

Animal biodiversity in the constructed wetland (ESF) of the Parco Naturale Regionale Molentargius-Saline.

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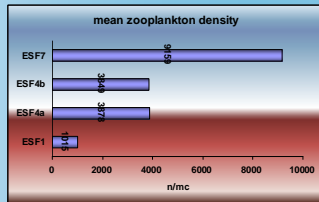
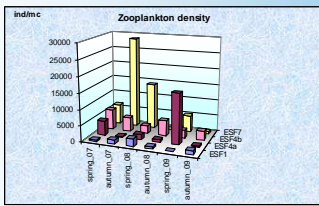
Introduction

The study of the animal biodiversity inside the phytodepuration plant (ESF) of the Molentargius-Saline Natural Regional Reserve was realized from 2007 to 2009, through the following activities: census of the avifauna; bird ringing, census of the herpetofauna, determination and census of the insect fauna, the characterization of the zooplankton and zoobenthos community. The area of study is the ESF, a phytodepuration plant with horizontal surface flow which treats the wastewater coming from the Is Arenas depuration plant, providing the appropriate quality and quantity water for the fresh water ponds called "Bellarosa Minore" and "Perdalonga". It is extended for 37 ha and it is composed of 10 basins divided in two lines (lines "a" and "b") characterized by the presence of *Phragmites australis* and *Tipha* vegetation. It has a treatment capacity of 300 l/s.

ZOOPLANKTON AND ZOOBENTHOS

The zooplankton samples and zoobenthos were taken with six-monthly sampling, to start to spring 2007 in four sampling stations located along the hydraulic distance: the "ESF1" station where the wastewaters are introduced after treatment, the "ESF7" at the end of the hydraulic way, the "ESF4a" and the "ESF4b" in the middle position.

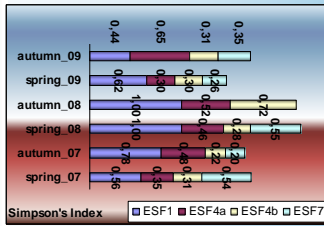
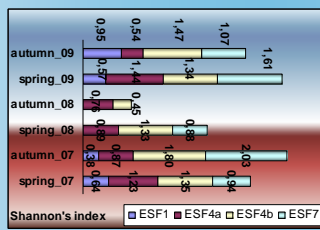
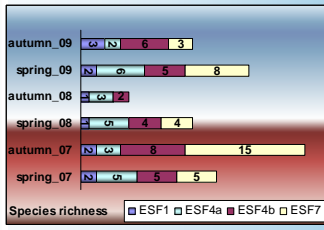
Zooplankton the maximum density has been registered in the "ESF7" station (autumn 2007, 28571 ind/mc); minimum values have on the contrary registered in the "ESF1" station (spring 2009, 95 ind/mc); in the "ESF7" station, in the biological samples related to the autumn 2008 the zooplankton was absent; the medium density has been verified to the maximum level in the "ESF7" station (9159 ind/mc), minimum density is present in the "ESF1" station (1015 ind/mc).



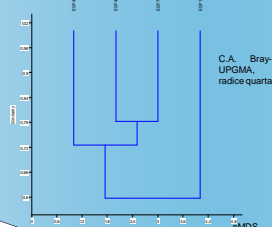
The most abundant taxa are following: Crustaceans, Rotifers, Insect larvae and Nematodes. In the "ESF1" station the community is dominated from the Chironomid larvae and Rotifers; in the "ESF4a" station from Cladocera and Copepods; in the "ESF4b" station the most abundant taxa are the Cladocera and the Rotifers; in the "ESF7" the most abundant taxa are Cladocera and Chironomid larvae.

	% taxa				% density/density tot.
	ESF1	ESF4a	ESF4b	ESF7	
Copepoda	9.1%	28.1%	21.2%	15.9%	19.3%
Cladocera	0.0%	62.0%	31.5%	25.2%	33.1%
Ostracoda	0.0%	0.0%	6.2%	18.7%	10.9%
Nematoda	6.5%	1.0%	7.6%	10.5%	7.6%
Anellida	1.2%	1.4%	1.0%	0.6%	0.9%
Diptera	53.8%	1.2%	1.9%	19.4%	13.6%
Hemiptera	0.0%	0.0%	0.0%	2.2%	1.1%
Platyhelminthes	0.0%	0.0%	1.0%	0.0%	0.2%
Protista	0.0%	1.0%	0.0%	0.0%	0.2%
Rotifera	29.4%	5.2%	29.6%	7.4%	13.0%

In the "ESF7" station the greater richness of taxa (with the higher values of the Shannon index) are associated; on the contrary, a less richness, and the lowest biodiversity index values has been observed in the "ESF1" station. The Simpson's Dominance Index become the higher values in the "ESF1" station, minimum index values are related to the "ESF7" station.



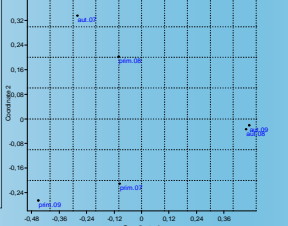
The cluster analysis was carried out using the Bray-Curtis similarity matrix based on the density data, verified in four sampling stations, means a greater similarity amongst the communities structure in the "ESF4b" station and the "ESF7". The "ESF1" is independent.



The cluster analysis and the nMDS have also been realized with the Bray - Curtis similitude matrix, based on the abundance of the populations found in four sampling stations, after n. six monitoring campaigns. It's important to underline the temporal preferential aggregation of the communities is

Zoobenthos

The maximum average of the zoobenthos density is registered in the "ESF7" (9374 ind/m2) and "ESF4b" stations; in the "ESF1" and "ESF4a" stations, densities are many inferior. Populations are above abundant in the spring campaigns. In general, the dominant taxa are the Annelids and the Nematodes in the "ESF1" station, the Cladocera (in the "ESF4a"), the Chironomids larvae (located in the "ESF4b"), and the Copepods" in the "ESF7" station.



Based on the estimated ecological index - related to the zooplankton community, the higher biodiversity level have to respectively ascribe to the "ESF7" station, while the lower level must be assigned to the "ESF1" station. Concerning also the structural parameters examined (as the numbers of the individuals, and their presence) an increase in the "ESF7" station is registered. The results we therefore indicate an important element: in such station - located at the end of phytodepuration plant the communities are more abundant and are biodiverse. Also the zoobenthonic community is more relevant in the terminus station, in which, taxa are sensitive about populations in the "ESF1" station.



AVIFAUNA

The ESF is included in the "Habitat 1150" according to the Habitats Directive 92/43/CEE Annex II and it is therefore an important stop-over and breeding site for a lot of ornithic species.

It is one of the most important fresh water sites in the Molentargius ecosystem for breeding and wintering aquatic bird, because of the presence of a luxuriant reed bed, algae and hydrophilic species that in some periods are presents in the basins. Although these components could sometimes create difficulties in the management of the ESF water flow it's important to underline that this vegetation constitute the principal food for many species (Rallidae and Anatidae), some of which particularly protected. In this site 15 aquatic birds species Non Passeriformes breed. They are about the 48% of the nesting birds in the fresh water biotopes: Podicipedidae, Ardeidae, Anatidae, Accipitridae and Rallidae. Among the several reed bed Passeriformes breed the genus *Acrocephalus*. A census of 83 Purple swamp hen was taken (IWC, 2008) and this is the 52% of the whole ecosystem Molentargius population. In Italy this priority species is present only in Sicily, where it was recently reintroduced, and it is included in a specific protection plan of the ISPRA and Environmental Ministry (2001).

The check list of the ESF avifauna it's constituted of the following species.

Species	Status	Species	Status
<i>Tachybaptus ruficollis</i>	N	<i>Actitis hypoleucos</i>	M/O
<i>Podiceps cristatus</i>	N	<i>Larus ridibundus</i>	N; M/O
<i>Phalacrocorax carbo sinensis</i>	M	<i>Larus genei</i>	M/O
<i>Botaurus stellaris</i>	M/O	<i>Larus michahellis</i>	N; M/O
<i>Ixobrychus minutus</i>	N PROB	<i>Gelochelidon nilotica</i>	N; M/O
<i>Nycticorax nycticorax</i>	N	<i>Sterna hirsundo</i>	N; M/O
<i>Ardeola ralloides</i>	N	<i>Sterna albifrons</i>	N; M/O
<i>Bubulcus ibis</i>	N	<i>Chlidonias niger</i>	M
<i>Egretta garzetta</i>	N	<i>Apus apus</i>	M/O
<i>Casmerodius albus</i>	M/O	<i>Apus pallidus</i>	M/O
<i>Ardea cinerea</i>	M/O	<i>Apus melba</i>	M/O
<i>Ardea purpurea</i>	N; M/O	<i>Alcedo atthis</i>	M
<i>Plegadis falcinellus</i>	M/O	<i>Riparia riparia</i>	M
<i>Platylela leucorodia</i>	M/O	<i>Hirundo rustica</i>	N
<i>Phoenicopus roseus</i>	N	<i>Delichon urbica</i>	N
<i>Anas penelope</i>	M/O	<i>Anthus pratensis</i>	M
<i>Anas strepera</i>	N	<i>Anthus spinoletta</i>	M
<i>Anas crecca</i>	M	<i>Motacilla flava</i>	M
<i>Anas platyrhynchos</i>	N	<i>Motacilla cinerea</i>	M
<i>Anas acuta</i>	M/O	<i>Motacilla alba</i>	M
<i>Anas querquedula</i>	M/O	<i>Erythacus rubecula</i>	M
<i>Anas clypeata</i>	N PROB	<i>Luscinia megarhynchos</i>	M
<i>Nettion rufina</i>	N	<i>Luscinia svecica</i>	M
<i>Aythya ferina</i>	N	<i>Phoenicurus ochruros</i>	M
<i>Aythya nyroca</i>	N; M/O	<i>Saxicola torquata</i>	N
<i>Aythya fuligula</i>	M/O	<i>Oenanthe oenanthe</i>	M
<i>Circus aeruginosus</i>	N; M/O	<i>Turdus merula</i>	M
<i>Buteo buteo</i>	M/O	<i>Turdus philomelos</i>	N
<i>Pandion haliaetus</i>	M/O	<i>Cettia cetti</i>	N
<i>Rallus aquaticus</i>	N PROB	<i>Cisticola juncidis</i>	N
<i>Porzana porzana</i>	M/O	<i>Locustella luscinolides</i>	M/O
<i>Gallinula chloropus</i>	N	<i>Acrocephalus melanopogon</i>	M
<i>Porphyrio porphyrio</i>	N	<i>Acrocephalus scirpaceus</i>	M
<i>Fulica atra</i>	N	<i>Acrocephalus schoenobaenus</i>	N
<i>Himantopus himantopus</i>	N	<i>Acrocephalus arundinaceus</i>	M
<i>Recurvirostra avosetta</i>	N; M/O	<i>Sylvia cantillans</i>	M/O
<i>Glareola pratensis</i>	M/O	<i>Sylvia melanocephala</i>	N
<i>Charadrius dubius</i>	N; M/O	<i>Sylvia atricapilla</i>	N; M/O
<i>Calidris minuta</i>	M/O	<i>Phylloscopus collybita</i>	M
<i>Calidris ferruginea</i>	M/O	<i>Phylloscopus trochilus</i>	M
<i>Calidris alpina</i>	M/O	<i>Remiz pendulinus</i>	M
<i>Philomachus pugnax</i>	M/O	<i>Corvus corone</i>	N
<i>Gallinago gallinago</i>	M/O	<i>Sturnus vulgaris</i>	M
<i>Limosa limosa</i>	M	<i>Sturnus unicolor</i>	N
<i>Tringa erythropus</i>	M/O	<i>Passer hispaniolensis</i>	N
<i>Tringa totanus</i>	M/O	<i>Passer montanus</i>	N
<i>Tringa nebularia</i>	M	<i>Serinus serinus</i>	N
<i>Tringa ochropus</i>	M/O	<i>Carduelis chloris</i>	N
<i>Tringa glareola</i>	M/O	<i>Emberiza schoeniclus</i>	M

Fish fauna

The periodically fish campaigns realized in the ESF reveal a consistent population of *Cyprinus carpio*, widespread in all the ESF basins.

Herpetofauna

The Check-list of Amphibians and Reptiles includes 13 different species. In particular in the ESF has been determined the presence of *Hyla sarda*, *Bufo balearicus*, *Hemorrohis hippocrepis* e *Emys orbicularis* (Annex II, IV, Directive 92/43/CEE).

Insect fauna

About the insects, the check list includes 302 species belonging to 7 Orders. In the ESF 18 species of Odonata were determined, while different species of Coleoptera Carabidae, belonging to the Cicindelinae and Chrysomelidae subfamily, are present: *Cephalota circumdata imperialis*, *Cephalota litorea goudoti*, *Cryptocephalus curvilinea*.

The Orthoptera species, related to the halophile vegetation, include a Sardinian endemism: the *Heteracris adpersa massai*. It is also important to remember, among the Heteroptera species, the presence of a characteristic pentatomidae, the *Brachynema cinctum*.

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