

GHADIRA S-SAFRA (MALTA) : A THREATENED COASTAL WETLAND WITH AN ENDANGERED BIOTA

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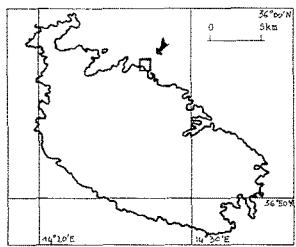
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FLORA RICHNESS AND ENDEMISM IN CROATIAN ADRIATIC ISLANDS

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Saline marshlands are very scarce in the Maltese Islands (SCHEMBRI *et al.*, 1987; ANDERSON & SCHEMBRI, 1989). Several have been obliterated by human activity and only five such sites are still extant, although under constant threat (SCHEMBRI & LANFRANCO, 1993).



Island of Malta indicating location of Ghadira s-Safra

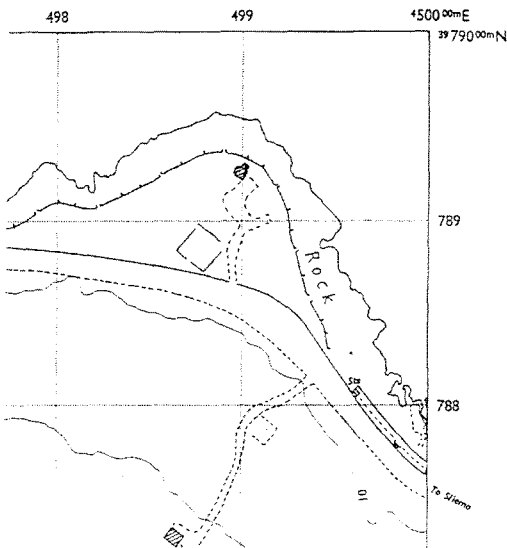
The environment of such habitats restricts colonisation to a highly specialised flora and fauna. Although many species are common to all marshlands in the Maltese Islands, each site has its own habitat characteristics and species assemblage (SCHEMBRI, 1991). The present study evaluates the ecological significance of a representative marshland and highlights the anthropogenic pressures to which it is subjected. Ghadira s-Safra is a seasonally flooded marshland of area 0.8 ha, and generally located less than 1 m above mean sea level on the northeastern coast of Malta, in the Maghtab-Ghallis area (Fig.1). The site outcrops on the Xlendi Member of the Lower Coralline Limestone Bed which is of Oligocene age. The substratum consists of a fine reddish soil underlain by a thin layer of alluvial clay which enables the marsh to retain water. In most years, the marsh contains water during the wet season (September/October to March/April) and is completely desiccated throughout summer. During the course of a typical wet season, Ghadira s-Safra undergoes several cycles of alternate wetting and drying since the large surface area and shallow depth of the water promote high rates of evapotranspiration which are sufficient to cause drying between successive flooding episodes. The marsh supports a biota of mixed character. The permanent community mainly comprises terrestrial halophilic macrophytes while the temporary community is typical of ephemeral fresh and brackish water habitats and is only present when the marsh contains water. A number of species inhabiting the marsh are of local or regional ecological significance :

- 1. *Triops cancriformis* (Bosc), (Crustacea: Branchiopoda: Notostraca). Ghadira s-Safra is one of the few localities where this locally rare species has been recorded in recent years.
- 2. *Branchipus visnyai* Kertész, (Crustacea: Branchiopoda: Anostraca). Ghadira s-Safra is the only locality in Malta where this species has been recorded.
- 3. *Crypsis aculeata* (Tracheophyta: Magnoliopsida: Poaceae). Restricted to Ghadira s-Safra.
- 4. *Riella helicophylla* (Bryophyta: Hepaticae); a very rare and endangered liverwort. Listed in Appendix 1 of the Berne Convention as a "Species to be Strictly Protected".

Additionally, an unrecorded epizoic association involving *Branchipus schaefferi* Fischer (Anostraca) and *Lyngbya* sp. (Cyanobacteria) has been observed at Ghadira s-Safra.

The marsh is subject to regular and severe anthropogenic disturbance. The site is easily accessible and is a popular recreational area with holidaymakers. Encroachment by vehicles is frequent and results in regular disruption of the upper layers of sediment. This favours the proliferation of weed species in preference to slower-growing specialists and may also damage the resting stages of organisms present during the aquatic phase. Frequent bonfires contribute to such disturbance. Although the species assemblage present would qualify Ghadira s-Safra for strict protection under current environmental and planning legislation, no concrete measures for its conservation have as yet been taken.

Vicinity of Ghadira s-Safra (side of square = 100 m)



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Besides the Greek islands, Croatian Archipelago in Dalmatia and Kvarner Gulf of Adriatic is the most dissected one by Mediterranean and European coasts. It has 1233 islands and islets covering together 4380 km² i.e. 98% of all Adriatic islands, the rest being some minute islets by eastern Italy, Yugoslav Montenegro and Albania. Among them 413 are low skerry reefs without plants or with some halophytes only. The total island flora of this archipelago includes more than 2700 taxa. So far one studied the vascular floras in nearly 300 islands, and in 45 islands the floral lists are well completed and treated in actual analysis. The richest floras grow in the largest Krk (1473 taxa) and Hvar (1163 taxa), and the prospected minute reefs included 2-45 taxa.

Following the Linear Correlation analysis of vascular floras and physical geographic parameters in studied islands (cf. table), the next partial correlations emerged. Vascular floral richness is significantly correlated with the island peak heights (R = 0.82), with the island area sizes (R = 0.80) and with the area/island length ratio (R = 0.85). The logistic (asymptotical) model could be better than linear model in the cases of island area and area/length ratio as independent variables, and it will be tested on a larger sample. There is no correlation with main sea depths, mainland distances and geographical latitudes.

The Multiple Correlation Analysis, including the vascular floras richness as dependent variable and main sea depth, island height, island area, area/length ratio, mainland distances and northward latitudes as independent variables, gave R = 0.88 with the island height and area/length ratio as the significant estimators.

After the similar analyses of the vascular endemism in the same islands, it presented no significant correlations with any of these physical parameters. Croatian Archipelago includes 68 exclusive insular endemics, but they are concentrated in 28 islands and chiefly in 3 local groups of the Senj, Vis and Elafiti archipelagoes. The most i.e. 17 endemics occur in the Prvic island, some also in Vis, Krk, Jabuka, Palagruza, Goli, Jakljan, etc. It is remarkable there are only few local stenoendemics of one island, mostly in Prvic and Jabuka, being the neoendemics from the postglacial island submersion and subsequent speciation.

The most of other insular endemics are the island group endemics of main island and adjacent islets or of linear islands series. They may be treated as the earlier mountain paleoendemics in Tertiary Adriatic plate, by the submersion then transformed into this archipelago with its endemics. The additional 129 subendemics of Croatian Archipelago, with their isolated sites also in Istra and Gargano peninsulas or in other minor promontories but absent elsewhere landwards, confirm the hypothesis of preinsular evolution of many Adriatic endemics. Thus the paleogeographical and paleoclimatic processes may be more decisive in these endemics, than the actual Adriatic geography.

ISLAND	A	B	D	E
Cres	903	0	648	404
Unije	596	0	138	37
Losinj	938	0	589	75
Plavnik	279	0	194	9
Kormat	29	0	6	1
Galun	45	0	10	0.4
Biskup	31	1	21	0.1
Krk	1473	6	569	410
St. Marko	169	1	102	1
St. Marin	35	0	7	0.1
Zec	24	1	13	0.2
Lisac	67	2	26	0.1
Prvic	351	17	363	15
Goli	308	4	226	5
St. Grgur	198	1	231	7
Rab	782	1	408	91
Pag	651	0	348	285
Silba	232	1	80	15
Molat	444	0	142	23
Dugi	605	1	338	114
Kornat	303	2	235	33
Drivenik	410	0	177	15
Solta	299	0	237	52
Brac	773	1	778	359
Hvar	1163	0	626	299
Jabuka	36	5	117	0.1
Svetac	419	4	305	4
Brusnik	38	1	43	0.1
Bisevo	398	1	240	6
Vis	535	6	587	90
Palagruza	245	5	105	1
Susac	255	1	243	4
Kopiste	127	0	93	1
Lastovo	737	0	417	47
Korcula	978	0	568	276
Mljet	667	0	514	101
Peljesac	862	1	963	348
Olipa	44	1	211	2
Jakljan	148	4	225	5
Sipan	618	3	243	16
Lopud	560	3	226	5
Koločep	488	2	125	3
Lokrum	400	1	91	1
Mrkran	179	1	46	1
Bobara	86	1	45	0.3

The sample of Adriatic islands and correlations with geographical parameters.

- Legend :
- A = vascular flora (24-1473 sp)
 - B = endemism (0-17 sp)
 - D = main peak (6-963 m)
 - E = island area (0,1-410 sqkm)