

What Is the Convenience of Treating a Wetland as an Agricultural Area?

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Abstract

The Gelsari and Lentini marshes, in east-central Sicily, are wetland under heavy anthropogenic pressure. This area is regularly subjected to water withdrawals and agriculture is practiced. Periodic bird census activities had been conducted in this area between 2016 and 2022 with collected data being supplemented with the data from a previous survey conducted between 2010 and 2016. During the censuses, numerous photographs were collected, which were later used for counts. In total, 121 surveys were carried out, with visits occurring approximately 20 times per year, covering all seasons. The data collected, both from bibliography and unpublished observations, were organised in table. 120 species and subspecies have been reported, 41 of which are in Annex I of the Birds Directive. Between 2021 and 2022, a water column measurement was taken in a central area of the Lentini marsh and compared with rainfall data in the area. It was found that water removal, occurring in both marshes in different modes, produced different effects on habitat conservation. Of the two marshes, Lentini is the one in which the existing favorable conditions in its most depressed areas, located below sea level, have allowed for the adequate conservation of the wetland. This environmental improvement having occurred with respect to the previous period has restored to the marsh its historically recognized possibility of not drying up completely during the summer period, allowing permanence of numerous birds. The obtained results suggest total elimination of agriculture and discontinuation of water withdrawals in the Lentini marsh as well as regulation of withdrawals in the Gelsari marsh.

Keywords

Sicily, Checklist, Conservation, Important Coastal Salt Marsh under the Sea Level, Pantano Lentini

1. Introduction

The conservation status of Mediterranean wetlands is worrying and subject to numerous environmental pressures; many wetlands are threatened by pollution, land consumption and invasive species. Their state of conservation is often totally inadequate, especially in Sicily [1] [2]. As a rule, the poor management of these environments affects the areas adjacent to them, which are affected by building settlements or human activities [3]. In Sicily, adequately protected wetlands, such as Vendicari or the Longarini and Cuba marshes, host very rich communities of birds; particularly, in these two areas, 251 [4] and 244 [5] species have been respectively recorded, which represent about 35 percent of all known species for the entire Italian territory [6].

The Gelsari and Lentini marshes represent a Sicilian wetland area, which in the past was among the most extensive ones, now reduced to an irregularly flooded area due to water drainage interventions intended for an agricultural use of the area. The income derived from these agricultural activities, which today are in part being abandoned, does not compensate for the costs required to keep some of its areas dry, all to the detriment of a wetland of potentially very high naturalistic value. Bird populations in the residual wetland have been periodically surveyed. In the same area, trends in water levels were also described by monitoring rainfall and forced water withdrawals. An update of ornithological research carried out between 2010 and 2016 is presented with this paper [7].

2. Study Area and State of Conservation

Gelsari and Lentini are two coastal brackish marshes in east-central Sicily, located geographically in the so-called “Plain of Catania”, the largest plain in Sicily (Figure 1); administratively they fall within the territories of Catania, Carlentini and Augusta. A large part of the northern depression, constituting the Lentini marsh, lies at an elevation below sea level.

Already in ancient times the landscape of this wetland, much larger and more pristine than today's, must have struck the imagination of the inhabitants of Leontinoi, an important Greek colony located less than 10 km away, as appears proven by the vessel production, with depictions of waterfowl, preserved in the archaeological museum of Lentini [8]. Historically, these marshes are known for their vastness and ability to accommodate abundant avifauna; their wealth of fauna attracted nobles and royalty in the past and, among them, Frederick II of Swabia [9] [10].

Historical and scientific information on the area is scarce and found in various works, lacking a one monograph. Nonetheless, while the available picture is partial, it is sufficient to outline the great importance of the area.

Currently, the confines of these marshes cannot be traced in a definitive manner, as their width depends on the amount of water present. These are two natural depressions, located to the north and south, of the terminal stretch of the San Leonardo River; over time they have been reshaped by humans, through artificial channels, in order to convey their waters to two respective pumping sta-

tions, where they are raised to end up in the sea. For a more in-depth description of the site, see [7].

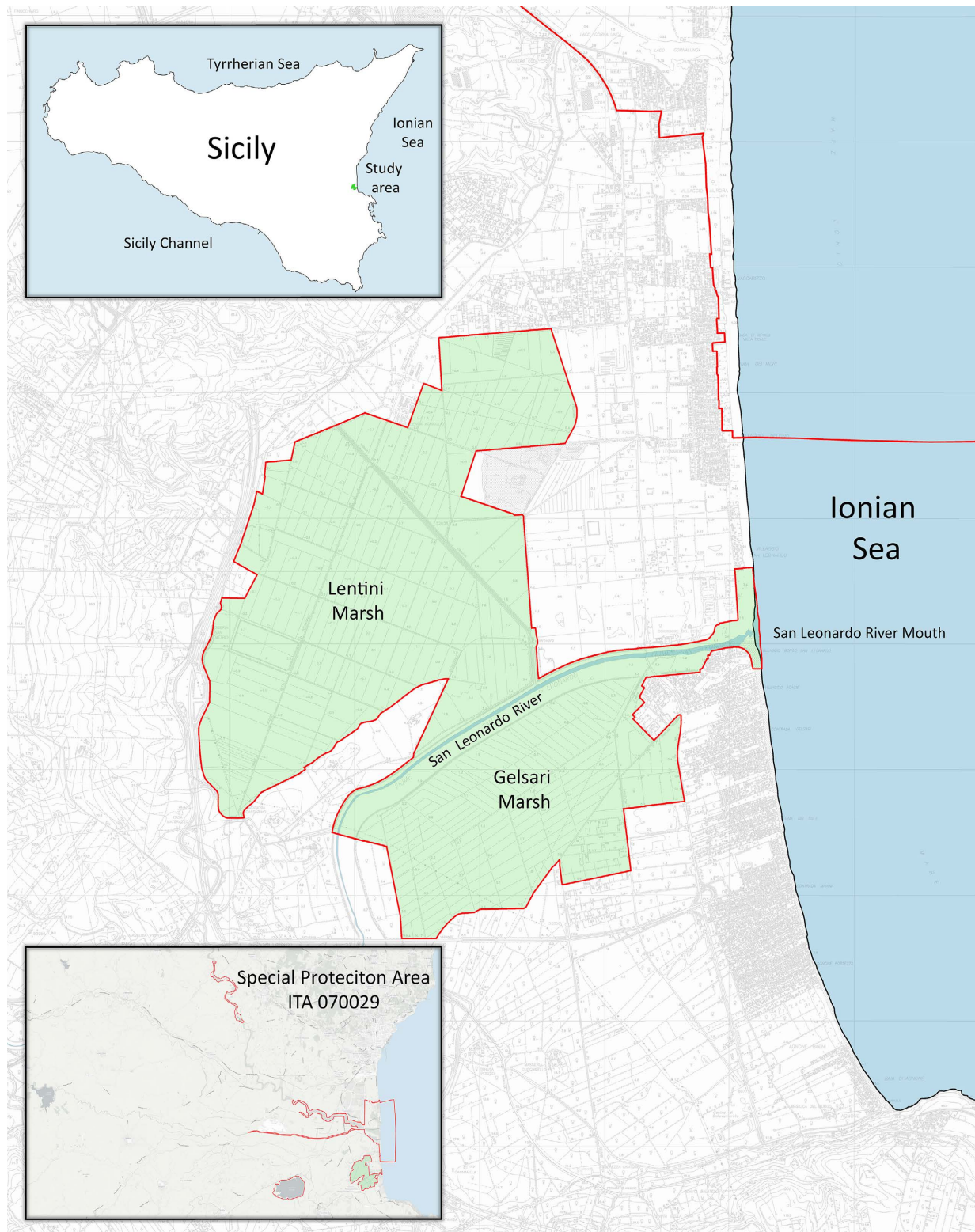


Figure 1. Localization of the study area and Special Protection Area ITA070029 (red section), with the portion covering the Gelsari and Lentini sloughs indicated (green background).

Since 2012, the Gelsari and Lentini marshes have been included in the Natura 2000 Network and are part of the Special Protection Area, codified ITA070029 (**Figure 1**). However, agricultural activities and water disposal by a Sicilian Region “reclamation” consortium persist; these are activities that pre-existed the establishment of the constraint, limiting or preventing the natural expression and evolution of the aquatic environment, from a floristic and faunal point of view. Recently, an additional impact factor has been added, consisting of a high-voltage power line, the route of which has, unjustifiably, involved the crossing of both marshes.

Compared to previous surveys [7], different environmental conditions have been found in the area. The Gelsari marsh, during the entire study period, was almost always dry as a result of the modernization and upgrading of the related water-supply plant. In the Lentini marsh, on the other hand, anthropogenic pressure was reduced following the abandonment of some areas, which were previously cultivated. In Lentini, water outcrops have been more permanently present, and in areas no longer subject to land clearing, significant vegetation cover has developed.

3. Material and Methods

Censuses of birds present in the Gelsari and Lentini wetland complex were conducted between October 2016 and September 2022. The visits were not conducted on a regular basis, but given the instability of the wetlands, brought about human activities and particularly water withdrawal, they were concentrated at times when water stagnation was present.

The census of birds in the wild was combined with a conspicuous collection of documentary images, acquired with a digital SLR camera. Subsequently, the photographic archive was consulted for further verification, identification, and recounting of individual species. A total of 121 surveys were carried out, with comprehensive censuses of aquatic species; there were approximately 20 visits per year, covering all seasons (37.2 percent in autumn, 17.3 percent in winter, 24.8 percent in spring, and 20.7 percent in summer).

Data taken from the bibliography and unpublished data are entered in **Table 1**, as described below. The species have been listed in the rows, or the subspecies, and reportings in the columns. The systematic order and nomenclature adopted are those proposed in the Handbook of the Birds of the World and BirdLife International [11]. The first column, if the species is cited in the literature, reports the references; the second and third columns report observations made between 2010 and 2016, taken from [7], and unpublished observations collected between 2016 and 2022, respectively. The values given for observations refer to the number of times the species was sighted, and the maximum number of individuals detected is given in parentheses. For the widespread species, values were not reported, but they were generically referred to as “Common”.

Table 1. Synoptic table of species sighted, compared with those sighted, in the same area, in an earlier period [7]. Historical and recent data, taken from the bibliography and censuses conducted, are listed. Total ascertained reports and maximum numbers of ascertained individuals are given for each species.

Scientific name	Common name	Historical sources	Sightings between 2010 (III) and 2016 (IX) De Pietro et al 2019	Sightings between 2016 (X) and 2022 (IX)
<i>Cygnus olor</i>	Mute Swan	[12] [13]		
<i>Cygnus cygnus</i>	Whooper Swan	[12] [14]		
<i>Melanitta fusca</i>	Velvet Scoter	[15]		
<i>Tadorna tadorna</i>	Common Shelduck		8 (max. 24 ind.)	31 (70 ind.)
<i>Aythya ferina</i>	Common Pochard	[16]-[18]		1 (1 ind.)
<i>Aythya nyroca</i>	Ferruginous Duck	[16] [18] [19]	2 (max. 13 ind.)	2 (max. 9 ind.)
<i>Aythya fuligula</i>	Tufted Duck	[17]		1 (1 ind.)
<i>Spatula querquedula</i>	Garganey	[17] [19]	4 (max. 6 ind.)	11 (16 ind.)
<i>Spatula clypeata</i>	Northern Shoveler	[20] [21]	3 (max. 50 about)	9 (max. 15 ind.)
<i>Mareca strepera</i>	Gadwall	[22]	1 (2 ind.)	1 (1 ind.)
<i>Mareca penelope</i>	Eurasian Wigeon	[12] [18] [21]	1 (17 ind.)	11 (15 ind.)
<i>Anas platyrhynchos</i>	Mallard	[19] [20] [23]	10 (max. 5 ind.)	27 (max. 10 ind.)
<i>Anas acuta</i>	Northern Pintail	[12] [17]-[20]	1 (2 ind.)	17 (max. 117 ind.)
<i>Anas crecca</i>	Common Teal	[17] [18]	1 (2 ind.)	6 (max. 75 ind.)
<i>Tachybaptus ruficollis</i>	Little Grebe	[19] [20]	7 (max, 4)	19 (max. 9 ind.)
<i>Podiceps cristatus</i>	Great Crested Grebe	[24]	6 (max. 15 ind.)	1 (1 ind.)
<i>Podiceps nigricollis</i>	Black-necked Grebe	[23]	3 (max. 4 ind.)	8 (max. 5 ind.)
<i>Phoenicopterus roseus</i>	Greater Flamingo	[21]	2 (max. 6 ind.)	55 (max. 34 ind.)
<i>Columba livia</i>	Rock Dove		Max. 250 ind.	common
<i>Columba palumbus</i>	Common Woodpigeon		Max. 50 ind.	common
<i>Streptopelia turtur</i>	European Turtle-dove	[23]		1 (2 ind.)
<i>Streptopelia decaocto</i>	Eurasian Collared-dove		common	common
<i>Apus pallidus</i>	Pallid Swift		common	common
<i>Apus apus</i>	Common Swift		common	common
<i>Gallinula chloropus</i>	Common Moorhen		3 (max. 4 ind.)	9 (max. 10 ind.)
<i>Fulica atra</i>	Common Coot	[17] [21]	17 (max. 338 ind.)	13 (max. 142 ind.)
<i>Ciconia ciconia</i>	White Stork	[12]	32 (max. 73 ind.)	65 (max. 73 ind.)
<i>Platalea leucorodia</i>	Eurasian Spoonbill	[12] [21]	6 (max. 22 ind.)	12 (max. 2 ind.)
<i>Plegadis falcinellus</i>	Glossy Ibis	[21]	5 (max. 22 ind.)	20 (max. 43 ind.)
<i>Ixobrychus minutus</i>	Common Little Bittern	[20] [25]	1 (1 ind.)	

Continued

<i>Nycticorax nycticorax</i>	Black-crowned Night-heron	[23]	1 (1 ind.)	2 (max. 9 ind.)
<i>Ardeola ralloides</i>	Squacco Heron	[18]	12 (max. 6 ind.)	10 (max. 8 ind.)
<i>Bubulcus ibis</i>	Cattle Egret		20 (max. 130 ind.), 1 in 1971 (Sorci <i>et al.</i> 1972)	47 (max. 138 ind.)
<i>Ardea cinerea</i>	Grey Heron	[13]	14 (max. 14 ind.)	16 (max. 11 ind.)
<i>Ardea purpurea</i>	Purple Heron	[16]-[19]	3 (max. 2 ind.)	4 (max. 2 ind.)
<i>Ardea alba</i>	Great White Egret	[18] [19]	17 (max. 5 ind.)	5 (max. 1 ind.)
<i>Egretta garzetta</i>	Little Egret	[17]	40 (max. 77 ind.)	85 (max. 71 ind.)
<i>Pelecanus onocrotalus</i>	Great White Pelican	[26] [27]		
<i>Phalacrocorax carbo</i>	Great Cormorant	[19] [27] [28]	2 (max. 3 ind.)	4 (max. 7 ind.)
<i>Burhinus oedicnemus</i>	Eurasian Thick-knee		2 (max. 2 ind.)	6 (max. 7 ind.)
<i>Recurvirostra avosetta</i>	Pied Avocet	[23]	1 (1 ind.)	6 (max. 6 ind.)
<i>Himantopus himantopus</i>	Black-winged Stilt	[17]	22 (max 72. ind.)	38 (max. 60 ind.)
<i>Pluvialis squatarola</i>	Grey Plover			2 (1 ind.)
<i>Pluvialis apricaria</i>	Eurasian Golden Plover	[17] [20] [21]	2 (max. 161 ind.)	1 (3 ind.)
<i>Charadrius hiaticula</i>	Common Ringed Plover			4 (max. 8 ind.)
<i>Charadrius dubius</i>	Little Ringed Plover		3 (max. 6 ind.)	16 (max. 10 ind.)
<i>Vanellus vanellus</i>	Northern Lapwing	[17]	7 (max. 80 ind. about)	24 (max. 371 ind.)
<i>Numenius arquata</i>	Eurasian Curlew	[13] [17]	1 (18 ind.)	1 (1 ind.)
<i>Numenius arquata orientalis</i>	Eurasian Curlew (orientalis)			1 (2 ind.)
<i>Limosa lapponica</i>	Bar-tailed Godwit			3 (max. 2 ind.)
<i>Limosa limosa</i>	Black-tailed Godwit		2 (max. 2 ind.)	2 (max. 3 ind.)
<i>Calidris pugnax</i>	Ruff	[17]	10 (max. 16 ind.)	22 (max. 361 ind.)
<i>Calidris ferruginea</i>	Curlew Sandpiper		3 (max. 15 ind.)	4 (max. 14 ind.)
<i>Calidris alpina</i>	Dunlin	[17] [20]	3 (max. 28 ind.)	17 (max. 334 ind.)
<i>Calidris minuta</i>	Little Stint	[20]	3 (max. 10 ind.)	17 (max. 28 ind.)
<i>Gallinago gallinago</i>	Common Snipe		5 (max. 7 ind.)	17 (max. 46 ind.)
<i>Lymnocyrtus minimus</i>	Jack Snipe			1 (2 ind.)
<i>Actitis hypoleucos</i>	Common Sandpiper	[24]	1 (1 ind.)	2 (1 ind.)
<i>Tringa ochropus</i>	Green Sandpiper	[17] [20] [21]	1 (1 ind.)	4 (1 ind.)
<i>Tringa erythropus</i>	Spotted Redshank	[17]	2 (max. 7 ind.)	10 (max. 14 ind.)
<i>Tringa nebularia</i>	Common Greenshank	[17]	14 (max. 21 ind.)	15 (max. 23 ind.)
<i>Tringa totanus</i>	Common Redshank	[17]	5 (1 ind.)	6 (max. 8 ind.)
<i>Tringa glareola</i>	Wood Sandpiper	[17]	8 (max. 70 ind. about)	17 (max. 25 ind.)

Continued

<i>Tringa stagnatilis</i>	Marsh Sandpiper	[17]		3 (max. 3 ind.)
<i>Larus genei</i>	Slender-billed Gull	[20]		
<i>Larus ridibundus</i>	Black-headed Gull		18 (max. 1000 ind. about)	common
<i>Larus melanocephalus</i>	Mediterranean Gull			2 (1 ind.)
<i>Larus fuscus</i>	Lesser Black-backed Gull		1 (1 ind.)	2 (max. 2 ind.)
<i>Larus michahellis</i>	Yellow-legged Gull		4 (max. 50 ind. about)	6 (max. 60 ind.)
<i>Gelochelidon nilotica</i>	Common Gull-billed Tern		1 (1 ind.)	
<i>Chlidonias hybrida</i>	Whiskered Tern		1 (1 ind.)	1 (1 ind.)
<i>Chlidonias niger</i>	Black Tern		1 (1 ind.)	
<i>Tyto alba</i>	Common Barn-owl		3 (1 ind.)	1 (1 ind.)
<i>Asio flammeus</i>	Short-eared Owl		1 in 2.II.1942 (Ciaccio and Priolo 1997)	
<i>Pandion haliaetus</i>	Osprey	[23] [29]	3 (1 ind.)	3 (1 ind.)
<i>Circaetus gallicus</i>	Short-toed Snake-eagle			3 (1 ind.)
<i>Aquila fasciata</i>	Bonelli's Eagle			1 (1 ind.)
<i>Hieraaetus pennatus</i>	Booted Eagle		3 (1 ind.)	6 (max. 2 ind.)
<i>Circus aeruginosus</i>	Western Marsh-harrier	[19]	19 (max. 2 ind.)	44 (max. 3 ind.)
<i>Circus macrourus</i>	Pallid Harrier		1 (1 ind.)	
<i>Circus pygargus</i>	Montagu's Harrier			4 (1 ind.)
<i>Milvus migrans</i>	Black Kite			1 (1 ind.)
<i>Buteo buteo</i>	Eurasian Buzzard		25 (max. 3 ind.)	44 (max. 4 ind.)
<i>Buteo rufinus</i>	Long-legged Buzzard			1 (1 ind.)
<i>Upupa epops</i>	Common Hoopoe		3 (1 ind.)	2 (1 ind.)
<i>Merops apiaster</i>	European Bee-eater		2 (1 ind.)	7 (max. 29 ind.)
<i>Alcedo atthis</i>	Common Kingfisher		1 (1 ind.)	3 (max. 2 ind.)
<i>Falco tinnunculus</i>	Common Kestrel		28 (max. 2 ind.)	33 (max. 2 ind.)
<i>Falco vespertinus</i>	Red-footed Falcon		1 (1 ind.)	1 (8 ind.)
<i>Falco peregrinus</i>	Peregrine Falcon			1 (1 ind.)
<i>Pica pica</i>	Eurasian Magpie		common	common
<i>Corvus monedula</i>	Eurasian Jackdaw		1 (2 ind.)	
<i>Corvus corone cornix</i>	Carrion Crow		common	common
<i>Calandrella brachydactyla</i>	Greater Short-toed Lark		1 (5 ind.)	
<i>Alauda arvensis</i>	Eurasian Skylark		common	5 (max. 20 ind.)
<i>Galerida cristata</i>	Crested Lark		common	common
<i>Cisticola juncidis</i>	Zitting Cisticola	[20]	common	common

Continued

<i>Acrocephalus paludicola</i>	Aquatic Warbler	[19]		
<i>Acrocephalus melanopogon</i>	Moustached Warbler	[20]		
<i>Acrocephalus palustris</i>	Marsh Warbler	[30]		
<i>Acrocephalus scirpaceus</i>	Common Reed-warbler	[20]	common	common
<i>Acrocephalus arundinaceus</i>	Great Reed-warbler		1 (1 ind.)	
<i>Delichon urbicum</i>	Northern House Martin		common	common
<i>Hirundo rustica</i>	Barn Swallow		common	common
<i>Riparia riparia</i>	Collared Sand Martin			2 (max. 4 ind.)
<i>Phylloscopus collybita</i>	Common Chiffchaff		common	8 (max. 2 ind.)
<i>Sturnus vulgaris</i>	Common Starling	[31]	max. c. 2000 ind.	10 (max. 500 ind.)
<i>Sturnus unicolor</i>	Spotless Starling		max. 200 ind.	3 (max. 15 ind.)
<i>Erithacus rubecula</i>	European Robin		common	1 (1 ind.)
<i>Phoenicurus ochruros</i>	Black Redstart		common	1 (1 ind.)
<i>Saxicola torquatus</i>	Common stonechat		common	common
<i>Anthus pratensis</i>	Meadow Pipit		common	1 (1 ind.)
<i>Motacilla flava ssp.</i>	Western Yellow Wagtail		common	common
<i>Motacilla f. flava</i>	“		1 (1 ind.)	
<i>Motacilla f. feldegg</i>	“		1 (1 ind.)	1 (2 ind.)
<i>Motacilla f. cinereocapilla</i>	“			1 (2 ind.)
<i>Motacilla alba</i>	White Wagtail	[20]	common	common
<i>Linaria cannabina</i>	Common linnet		common	common
<i>Carduelis carduelis</i>	European Goldfinch		common	common
<i>Emberiza calandra</i>	Corn Bunting		common	common

A second table (**Table 2**) was also made, indicating, for each species, the phenological category and the framing in the regulatory and conservation fields. The phenological categories adopted, with the abbreviation used, are as follows: S = Sedentary; B = Breeding; W = Wintering; M = Migrant; A = Accidental; P = Presence (less than 10 records). Irr = Irregular.

In 2021 and 2022, in conjunction with the censuses, the water level of the Lentini marsh was surveyed; the measurements were taken in a channel, called “western low water”, at a point affecting the central portion of the marsh. The data was obtained with reference to a landmark surveyed altimetrically with a topographic instrument with GNSS receiver (Stonex S850+). In the analysis, the discrete point-type data related to the water column, surveyed in the field, were compared with rainfall data from some rainfall stations of the Sicilian Agrometeorological Information Service, which is part of the Sicilian Region’s Agricultural and Food Resources Department. The stations examined are those of Au-

gusta, Catania and Lentini, which are those closest to the marsh (identified, respectively, by the geographical coordinates in decimal degrees 37.248625° 15.142567, 37.441788° 15.067711° and 37.350490° 14.908070°). By constructing the relevant Thiessen polygons, it appears that the Lentini marsh is mainly influenced by the Catania rainfall station; it has been referred to in **Figure 3** for the comparison of rainfall trends and water levels in the marsh.

Table 2. List of species. for each species the phenology and abundance, the inclusion in annex I of EU Directive 147/2009, the global and Italian status IUCN and the category of SPEC accordind to Birdlife International (2017) are indicated. S = Sedentary; B = Breeding; W = Wintering; M = Migrant; A = Accidental; P = Presence (Less 10records); I = Irregular.

Scientific name	Phenology and abundance	Appendix I EU Directive 147/2009	Global status IUCN	Italian status IUCN (only nesting birds)	SPEC1 or SPEC2
<i>Cygnus olor</i>	P	no	LC	LC	no
<i>Cygnus cygnus</i>	A	yes	LC	no	no
<i>Melanitta fusca</i>	A	no	VU A2abcde	no	SPEC 1
<i>Tadorna tadorna</i>	W, M	no	LC	VU D1	no
<i>Aythya ferina</i>	M irr	no	VU A2abcde + 3bcde + 4abcde	VU D1	SPEC 1
<i>Aythya nyroca</i>	M irr, possible B	yes	NT	EN D	SPEC 1
<i>Aythya fuligula</i>	M, rare	no	LC	VU D	no
<i>Spatula querquedula</i>	M	no	LC	VU C2a(i); D1	no
<i>Spatula clypeata</i>	W rare, M	no	LC	VU D1	no
<i>Mareca strepera</i>	M, rare	no	LC	NT D1	no
<i>Mareca penelope</i>	M	no	LC	no	no
<i>Anas platyrhynchos</i>	S, B	no	LC	LC	no
<i>Anas acuta</i>	W rare, M	no	LC	no	no
<i>Anas crecca</i>	W rare, M	no	LC	EN D	no
<i>Tachybaptus ruficollis</i>	W, B	no	LC	LC	no
<i>Podiceps cristatus</i>	M irr	no	LC	LC	no
<i>Podiceps nigricollis</i>	M irr	no	LC	no	no
<i>Phoenicopiterus roseus</i>	W irr, M irr	yes	LC	LC	no
<i>Columba livia</i>	S, B, common	no	DD	LC	no
<i>Columba palumbus</i>	S, B, common	no	LC	LC	no
<i>Streptopelia turtur</i>	M irr	no	VU A2bcde + 4bcde	LC	SPEC 1
<i>Streptopelia decaocto</i>	S common	no	LC	LC	no
<i>Apus pallidus</i>	B around, M common	no	LC	LC	no
<i>Apus apus</i>	B around, M common	no	LC	LC	no
<i>Gallinula chloropus</i>	S common	no	LC	LC	no
<i>Fulica atra</i>	M irr, B	no	LC	LC	no

Continued

<i>Ciconia ciconia</i>	S, B	yes	LC	LC	no
<i>Platalea leucorodia</i>	W irr, M irr	yes	LC	NT D1	no
<i>Plegadis falcinellus</i>	M irr	yes	LC	VU D	no
<i>Ixobrychus minutus</i>	M irr	yes	LC	VU C1	no
<i>Nycticorax nycticorax</i>	M irr	yes	LC	LC	no
<i>Ardeola ralloides</i>	M irr	yes	LC	NT D1	no
<i>Bubulcus ibis</i>	S common	no	LC	LC	no
<i>Ardea cinerea</i>	W irr, M irr	no	LC	LC	no
<i>Ardea purpurea</i>	M irr	yes	LC	LC	no
<i>Ardea alba</i>	W irr, M irr	yes	LC	NT D1	no
<i>Egretta garzetta</i>	W irr, M irr	yes	LC	LC	no
<i>Pelecanus onocrotalus</i>	A	yes	LC	no	no
<i>Phalacrocorax carbo</i>	M irr	no	LC	LC	no
<i>Burhinus oedienemus</i>	M irr, possible B	yes	LC	LC	no
<i>Recurvirostra avosetta</i>	M irr	yes	LC	LC	no
<i>Himantopus himantopus</i>	M irr, B	yes	LC	LC	no
<i>Pluvialis squatarola</i>	P	no	LC	no	no
<i>Pluvialis apricaria</i>	W irr, M irr	yes	LC	no	no
<i>Charadrius hiaticula</i>	M irr	no	LC	no	no
<i>Charadrius dubius</i>	W irr, M irr	no	LC	LC	no
<i>Vanellus vanellus</i>	W irr, M irr	no	NT	LC	SPEC 1
<i>Numenius arquata</i>	M irr	yes	NT	no	SPEC 1
<i>Limosa lapponica</i>	W irr	yes	NT	no	SPEC 1
<i>Limosa limosa</i>	M irr	no	NT	EN D	SPEC 1
<i>Calidris pugnax</i>	M irr, W irr	no	LC	no	SPEC 2
<i>Calidris ferruginea</i>	M irr	no	LC	no	SPEC 1
<i>Calidris alpina</i>	W irr, M irr	no	LC	no	no
<i>Calidris minuta</i>	W irr, M irr	no	LC	no	no
<i>Gallinago gallinago</i>	W irr, M irr	no	LC	no	no
<i>Lymnocyptes minimus</i>	W irr	no	LC	no	no
<i>Actitis hypoleucos</i>	M irr	no	LC	NT D1	no
<i>Tringa ochropus</i>	M irr, W irr	no	LC	no	no
<i>Tringa erythropus</i>	M irr, W irr	no	LC	no	no
<i>Tringa nebularia</i>	M irr, W irr	no	LC	no	no
<i>Tringa totanus</i>	W irr, M irr	no	LC	LC	SPEC 2

Continued

<i>Tringa glareola</i>	M irr	yes	LC	no	no
<i>Tringa stagnatilis</i>	M irr	no	LC	no	no
<i>Larus genei</i>	P	yes	LC	NT D2	no
<i>Larus ridibundus</i>	W irr, M irr	no	LC	LC	no
<i>Larus melanocephalus</i>	M irr	yes	LC	NT D2	no
<i>Larus fuscus</i>	W irr	no	LC	no	no
<i>Larus michahellis</i>	S irr	no	LC	LC	no
<i>Gelochelidon nilotica</i>	M irr	yes	LC	NT	no
<i>Chlidonias hybrida</i>	M irr	yes	LC	VU D1	no
<i>Chlidonias niger</i>	M irr	yes	LC	CR C2a(ii)	no
<i>Tyto alba</i>	S, possible B	no	LC	LC	no
<i>Asio flammeus</i>	M irr	yes	LC	no	no
<i>Pandion haliaetus</i>	M irr	yes	LC	CR D	no
<i>Circus gallicus</i>	M irr	yes	LC	LC	no
<i>Aquila fasciata</i>	P	yes	LC	EN D	no
<i>Hieraaetus pennatus</i>	W irr, M irr	yes	LC	no	no
<i>Circus aeruginosus</i>	W irr, M irr	yes	LC	VU D1	no
<i>Circus macrourus</i>	M irr	yes	NT	no	SPEC 1
<i>Circus pygargus</i>	M irr	yes	LC	VU D1	no
<i>Milvus migrans</i>	M irr	yes	LC	LC	no
<i>Buteo buteo</i>	S, B	no	LC	LC	no
<i>Buteo rufinus</i>	P	yes	LC	no	no
<i>Upupa epops</i>	M, W irr	no	LC	LC	no
<i>Merops apiaster</i>	M common	no	LC	LC	no
<i>Alcedo atthis</i>	M irr	yes	LC	LC	no
<i>Falco tinnunculus</i>	S, B	no	LC	LC	no
<i>Falco vespertinus</i>	M irr	yes	NT	VU D	SPEC 1
<i>Falco peregrinus</i>	W irr	yes	LC	LC	no
<i>Pica pica</i>	S, B, common	no	LC	LC	no
<i>Corvus monedula</i>	S irr	no	LC	LC	no
<i>Corvus corone cornix</i>	S, B, common	no	LC	LC	no
<i>Calandrella brachydactyla</i>	B irr	yes	LC	NT A2b	no
<i>Alauda arvensis</i>	W, M, common	no	LC	NT A2b	no
<i>Galerida cristata</i>	S, B, common	no	LC	LC	no
<i>Cisticola juncidis</i>	S, B, common	no	LC	LC	no

Continued

<i>Acrocephalus paludicola</i>	A	yes	VU B2ab (i, ii, iii, iv, v)	no	SPEC 1
<i>Acrocephalus melanopogon</i>	P	yes	LC	CR D	no
<i>Acrocephalus palustris</i>	P	no	LC	LC	no
<i>Acrocephalus scirpaceus</i>	B, M, common	no	LC	LC	no
<i>Acrocephalus arundinaceus</i>	M	no	LC	NT A2b	no
<i>Delichon urbicum</i>	B around, M common	no	LC	NT A2b	SPEC 2
<i>Hirundo rustica</i>	B, M, common	no	LC	NT A2a-b	no
<i>Riparia riparia</i>	M	no	LC	VU A2b	no
<i>Phylloscopus collybita</i>	W, M, common	no	LC	LC	no
<i>Sturnus vulgaris</i>	W, M, common	no	LC	LC	no
<i>Sturnus unicolor</i>	S, B common	no	LC	LC	no
<i>Erithacus rubecula</i>	W, M	no	LC	LC	no
<i>Phoenicurus ochruros</i>	W, M	no	LC	LC	no
<i>Saxicola torquatus</i>	W, M	no	LC	EN A2b	no
<i>Anthus pratensis</i>	W, M	no	NT	no	SPEC 1
<i>Motacilla flava ssp.</i>	M, B irr	no	LC	LC	no
<i>Motacilla alba</i>	W, M	no	LC	LC	no
<i>Linaria cannabina</i>	S, B, common	no	LC	LC	SPEC 2
<i>Carduelis carduelis</i>	S, B, common	no	LC	LC	no
<i>Emberiza calandra</i>	S, B	no	LC	LC	SPEC 2

4. Results

Altogether, information was collected on 120 taxa, 116 species, and 4 subspecies. References were found in the literature on 56 species, in the following works: [12]-[31]. Comparison of the data collected in the three periods investigated shows 42 species reported in all three periods; 56 in historical period, 94 between 2010 and 2016, and 103 between 2016 and 2022; 9 species reported in historical period were not confirmed.

The distribution of birds in Gelsari and Lentini, between 2016 and 2022, was very heterogeneous. Waterfowl, which include the species of greatest conservation value, were found only in the Lentini marsh; the Gelsari marsh was practically deserted by waterfowl, having been rendered devoid of water outcrops.

Overall, the number of species reported over time is increasing; the continuation of censuses over the years has provided data on 9 new species, in addition to reconfirming presences already verified.

In many cases, the species reported are of significant conservation interest, being very rare or in steep decline in Europe. Specifically, the species of greatest interest are: 41 in Annex I of the Birds Directive; 18 SPEC 1 or 2, 4 VU according to IUCN global status; 3 CR, 5 EN, 12 VU, 1 NT according to IUCN status in Italy. Regard-

ing phenology: 23 are breeding, 37 wintering; the remaining species are migratory, while 4 are of incidental occurrence, as they are very rare in southern Italy.

Among the species reported for the first time in the area, most notable in particular are the following Charadriiformes: *Limosa lapponica* (Bar-tailed Godwit) (Figure 2) and *Lymnocyrtus minimus* (Jack Snipe).



Figure 2. Many of the bird species present are of great interest for conservation. The photo shows a large flock of *Calidris alpina* (Dunlin) and some *Limosa lapponica* (Bar-tailed Godwit) specimens in the Lentini marsh, December 8, 2021.

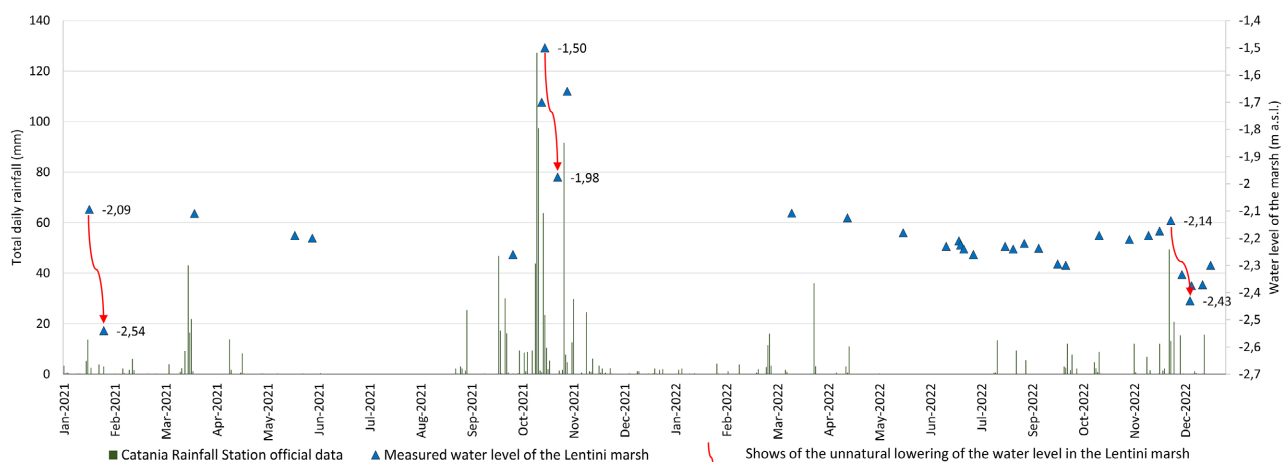


Figure 3. The diagram shows daily rainfall data of the “Catania” rainfall station of the Sicilian Agrometeorological Information Service (green bar chart) and the point level measurements of the Lentini marsh carried out in the years 2021 and 2022 (blue triangular indicator) where the unnatural lowering in levels due to the water drainage are highlighted by a red arrow connecting the indicators.

An additional significant aspect, which had not become apparent with the first surveys, but which takes on an important dimension with these further surveys, is the presence of raptors; a total of 15 species appears in this new list, including

Aquila fasciata (Bonelli's Eagle) and *Circaetus gallicus* (Short-toed Snake Eagle), while recurring are the observations of *Hieraaetus pennatus* (Booted Eagle).

Water levels compared with rainfall trends, are shown in **Figure 3**. Analysis of the data, indicates that during the spring and summer periods, in which rainfall is reduced, the water level in the Lentini marsh, after a natural and gradual decrease from previous months, tends to remain at an almost stable level. In the years 2021 and 2022, the favorable conditions subsisting in the most depressed areas and the absence or reduction, compared to past years, of withdrawals by the “reclamation” consortium, allowed the marsh not to dry up completely in the summer period, as was the case in the past and as is documented in the literature [32] (**Figure 4** and **Figure 5**).

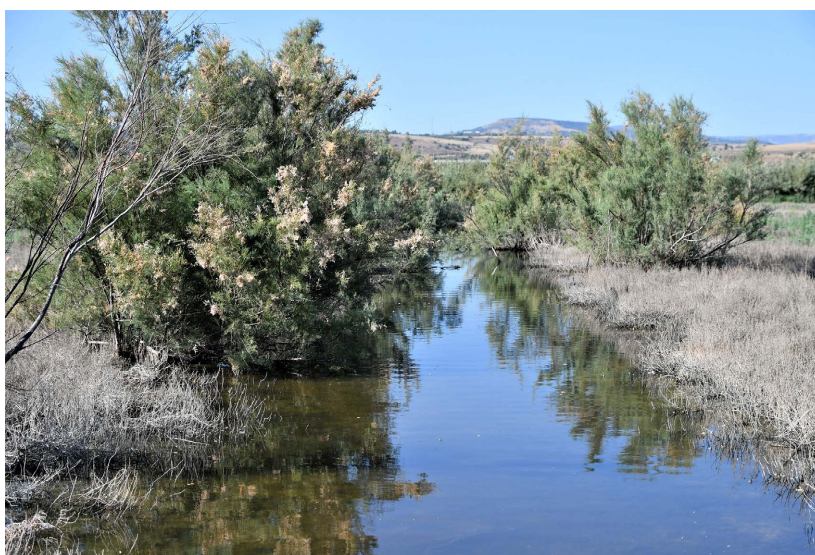


Figure 4. Nesting of many bird species is linked to the permanence of water in spring and summer. Pantano Lentini, July 2022.



Figure 5. Permanence of water in mid-August 2022 in the Lentini marsh.

The diagram in **Figure 3** also shows the natural level rise due to meteoric inputs and the sudden and unnatural lowering (shown by red arrows) as a result of the artificial water withdrawals carried out by the Consortium during rainy periods; about -0.5 m in January 2021, about -0.5 m between late October and early November 2021, and about -0.3 m between late November and early December 2022. It emerges that artificial water removal was carried out despite the absence of significant rainfall, and that the marsh was forced to lower water levels in autumn and winter than in summer.

5. Conclusions

The new surveys conducted in the Gelsari-Lentini wetland system confirm and consolidate the value of this site with regard to avifauna. Despite heavy anthropogenic pressure, the area plays an important naturalistic role internationally, with a high number of species that are rare in Europe. Further investigations over time will surely further enrich this already very significant picture. In this regard, it should be noted that during the drafting phase of this paper, the following additional species were observed for the first time in the Lentini marsh: *Rallus aquaticus* (Western Water Rail), repeatedly observed in June 2023 (breeding), *Numenius phaeopus* (Whimbrel), observed in mid-March 2023 and *Grus grus* (Common Crane), in migration in March 2023. In relation to the presence of birds of prey, at both Gelsari and Lentini marshes, in January 2023, was observed, wintering, *Clanga pomarina* (Lesser Spotted Eagle) and in the Lentini marsh, in December 2023, the presence of *Accipiter nisus* (Eurasian Sparrowhawk) was recorded.

In the course of this investigation, thanks to the surveys carried out, for a number of years it was possible to estimate on the present water column how much water withdrawal affects the basin and to define the periods in which this is exercised. From the analysis of the data and environmental monitoring related to the survey period, it emerges that the withdrawals are the greatest impact factor for the avifauna and that, if carried out in the summer period, they are capable of conditioning the permanence of water in the most depressed areas.

Stopping water withdrawals would immediately increase the international relevance of the Gelsari and Lentini marshes for bird conservation. Their positions, at the center of important migratory flows between Europe and Africa, together with the inherent capacities of wetland environments to host complex biological communities, make this site of high importance and require its management for naturalistic purposes, especially in the face of the very modest agropastoral value of the land and the high operating costs for water drainage. The data collected demonstrate the almost immediate ability of the avifauna to colonize the site and at the same time abandon it as a result of its drainage.

The contrasting trend between Gelsari and Lentini, indicates the two possible evolutions of the site: on the one hand, Lentini, demonstrates the resilience of the area; on the other hand, Gelsari shows the ability of man to totally inhibit the aquatic environment, causing its disappearance.

The highlighted ability of the Lentini marsh to maintain water even in the summer period deserves to be strictly protected, since it allows numerous species to be present or to reproduce, unlike in other Sicilian wetlands, which are naturally subject to complete drying up. The Lentini marsh, lying for the most part at an elevation below sea level, is replenished by rising waters; this phenomenon makes it better able to counteract artificial withdrawal activities, and for this reason, over time, it has preserved its more natural characteristics.

The results obtained indicate that for proper conservation of the wetland, it is certainly strategic and of primary importance to change the water management criteria of the marshes [33].

For the Lentini marsh, the elimination of agriculture would be imposed even in the northern parts, where it still continues to be practiced. It should be coupled with an area acquisition policy justified by comparing the very high environmental value of this marsh, the costs required to keep the water drainage and disposal system efficient, and the revenues from agriculture rendered irrational by the peculiar characteristics of the marsh.

While waiting for this to happen, water withdrawals should, however, cease, and, especially, peremptorily in spring and summer; they should be allowed only if the water level of the marsh should exceed a threshold to be established as “critical”. Furthermore, the project provisions, also recently put forward during the studied period, to enhance, as was the case for Gelsari, the hydro-swelling plant and make the water drainage system more efficient should be definitively abandoned.

With regard to the Gelsari marsh, on the other hand, strict regulation of withdrawals, respecting certain minimum criteria, would be appropriate to encourage the natural evolution of this environment, which could return, in a short time, to host a richer and more articulate flora and fauna than at present.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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