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Global Model for Nutrient Flux and Biomass Production in the Albufera of Valencia, Spain

E. VICENTE, M.-R. MIRACLE and J.-M. SORIA

Ecologia, Facultad Ciencias Biologicas, Universitat de Valencia, Burjassot (Spain)

The Albufera of Valencia is an hypertrophic lagoon of 26 km² surface and mean depth 1.1 m. It constitutes the center of a Natural Park composed by this lagoon and the surrounding marsh land, dedicated almost completely to rice fields. Miracle et al (1986, 1988) emphasize the heavy eutrophication impact suffered by this lagoon in recent years. The present paper gives the global model of functioning of the Albufera in respect to the total nutrient input and the consequent biomass production which will be discharged in part to the sea, but in another and more important part to its own sediments. This study compiles results of seasonal measurements made in the 36 most important inflowing channels, the three outflowing channels and inside the Albufera during the year 1988. Parameters measured were the rate of inflow or outflow in the channels, and nutrient and chlorophyll contents in all sampling points (phytoplankton cells were also counted and identified). Primary production was also evaluated by ^{14}C experiments.

Results and discussion

The annual inputs of nutrients in Albufera of Valencia are extremely high (table 1). The inflow of sewage water registered in table 1 was calculated measuring the P concentration in the sewage discharge at their exit from the surrounding villages and estimating the proportion of sewage in the mouth of the channels from their P content. The concentration of nutrients in Albufera water is very low, as well as the inorganic nutrient output. Inorganic N and P outputs are respectively 10 and 50 times less than their corresponding inputs. The entrance of particulate P is mainly due to organic matter, while the outflow is mainly constituted by phytoplankton biomass.

Table 1. Albufera of Valencia. Global nutrient flux and pollution.

	N-ammonia	N-nitrate+nitrite	N-org	O - P	P - P	Sewage
INFLOW CHANNELS						
T/y	1907.9	2076.9	4335.1	371.8	619.3	Hm^3 /y 78.6
$g/m^2.y$	74.3	80.8	168.7	14.5	24.1	$m^3/m^2.y$ 3.1
						28 % total water inflow
OUTFLOW CHANNELS						
T/y	178.8	191.8	1470.0	8.7	210.0	
$g/m^2.y$	7.0	7.5	57.2	0.3	8.2	

Figure 1 shows the functioning of Albufera of Valencia based on a phosphorous balance. Phosphorous enters in the Albufera in soluble inorganic form or as particles of organic matter with a low proportion of algal cells, and it goes out of the Albufera mainly in the form of phytoplankton biomass. Experiments in aquaria using Albufera water and mud, demonstrated that added dissolved phosphorus remains in the water and the rate of deposition in the sediments is extremely low. Nevertheless particulate phosphorus may be deposited in the sediment as not recycled organic matter.

On the other hand, 100 times more biomass goes out of the system than enters in it. This is because the lagoon acts as a continuous culture; primary production in the lagoon was evaluated to be 40,000 Tons of C/year. In the lake it is produced five times more biomass than it is outflowed. It is assumed that phosphorous used in primary production comes in equal parts from the external input and from the recycling of the decomposition of previous phytoplanktonic production. From this assumption and considering the relationship P/biomass = 1/500, it is estimated that the phytoplankton uses about half of the total P input (which was around 1,000 Tons/year). If soluble inorganic P is maintained in the water, then about 500 Tons of the alloctonous particulate P must have gone that year to the sediment altogether with 300 Tons of the particulate P of the 150,000 Tons of autochthonous not recycled primary production. Summarizing, half of the primary production is recycled and reincorporated again to enhance new production, while the other half is exported: 20 % to the sea and 30 % to the sediment. Primary production is low when compared with P input and the standing stock of algal biomass in the lake. The system is limited by light and production is around 2 g C/m³.h (corresponding to 4 mg C/mg chlorophyll) restricted to a thin surface layer, being negligible in the rest of the water profile. Thus, daily primary production is around 4 g C/m².

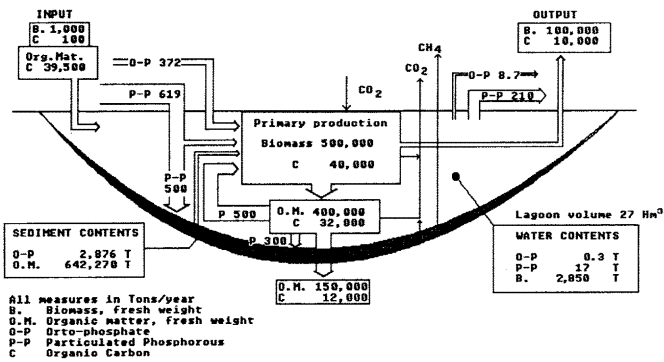

Figure 1. Functioning model of the Albufera.
Double lined arrows and numbers correspond to the estimated values of P circulation; single lines to C not quantified circulations.

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