

Model for the Distribution of Submerged Vegetation in a Gradient of Coastal Marsh. Albufera of Majorca (Balearic Islands)

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On the basis of the dynamics of physico-chemical variables of water outcropping in the Albufera and the environmental tolerances of submersed macrophytes, the most probable composition of submersed vegetation of rehabilitated lagoons in the silted coastal marsh is predicted.

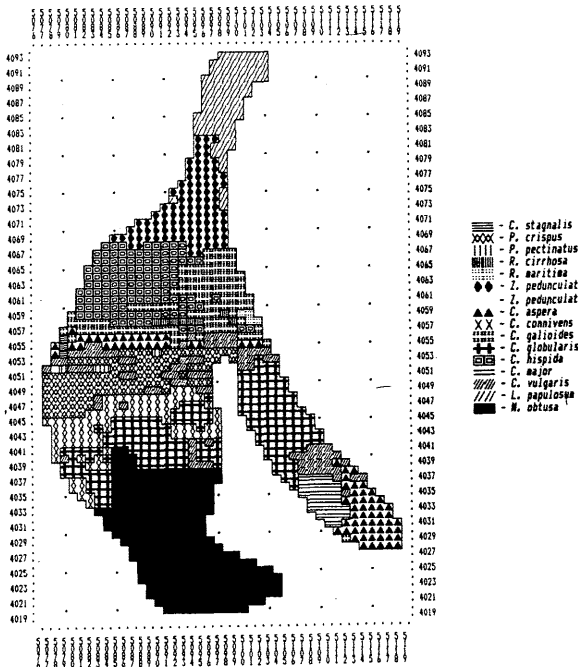
After dividing the Albufera into 10000 m² squares we plotted the seasonal distribution of values for variables of the environment over the digital cartography. These values include all the squares of the margins of the Albufera and the values of the isolines among sample stations. The values Z of empty slots among squares with values are a function of the variable Z in the closest 4 slots, as an extension of the UTM axes, and their distance in relation to the problem slot are extrapolated. The Z values in the problem slot p would be as follows:

$$Z_p = \frac{(Z_a/Y_a - Y_p) + (Z_b/(X_b - X_p) + (Z_c/Y_p - Y_c) + (Z_d/X_p - X_d)}{(1/Y_a - Y_p) + (1/X_b - X_p) + (1/Y_p - Y_c) + (1/X_p - X_d)}$$

Zi: value of the parameter Z for each slot.
 Xi, Yi: values of co-ordinates for each slot.

These extrapolations have been applied to NO₂+NO₃, PO₄ and conductivity, which correspond to the most important loading factors derived from the principal components analysis of the system, and for each season during two years. As a consequence we obtain the margins and range of variation for each variable within each square.

The second step consists of the introduction of the data referring to the margins and range of environmental tolerance of submersed macrophytes for the parameters previously used.



From the information of slots and tolerances we calculated the overlap between the degree of variation of each square and the tolerance of each species by means of a procedure of iterative integration which applies the Jaccard index modified for quantitative data (MARTINEZ-TABERNER, 1983). This index has a range of variation between 0 and 1 which allows its treatment as a value of the probability of occurrence of each species in each of the geographical squares.

The probability of occurrence of specie x within square y is a function of all parameters used. For this purpose the following open expression is calculated:

$$P_{x,y} = \sqrt{S_1 \times S_2 \times \dots \times S_n}$$

S is the probability of species x within square y for the parameter i. P is a total probability and Si represents partial probabilities of each variable used.

Finally, species are arranged from highest to lowest probability, and an inventory of potential vegetation for each square is produced.

References:
 MARTINEZ-TABERNER, A. (1983). *Boll. Soc. Hist. Nat. Bal.* 27,23-32.

An Ecological View of a Littoral Zone in a Gulf in West Greece

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The studied area from ecological point of view can be divided into: the coastal lagoons, the marsh regions with salt plains and the mouths of the rivers (Lourous and Arachthos). Most of the lagoons are being located at the delta area and their boundaries fluctuate depending on climate and hydrological conditions. Their functions are like a natural fishery and can be classified from nutrition point of view as oligomesotrophic. Their fauna and flora are typical for brackish water. This lagoon system is one of the largest in the Mediterranean region.

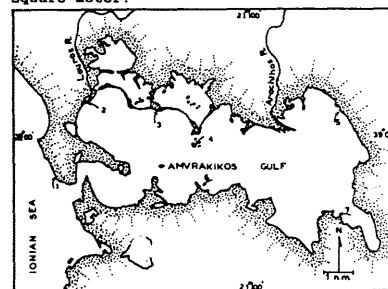
The delta area under investigation is located at the Amvrakikos Gulf (20°44' -21°07' E and 38°59' -39°11' B). This Gulf represents the major Gulf along the West Greek coast (Fig. 1). It is an almost enclosed embayment with a surface of 385 Km² and a maximum depth of 60m. The whole delta coastal region covers an area of about 450 Km². The delta forming rivers of Lourous and Arachthos differ with respect to their hydrology and kind of drifts

According to recent information dealing with the studied area Lourous and Arachthos rivers are the main contributors of water from a great run-off basin of 4.400 Km². The delta area which is bounded by the two rivers, the extended wetlands between them, as well as the lagoon system with their coastal ridges, cover an area of 450 Km².

Most of the lagoons are located at the delta zone and their boundaries fluctuate, depending mainly on climatic and hydrological conditions. The total surface area and mean depth of all lagoons is about 64 Km² and 1 meter respectively. The bottom of the lagoons is composed of decomposing mud where anaerobic processes occur, typical of natural conditions. The main aquatic vegetation, which covers part of the bottom, consists with *Zostera noltii* Horneman and *Ruppia maritima* Linne-Salinity fluctuates from mesohaline to polyhaline level and pH is weak alkaline (pH=8.8). Their typical functions are like a natural fishing ground, while with respect to water quality and from nutrition point of view, they can be classified as mesotrophic.

The coastal lagoon system are protected from the sea by coastal bars ridges that consist mostly of coastal sands (shells, detritus, sludge and other organic materials). In the early summertime some areas dry out and are covered with the green alga *Valoniopsis utricularis* (Roth) Agarch, forming balls. Late in summer *Salicornia europea* Linne and other halophytes colonize the area.

Along the littoral zone of the sea coast, sea grass meadows cover in patches the area. Here predominate *Cymodocea nodosa* (Ucria) Aschers. and *Zostera noltii*. Most of them are degraded by the grazing activities of sea urchins, mainly *Paracentrotus lividus* Lam. and *Psammechinus* sp. The abundance of these species are rather high in most areas (except in areas close to the proximity of the river estuaries), as high as 20 individuals per square meter.



Marsh regions have an extensive reed belt with an area of 31 Km² and with a rich diversified fauna (fish, insects, birds). The major reed belt area on the Lourous can be characterized as one of the largest coherent belt of *Phragmites australis* (Cav.) Trin in Greece. The extended zone of *Phragmites australis* is located in certain locations of Lourous and the lagoons,

with stands mainly consisted of *Scheuchzeria palustris* L., while in locations with strong wave activity *Typha angustifolia* Ch. and B., *Bolboschoenus maritimus* Palla and *Iris pseudacorus* Linne, occur.

The two rivers discharging to the delta area differ both in morphology flora and fauna. This is primarily due to their different water hydrological characteristics.

The slower continuously flowing Lourous river, with an average annual flow rate of 19.4 m³/sec, spillover the banks fine sediments that have led to highly oxygenated and nutritive riverside soils. Vegetation communities predominantly reed belts (*Phragmites australis*, *Iris pseudacorus* etc.), have been developed in clearly zoned regions of great extension and the aquatic fauna is characterized by a high diversity. Green algae (*Cladophora* spp and *Enteromorpha* spp) and the red alga *Thorea ramosissima* Bory are encountered in the area of the river mouth. The water moss *Salvinia natans* is found in higher region of the river. The benthic or epiphytic fauna of the Lourous river composed of gastropods, crustacea and larval stages of odonata, diptera and trichoptera.

Arachthos river has a peculiar hydrological regime. It depends on the water that the dam of Public Power Corporation releases regulating thus the flow of the river.

The diversity of the flora and fauna is very low. Around the mouth area the sea grass *Cymodocea nodosa*, the red alga *Laurencia* sp and blue green alga (*Phormidium* sp, etc) are found. Along its banks in rare stands the *Phragmites australis* grows up, while in salt plains stands of *Juncus* spp are found.

Further upstream odonata *Ishnura elegans*, hemiptera (*Corixa* sp) and the gastropoda *Theodoxus fluviatilis*, *Valvata piscinalis*, *Limnaea stagnalis*, etc dominate.

Finally the potential resources of the delta areas are severely altered by various anthropogenic and or natural disturbances.