accounted and catalogued, limiting their potential for donations to public institutions. For these reasons, we excluded private collections from the scope of this work entirely.

THE MUSEUMS AND THE COLLECTIONS

Museo Regionale di Storia Naturale e Mostra Permanente del Carretto Siciliano, Terrasini (PA) – MRSNT

Founded in 2001 and housed in the XIX century Palazzo d'Aumale in Terrasini, the Museo Regionale di Storia Naturale e Mostra Permanente del Carretto Siciliano in all likelihood contains the largest ornithological collection in Sicily, with over 9000 specimens. The specimens in this catalogue belong to several zoological collections (Orlando, Trischitta, Iannizzotto, Vitale, Mercurio and Giambona) acquired by the Regional Administration of Cultural Heritage. The collections were assembled during the 20th century, over the time span of almost fifty years (between 1930 and 1980) and mainly comprise birds collected in Sicily (fig. 3). Some of the specimens in this list have been the object of study and research (Venezia, 1898; Iannizzotto, 1910; Orlando, 1937; Ajola, 1948, 1951; Orlando, 1954, 1955a, 1955b, 1955c, 1957a, 1957b., 1958a, 1958b, 1962; Lo Valvo

& Lo Verde, 1989; Massa et al., 1991; Lo Valvo, 1999; Massa & Brichetti, 2003). The Museum has received several private collections which made the structure a reference museum for the huge amount of avian material; indeed, the museum stores the most abundant collection of raptors (797 raptors), though it is not the oldest one in Sicily.

Museo Civico di Scienze Naturali "A. Priolo", Randazzo (CT) – MSNRAN

Established in 1983 and inaugurated in 1989, the Museo Civico di Scienze Naturali in Randazzo houses the Priolo ornithological collection, created by the homonymous researcher over a period of thirty years starting in 1939. Initially dedicated exclusively to Italian birds, it was enriched over the years by the addition of exotic bird species. It comprises 2250 specimens belonging to 389 species (Priolo & Di Palma, 1995), many represented by different plumages linked to sex, age or season. Some of the specimens have particular historical value, such as the Sicilian Griffon vultures, inserted in a diorama (Priolo, 1995). Other specimens represent first reports of rare species in Italy or Sicily (Priolo 1946, 1948; Caterini, 1962; Priolo, 1972). As shown by the large scientific production of the ornithologist Angelo Priolo, the material conserved at the Museum has been the subject of numerous studies that have contributed, in the course of the last century, to the deepening of our knowledge on the distribution and intraspecific variability of many species of birds in Italy. The Museum also houses a geological collection including minerals, rocks and shells, volcanic products from Mount Etna and fossils including remains of Pleistocene fauna and fossil fish from both Sicily and Brazil.



Fig. 3. A view of Falconiformes collection at the Museo Regionale di Storia Naturale e Mostra Permanente del Carretto Siciliano, Terrasini (PA).

Museo di Zoologia "P. Doderlein", Palermo – MZPA

Established in 1863 by the Dalmatian professor Pietro Doderlein (Massa et al., 2018), when he moved to Palermo to cover the position of Professor of Zoology and Comparative Anatomy, the Museo di Zoologia "P. Doderlein" was originally located in the first venue of the University of Palermo. In 1913, the collections were transferred to the present venue, where they suffered decades of decline and abandonment, due to the two World Wars. At the start of the 1970's, the collections and the structure started to be reevaluated, but in the meantime several specimens had been lost (Bellomo et al., 2018).

It houses a vast ornithological collection, mostly dating back to the time of activity of the founder and his collaborators (1863-1920) (De Stefani, 1918; Riggio, 1987; Massa et al., 2018), who collected and prepared the greatest portion of the specimens and acquired others through exchanges and donations. Doderlein was on friendly relations with many scientists and aristocrats in Italy and abroad, and also received donation from exploratory or hunting expeditions (Doderlein, 1869). In this regard, the collaboration with the ornithologist Howard Saunders was instrumental in augmenting the bird collection. The ornithological collection counts over 1800 specimens, including some exotic species, among which several specimens from the Americas and Africa. Some raptors are collocated in diorama (fig. 4).

A large part of the collection is made up by the Ichthyology section, representing the near-totality of Mediterranean fish species in a naturalized state and often with specimens reaching exceptional sizes and being found in localities that are outside of their respective species' range nowadays, illustrating the ecological changes that Mediterranean Sea environments have undergone over the past Century and a half. The Museum also presents substantial Mamma-



Fig. 4. Western Barn Owl within a diorama at the Museo di Zoologia "P. Doderlein", SIMUA, Università degli Studi di Palermo.

logical, Herpetological, Malacological and Carcinological collections, including several holotypes.

The Museum is now part of the SIMUA (Museum System of the University of Palermo) whose aim is to promote the technical and scientific heritage of the university museums (Lo Brutto et al., 2019; Lo Brutto et al., 2020).

Museo Ornitologico "F.lli Azzara", Chiaromonte Gulfi (RG) – MOCCG

At the end of the 1950's, the twins Paolo and Giuseppe Azzara assembled an ornithological collection with over 600 specimens, not exclusively belonging to common species. In the 1980's, the Regional Administration of Cultural Heritage acquired the collection and ceded it to the Comune of Chiaromonte Gulfi for public fruition.

Museo Ornitologico, Mazara del Vallo (TP) – MOMV

This collection started being assembled in 1924, with the birth of the local hunters' circle, and in 1986 it was passed on to the Comune of Mazara del Vallo, which established the Museo Ornitologico. The collection comprises 366 naturalized birds, mainly representing the local avifauna, including some rare or uncommon species.

Museo di Zoologia e Casa delle Farfalle dell'Università degli Studi di Catania, Catania – MZUNICT

This is the oldest Sicilian Zoological Museum, founded in 1853 by prof. Andrea Aradas, first holder of a Zoology Chair at the University of Catania. Founded as a Cabinet of the Chair of Zoology housed in the central building of the University of Catania, in Piazza Università. The initial nucleus of this Cabinet was made up of collections of members of the Gioenia Academy of Natural Sciences, donated by the Academy to the Museum. Since 1920 it has been moved in 81, via Androne, in a wing of a specifically-built Liberty-style building and now belongs to the SIMUA (University Museum System) of the University of Catania.

It houses numerous invertebrate collections, including part of the Aradas malacological collection, restored and revised by the malacologist Danilo Scuderi (Scuderi, 2007), and the most important Sicilian coleopterological collection, the Ragusa collection (89 entomological boxes with more than 18000 specimens of the Sicilian beetle fauna, and also 88 entomological boxes with approximately 5800 European Lepidoptera and 43 entomological boxes containing approximately 8500 European beetles), entirely restored in 2002 thanks to funds from the Catania-Lecce project (Sabella & Arnone, 2002), and the Briganti collection (with about 30000 specimens of Italian and Maghreb staphylinid beetles, among

which there are also holotypes and paratypes) purchased in the early 1990s. Of great relevance are the scientific collections of researchers from the Department's Animal Biology section, which include numerous holotypes and paratypes of Nematodes, Tardigrades, Polychaete Annelids, Isopods, Spiders, Opiliones, Mites, Mantises, Homoptera, Heteroptera, and Coleoptera.

The Vertebrate collections are also very significant, including around 80 specimens of large mammals, including some specimens of Cetaceans among which is the oldest preserved skeleton in Sicily belonging to one of the seven *Physeter macrocephalus* beached in Marsala (TP) in 1892 (Insacco et al., 2014), more than 300 specimens of the herpetofauna and 200 specimens of Pisces s.l.

Among the bird collections there is the Hunters Club one, acquired by donation in 1911, which includes about 160 specimens, and the Auteri Collection, donated by noblewoman Anna Paternò Castello in 1923, which includes more than 1000 specimens, mainly exotic, among which a hundred hummingbirds, which represent the second Italian collection by number of species and specimens. Finally, in 1989 the "Baglieri-Benanti" and "Baglieri" ornithological collections were purchased (Grasso & Lentile, 1997, 1999a), including over 500 Sicilian specimens. Some of the preserved specimens are of particular interest and have been mentioned in the literature (Priolo, 1949; Ciaccio & Priolo, 1997; Grasso & Lentile, 1999b; De Pietro et al., 2019).

The specific identifications and the list of birds of prey, presents in the collections of the Museum of Zoology of Catania University, have been controlled and confirmed by R. Lentile.

Museo Ambientalistico Madonita, Polizzi Generosa (PA) – MAM

Established in 1990, the Museo Ambientalistico Madonita (MAM), in collaboration with the non-profit



Fig. 5. The cloister of the Museo Naturalistico "F. Minà Palumbo", Castelbuono (PA).

cultural association of the same name, aims to educate the public on the conservation of Nature and to be a focal point for scientific research through the collection of specimens, photographic evidence etc., focusing on the territory of the Madonie Mountains. It preserves a small collection of local mammal and avian species mainly addressed for educational purposes.

Ente Parco dei Nebrodi Sites – MEPN

This denomination includes specimens housed at two sites in the Parco dei Nebrodi: the Museo della Fauna in Mistretta and at the park administration office in Alcara Li Fusi.

A large part of the taxidermied animals of the Ente Parco dei Nebrodi, which in total includes 382 bird specimens, originated in the "Giambona" collection, with specimens almost exclusively collected in Sicily, among which are several birds of prey from the 1970's. It is exhibited at the Museo della Fauna in Palazzo Portera, Mistretta; in an educational itinerary called "La tana delle idee" in the visiting centre in Alcara Li Fusi (housing several life-sized dioramas, among which "Il nido dell'aquila reale", a Golden Eagle's eyrie; "Il banchetto degli uccelli necrofagi", with scavenging birds feeding on carrion; and "La causa di estinzione dei grifoni", on the causes of extinction of the Griffon Vulture in Sicily); and at the venue in Vendipiano di Longi (housing life-sized dioramas including "Le Rocche del Crasto", "Il Bosco di Mangalaviti" and "La stretta di Longi").

Museo Naturalistico "F. Minà Palumbo", Castelbuono (PA) – MNMP

Dedicated to Castelbuono-born naturalist Francesco Minà Palumbo, the Museo Naturalistico "F. Minà Palumbo" (fig. 5) houses collections assembled between 1837 and 1899 by Minà Palumbo himself, over the course of his studies carried out in the territory of the Madonie Mountains. The collections, involving several research fields among which botany, zoology, geology, paleontology, history, agriculture and industry, paint a complete picture of Natural History and human activity in the region from the beginnings to the late XIX century. Minà Palumbo's original ornithological collection has been lost and has not reached the present day.

However, a small part of the ornithological collection of Carlo Orlando (1898-1976) was added to the original nucleus of the multiple collections made by Minà Palumbo, in the 1970s, donated by his son Vittorio Emanuele Orlando. More recently, in 2006, a collection of vertebrates was added, created by Antonio Venchierutti from Cefalù and donated to the Museum by his nephew Saverio Biondo. This collection includes almost two hundred specimens, mainly birds, found largely in the Madonie area (Catalisano & Lo Valvo, 2011). Together, donations

from these two collections add up to 225 bird specimens. Thanks to these collections, it is possible to have a complete picture of the birdlife of this part of the island's territory.

Collezione Cutgana, Università degli Studi di Catania – CUNICT

The Cutgana (the Università di Catania's Center for the protection and management of natural environments and agro-ecosystems) owns about 70 naturalized bird specimens, all donated between 2002 and 2003 by the LIPU rehabilitation center in Ficuzza (PA), where the individuals had originally arrived with trauma or disease that eventually led to their deaths. Exhibited in part in dioramas and together with collections of minerals, plants, fungi, insects, marine invertebrates, fish and mammals, they are spread between several educational and exhibit structures: the Museo Naturalistico-Ambientale "Diodoro Siculo" in Agira; the Museo della Stazione Studi sul Mare on Isola Lachea, Aci Castello; the Eco Museo dei Monti Climiti in Melilli; and the Museo Naturalistico Regionale di Isolabella e Villa Caronia on Isola Bella, Taormina.

Museo della Fauna del Dipartimento di Scienze Veterinarie dell'Università degli Studi di Messina – MFUNIME

The Museo della Fauna del Dipartimento di Scienze Veterinarie dell'Università di Messina was established in 2011 and has been a Scientific Institution recognized by the Ministry of the Environment and Protection of the Territory and the Sea since 2017. It is dedicated to the conservation, divulgation and research-use of zoological (both marine and terrestrial) and paleontological collections, aiming to educate the public through exhibitions, and also to contribute to scientific research with the production of publications, the organization of conferences, collecting campaigns, etc. The Museum's raptor collection is small, comprising 20 taxidermied specimens from antique private collections, particularly the "Collezione Lauricella" – not counting osteological remains of 46 individuals of different species (Lauricella & Scaravelli 2012; Spadola et al., 2013-14).

Museo Civico del Comune di Niscemi (CL) – MCNIS

The Museo Civico in Niscemi houses specimens dating back to the last decades of the past century. The birds of prey are all from the area around the Gela plain, except the Egyptian Vulture, which is from the province of Ragusa.

Collezione Istituto Statale Gemmellaro, Catania – IGCT

The Istituto Statale Gemmellaro in Catania houses an ornithological collection that was assembled

between 1880 and 1888, comprising both Sicilian and exotic species among which 20 hummingbirds. The ornithological collection counts 119 specimens (Cantarero & Siracusa, 1993).

Museo di Storia Naturale dell'Istituto Tecnico "Filippo Parlatore", Palermo – MSNP

The Istituto Tecnico Statale "Filippo Parlatore", established in 1862 in the middle of the historical centre of Palermo, contains a Natural History Museum on its first floor, the establishment of which is dated to 1869 by reliable and documented sources, citing it as Gabinetto di Storia Naturale del Regio Istituto Tecnico.

The collections it houses comprise mineralogico-petrographical, paleontological, zoological, osteological and anatomical specimens, anatomical and botanical models, a collection of historical geographical and geological maps, a repertoire of historical optical microscopes and a herbarium of some scientific relevance – all dated to between the late XIX and the early XX centuries.

The zoological collections are estimated to contain around a thousand invertebrates and 513 vertebrates, which have recently been catalogued. Historically, the ornithology section included 27 birds of prey of Sicilian provenance, acquired between 1869 and 1906, as per one of the inventories in "Elenco meto-dico degli Uccelli del Gab.^o di St. Naturale. Uccelli italiani ordinati secondo l'Avifauna italiana del prof. E.H. Giglioli (Ediz. 1907)" (Sansone, 1920). It is now reduced to 10 specimens, belonging to 9 species represented by one specimen each except for the Short-eared Owl, which is represented by two mounted skins on the same pedestal.

Istituto Zooprofilattico Sperimentale della Sicilia "A. Mirri", Palermo – IZSS

The Istituto Zooprofilattico Sperimentale della Sicilia "A. Mirri", based in Palermo, is the public scientific and administrative authority on zooprophyllaxis, animal health and animal-based product security in Sicily. As part of its connections with conservation efforts (through its activity in necropsies of wild and captive animals, wildlife veterinary work and rehabilitation and release of sea turtles), in 2018 – the 90th anniversary of the its founding – the IZSS created in its headquarters in Palermo a didactic museum, called "Il percorso didattico sensoriale", to educate the public on the Institute's history and on its role in both the sanitary and environmental fields. It is a permanent exhibition featuring, among other things, some full-size dioramas recreating natural environments present in Sicily, including woodland; specifically, depicting a view of the Munciarrati wood, in the Comune of Isnello in the Parco Regionale delle Madonie. Several naturalized animals have been placed in this diorama, including birds of prey.

Order	Family	Species	Authorship	Italian name	English name	MRSNT	MSNRAN	
Accipitriformes	Accipitridae	<i>Accipiter gentilis</i>	(Linnaeus, 1758)	Astore	Northern Goshawk	10	10	
Accipitriformes	Accipitridae	<i>Accipiter nisus</i>	(Linnaeus, 1758)	Sparviere	Eurasian Sparrowhawk	53	13	
Accipitriformes	Accipitridae	<i>Accipiter tachiro</i>	(Daudin, 1800)	Astore africano	African Goshawk			
Accipitriformes	Accipitridae	<i>Aegypius monachus</i>	(Linnaeus, 1766)	Avoltoio monaco	Cinereous Vulture	1	1	
Accipitriformes	Accipitridae	<i>Aquila adalberti</i>	C. L. Brehm, 1861	Aquila imperiale spagnola	Spanish Imperial Eagle			
Accipitriformes	Accipitridae	<i>Aquila chrysaetos</i>	(Linnaeus, 1758)	Aquila reale	Golden Eagle	13	4	
Accipitriformes	Accipitridae	<i>Aquila fasciata</i>	Vieillot, 1823	Aquila del Bonelli	Bonelli's Eagle	8	5	
Accipitriformes	Accipitridae	<i>Aquila heliaca</i>	Savigny, 1809	Aquila imperiale	Eastern Imperial Eagle	1		
Accipitriformes	Accipitridae	<i>Aquila nipalensis</i>	Hodgson, 1833	Aquila delle steppe	Steppe Eagle			
Accipitriformes	Accipitridae	<i>Aquila rapax</i>	(Temminck, 1828)	Aquila rapace	Tawny Eagle			
Accipitriformes	Accipitridae	<i>Buteo augur</i>	(Rüppell, 1836)	Poiana augure	Augur Buzzard			
Accipitriformes	Accipitridae	<i>Buteo buteo</i>	(Linnaeus, 1758)	Poiana	Common Buzzard	65	21	
Accipitriformes	Accipitridae	<i>Buteo buteo vulpinus</i>	(Gloger, 1833)	Poiana delle steppe	Steppe Buzzard			
Accipitriformes	Accipitridae	<i>Buteo lagopus</i>	(Pontoppidan, 1763)	Poiana calzata	Rough-legged Buzzard	2	1	
Accipitriformes	Accipitridae	<i>Buteo rufinus</i>	(Cretzschmar, 1829)	Poiana codabianca	Long-legged Buzzard	2		
Accipitriformes	Accipitridae	<i>Chondrohierax uncinatus</i>	(Temminck, 1822)	Nibbio uncinato	Hook-billed Kite			
Accipitriformes	Accipitridae	<i>Circaetus gallicus</i>	(J. F. Gmelin, 1788)	Biancone	Short-toed Snake Eagle	6	4	
Accipitriformes	Accipitridae	<i>Circus aeruginosus</i>	(Linnaeus, 1758)	Falco di palude	Western Marsh Harrier	11	11	
Accipitriformes	Accipitridae	<i>Circus buffoni</i>	(J. F. Gmelin, 1788)	Albanella allunghe	Long-winged Harrier			
Accipitriformes	Accipitridae	<i>Circus cyaneus</i>	(Linnaeus, 1766)	Albanella reale	Hen Harrier	13	3	
Accipitriformes	Accipitridae	<i>Circus macrourus</i>	(S. G. Gmelin, 1770)	Albanella pallida	Pallid Harrier	10	7	
Accipitriformes	Accipitridae	<i>Circus pygargus</i>	(Linnaeus, 1758)	Albanella minore	Montagu's Harrier	11	5	
Accipitriformes	Accipitridae	<i>Clanga clanga</i>	(Pallas, 1811)	Aquila anatraia maggiore	Greater Spotted Eagle	5	1	
Accipitriformes	Accipitridae	<i>Clanga pomarina</i>	(C. L. Brehm, 1831)	Aquila anatraia minore	Lesser Spotted Eagle	1		
Accipitriformes	Accipitridae	<i>Elanus caeruleus</i>	(Desfontaines, 1789)	Nibbio bianco	Black-winged Kite	2		
Accipitriformes	Accipitridae	<i>Gypaetus barbatus</i>	(Linnaeus, 1758)	Avoltoio degli agnelli	Bearded Vulture	2	3	
Accipitriformes	Accipitridae	<i>Gyps fulvus</i>	(Hablizl, 1783)	Grifone	Griffon Vulture	10	4	
Accipitriformes	Accipitridae	<i>Haliaeetus albicilla</i>	(Linnaeus, 1758)	Aquila di mare	White-tailed Eagle	1	1	
Accipitriformes	Accipitridae	<i>Hieraetus pennatus</i>	(J. F. Gmelin, 1788)	Aquila minore	Booted Eagle	3		
Accipitriformes	Accipitridae	<i>Lophaeetus occipitalis</i>	(Daudin, 1800)	Aquila dal ciuffo	Black-crested Eagle			
Accipitriformes	Accipitridae	<i>Melierax metabates</i>	von Heuglin, 1861	Astore cantante scuro	Dark Chanting Goshawk			
Accipitriformes	Accipitridae	<i>Micronisus gabar</i>	(Daudin, 1800)	Astore gabar	Gabar Goshawk			
Accipitriformes	Accipitridae	<i>Milvus migrans</i>	(Boddaert, 1783)	Nibbio bruno	Black Kite	13	4	
Accipitriformes	Accipitridae	<i>Milvus milvus</i>	(Linnaeus, 1758)	Nibbio reale	Red Kite	8	2	
Accipitriformes	Accipitridae	<i>Neophron percnopterus</i>	(Linnaeus, 1758)	Capovacciaio	Egyptian Vulture	5	1	
Accipitriformes	Accipitridae	<i>Pernis apivorus</i>	(Linnaeus, 1758)	Pecchiolo	European Honey Buzzard	25	9	
Accipitriformes	Accipitridae	<i>Rupornis magnirostris</i>	(J. F. Gmelin, 1788)	Poiana beccogrosso	Roadside Hawk			
Accipitriformes	Accipitridae	<i>Terathopius ecaudatus</i>	(Daudin, 1800)	Falco giocoliere	Bateleur			
Accipitriformes	Cathartidae	<i>Vultur gryphus</i>	Linnaeus, 1758	Condor delle Ande	Andean Condor			
Accipitriformes	Pandionidae	<i>Pandion haliaetus</i>	(Linnaeus, 1758)	Falco pescatore	Western Osprey	13	4	
Falconiformes	Falconidae	<i>Caracara plancus</i>	(J. F. Miller, 1777)	Caracara	Southern Crested Caracara			
Falconiformes	Falconidae	<i>Falco biarmicus</i>	Temminck, 1825	Lanario	Lanner Falcon	17	4	
Falconiformes	Falconidae	<i>Falco cherrug</i>	J. E. Gray, 1834	Sacro	Saker Falcon	2	1	
Falconiformes	Falconidae	<i>Falco columbarius</i>	Linnaeus, 1758	Smeriglio	Merlin	9	3	
Falconiformes	Falconidae	<i>Falco eleonorae</i>	Gené, 1839	Falco della regina	Eleonora's Falcon	18	13	
Falconiformes	Falconidae	<i>Falco femoralis</i>	Temminck, 1822	Falco aplomado	Aplomado Falcon			
Falconiformes	Falconidae	<i>Falco naumanni</i>	Fleischer, 1818	Grillaio	Lesser Kestrel	28	10	
Falconiformes	Falconidae	<i>Falco peregrinus</i>	Tunstall, 1771	Pellegrino	Peregrine Falcon	39	13	
Falconiformes	Falconidae	<i>Falco rusticolus</i>	Linnaeus, 1758	Girfalco	Gyr Falcon	1		
Falconiformes	Falconidae	<i>Falco sparverius</i>	Linnaeus, 1758	Gheppio americano	American Kestrel	1		
Falconiformes	Falconidae	<i>Falco subbuteo</i>	Linnaeus, 1758	Lodolaio	Eurasian Hobby	24	8	
Falconiformes	Falconidae	<i>Falco tinnunculus</i>	Linnaeus, 1758	Gheppio	Common Kestrel	101	24	
Falconiformes	Falconidae	<i>Falco vespertinus</i>	Linnaeus, 1766	Falco cuculo	Red-footed Falcon	43	26	
Strigiformes	Strigidae	<i>Aegolius funereus</i>	(Linnaeus, 1758)	Civetta capogrosso	Boreal Owl	6	2	
Strigiformes	Strigidae	<i>Asio flammeus</i>	(Pontoppidan, 1763)	Gufo di palude	Short-eared Owl	31	9	
Strigiformes	Strigidae	<i>Asio otus</i>	(Linnaeus, 1758)	Gufo comune	Long-eared Owl	18	11	
Strigiformes	Strigidae	<i>Athene noctua</i>	(Scopoli, 1769)	Civetta	Little Owl	53	8	
Strigiformes	Strigidae	<i>Bubo bubo</i>	(Linnaeus, 1758)	Gufo reale	Eurasian Eagle-Owl	9	3	
Strigiformes	Strigidae	<i>Bubo scandiacus</i>	(Linnaeus, 1758)	Gufo delle nevi	Snowy Owl			
Strigiformes	Strigidae	<i>Glaucidium passerinum</i>	(Linnaeus, 1758)	Civetta nana	Eurasian Pygmy Owl	4	3	
Strigiformes	Strigidae	<i>Otus scops</i>	(Linnaeus, 1758)	Assiolo	Eurasian Scops Owl	32	10	
Strigiformes	Strigidae	<i>Strix aluco</i>	Linnaeus, 1758	Allocco	Tawny Owl	31	7	
Strigiformes	Strigidae	<i>Strix uralensis</i>	Pallas, 1771	Allocco degli Urali	Ural Owl			
Strigiformes	Tytonidae	<i>Tyto alba</i>	(Scopoli, 1769)	Barbagianni	Western Barn Owl	36	7	
TOTAL per museum						797	276	

Tab. 1. Inventory of raptors of Sicilian museums. Number of specimens per museum (see acronyms of the museums in the text).

	MZPA	MOCG	MOMV	MZUNICT	MAM	MEPN	MNMP	CUNICT	MFUNIME	MCNIS	IGCT	MSNP	IZSS	IPPA	MTAG	MAF	TOTAL per species
	1	5	1	1	2	1											31
	9	6	12	5	2	4	2		6		1		2				115
		1							1								1
																	3
	1																1
	1	2	1	1	1	3	1									1	28
	4	1		2	1					1	1						23
	1			1													3
	1																1
	1																1
	14	2	7	6	4	3	4	4	2	1		1	1				135
		2	1		1												4
	2	2			1												8
		1	1	1													5
	1																1
	2	2	3	1	1					1	1						21
	6	6	7	6	2	2		5	2		3	1		1			63
	1																1
	3	3	2	1	1												26
	3	3	1	7	1												32
	5	5	3	2	1	2					1						35
		1		2													9
	1			1													3
	3	1		1													7
	1	1		1													8
	3	2		2	2	8	1					1			1		34
	3			2											1		8
		4	3														10
	1																1
	1																1
	1																1
	4	1	2	1	2												27
	1	3	4	1	1	2	1			1					1		25
	3	2	2	1	2		1			1							18
	7	2	8	5	2	2	2	2		1							65
	2																2
				1													1
				1													1
	1	2	3	3	1	2	1									1	31
	2																2
	1	2	5	2	1		1	1									34
	1																4
	1	5	1	3	2	1											25
	2	2	3	2	2	1											43
									1								1
	2	2	3	3	1	1	1					1					52
	7	1	3	6	6	1	3	6									85
																	1
	2																3
	4	4		2	2	1	2		1			1					49
	18	3		5	3	1	4	3	4	1		1	1	2	1		172
	1	5	9	7	2	2	1							1			97
		2	1														11
	3	1	3	3	2		2		1	1		2		1	1		60
	10	3	3	2	2	2	1	1		1			1				55
	15	3	3	1	2	1	1	1		2			1				91
	5	2		3	2		1				1	1					27
		1															1
	1	1															9
	15	4	3	1	1	1	3	1		1			1	1			74
	11	3	1	2	4	2	1			1		1	1				65
	1	1															2
	18	2	5	3	1	2	2	3	2	2	2		1				86
	209	107	104	101	61	45	36	27	20	13	12	10	9	6	5	2	1840

**Istituto Comprensivo “Giovanni XXIII - Piazzì”,
Palermo – IPPA**

The Istituto Comprensivo “Giovanni XXIII - Piazzì”, born from the fusion of the Scuola dell’Infanzia e Primaria Giovanni XXIII and of the Scuola Secondaria di I Grado Giuseppe Piazzì, has inherited from the latter a collection of scientific instruments and faunistic specimens (a majority of these being taxidermied birds, some of them placed in small dioramas), assembled in the time since the establishment of the school in 1868.

**Museo di Scienze Naturali “Terrachini”
del Liceo Classico Statale “Empedocle”,
Agrigento – MTAG**

The history of this Natural History Museum has always followed that of the school it belongs to. A Natural History Museum dedicated to great Agrigentine physiologist Michele Foderà was merged to the Regio Liceo Scinà in 1868 – as per historian Giuseppe Picone’s “Memorie Storiche Agrigentine” (Picone, 1933-35). Later, in 1934, the new Museum was instituted and dedicated to prof. Terrachini, a Natural Sciences teacher at the school from 1868 to 1883 and a great contributor to the maintenance of the Museum. Today its halls house well-preserved remains including 18 birds.

**Museo Agro-forestale “San Matteo”,
Erice (TP) – MAF**

The Museo Agro-forestale “San Matteo” in Erice (Trapani) preserves part of the historical collection of the Liceo Classico “L. Ximenes”, Trapani. This collection, assembled between the late 1800’s and 1925 (Orlando, 1993), has been partially lost. The 10 surviving specimens, 9 of them birds, are now contained in the “San Matteo” centre. The Museo Agro-forestale is housed

in the premises of the Baglio Cusenza, in the Comune di Valderice. It contains naturalized birds and mammals, reptiles under formalin, bird nests, tree trunk sections, forest plants and desiccated fungi, constituting a veritable panoramic of the naturalistic patrimony of the province. The Museum also houses a section with items of ethnographic interest, illustrating the history of the people who inhabited the fields of the Ager Erycinus.

THE INVENTORY

Table 1 shows the list of examined species detected in the Sicilian collections. The classification follows Lerner and Mindell (2005) for Accipitriformes and Wink et al. (2009) for Strigiformes. The nomenclature in the list refers to that used by Brichetti and Fracasso (2015) and is consistent with Gill et al. (2020). The Roadside Hawk, listed in the historical catalogue of the Museum Doderlein (MZPA) as *Buteo magnirostris*, is here referred to the monotypic genus *Rupornis* Kaup, 1844, following the phylogenetic analysis carried out by Riesing et al. (2003), Lerner et al. (2008) and Amaral et al. (2009), in which it is an outlier branch from a clade including both the other *Buteo* species – except *B. leucorrhous*, which is accordingly mostly transferred to *Parabuteo* – and *Geranoaetus* and some *Leucopternis* species. The Gabar Goshawk, listed historically as *Melierax gabar*, is here referred to monotypic genus *Micronisus* Gray, 1840, following Roberts (1931) who considered this species distinct enough from the Chanting Goshawks (*Melierax sensu stricto*), which seems to be the prevailing trend in recent literature.

Our study reveals the presence of 1840 specimens in the inventoried collections, representing 64 raptor species (40 Accipitriformes, 13 Falconiformes and 11 Strigiformes). Of these species, 49 occur in Italy, of



Fig. 6. Bearded Vulture at the Museo Civico di Scienze Naturali “Angelo Priolo”, Randazzo (CT).



Fig. 7. Albin Common Buzzard specimen at the Museo Regionale di Storia Naturale e Mostra Permanente del Carretto Siciliano, Terrasini (PA).

which 3 as vagrant (*Aquila nipalensis*, *Aquila rapax*, and *Elanus caeruleus*), 2 as irregular occurrences (*Aegyptus monachus* and *Aquila heliaca*), and the rest as regular (Brichetti & Fracasso, 2015). Among the latter, 8 species are not recorded as regular in Sicily but elsewhere in Italy, either having gone locally extinct in historic times (*Bubo bubo* and *Gypaetus barbatus*) (fig. 6), being only irregularly recorded as vagrants (*Accipiter gentilis*, *Haliaeetus albicilla*) or outright absent (*Buteo lagopus*, *Glaucidium passerinum*, *Aegolius funereus*, *Strix uralensis*). The distribution of the 15 species that are not recorded in Italy is either North and South American (7 species: *Caracara plancus*, *Chondrohierax uncinatus*, *Circus buffoni*, *Falco femoralis*, *Falco sparverius*, *Rupornis magnirostris*, *Vultur gryphus*), African (6 species: *Accipiter tachiro*, *Buteo augur*, *Terathopius ecaudatus*, *Lophaetus occipitalis*, *Melierax metabates*, *Micronisus gabar*) or Holarctic (2 species: *Bubo scandiacus* and *Falco rusticolus*).

Given that the bulk of the specimens (essentially, all of those representing species present in Sicily during the period of collection) were collected in Sicily, it is not surprising that the relative abundance of each species in the collections generally mirrors the abundance of the species on the territory. The two most represented species, the Common Kestrel, *Falco tinnunculus*, and Common Buzzard, *Buteo buteo* (fig. 7) (172 and 135 specimens respectively) are in all likelihood the most abundant, widespread and commonly encountered raptors in Sicily, as they are over most of their European range; the third most represented species, the Eurasian Sparrowhawk, *Accipiter nisus* (115 specimens), is also widespread and reasonably abundant, though much more elusive and less easily encountered than the two former species. The abundance of this species in the collections, along with, notably some species that are not, per se, particularly common nor sedentary in Sicily, namely the Red Footed Falcon, *Falco vespertinus*, with 97 specimens and European Honey Buzzard, *Pernis apivorus*, with 65, can probably be better explained with the tactic, utilized by Sicilian hunters traditionally and by poachers even today, of hunting in migration corridors, like the Strait of Messina, the island of Ustica and the Aegadian and Aeolian Archipelagos. These are strategic passage points for many of these species, and some are targeted more than others in sight of their impressiveness or because of specific superstitions and cultural associations. The targeting of conspicuous and "charismatic" species can possibly explain the common detection of the Griffon, *Gyps fulvus* (34 specimens), in spite of its decline and eventual disappearance, relative to the Aegyptian Vulture, *Neophron percnopterus* (fig. 8) (18 specimens), which is still extant although rare in Sicily.

The fact that the specimens were mostly collected between the mid-1800s and the early XX century also explains how two species that declined and went locally extinct during the XX century, the aforementioned Griffon and the Eurasian Eagle Owl, *Bubo bubo*

(27 specimens), are still comparably well-represented. A third species that went extinct in Sicily after the second half of the XIX Century, the Bearded Vulture, *Gypaetus barbatus*, is not well represented (8 specimens) in spite of its conspicuous and indubitably impressive nature; that can be explained, however, by this species never having been particularly common in recent times, being considered an accidental passage migrant and a very rare breeder by Minà Palumbo (1853) and as very rare by Doderlein (1869).

CONCLUSIONS

The dataset herein shown is the first inventory of raptors preserved in the Sicilian collections. It gives an overview of which species and how many species are stored in sixteen museum structures.

The realized inventory sums up a wide scientific and cultural heritage, making it easily accessible. It represents a point of reference for the scientific community, offering information on the historical distribution of now rare or locally extinct species, and indications on the localization of biological material that might be of use to further research at many levels. At the same time, this work has made it possible to offer a picture of the birds of prey in Sicilian collections, promoting this charismatic group which rises interest and curiosity in the greater public, contributing to the dissemination of scientific information regarding the naturalistic patrimony. However, in many cases the old collections stored in the public museums founded in the last two centuries lack sampling date and locality information adequate for analyses and statistics (Winker et al., 1991). Public avian collections could be much improved thanks to donations by private collectors, many of which have documented locality and date of capture for each specimen. Unfortunately, the legal restriction and bureaucratic impediments have much limited birds transferring, especially to university museums; yet public museums and the scientific community could benefit.



Fig. 8. Egyptian Vulture at the Museo di Zoologia "P. Doderlein", SIMUA, Università degli Studi di Palermo.

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