Rice field flora and vegetation in the provinces of Valencia and Tarragona

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Abstract

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Twenty nine emergent and twenty floating or submerged taxa, were found in the rice fields in Valencia and Tarragona provinces. Eleven of these taxa, all them emergent, are alien or introduced ones. *Echinochloa oryzoides* and *E. oryzicola* are the most important in both areas, together with *Cyperus difformis* and *Echinochloa hispidula* in Valencia. The remaining thirty eight taxa belong to the native flora. There are predominantly the emergent *Scirpus maritimus, Alisma plantago-aquatica, Echinochloa crus-galli* and *Paspalum distichum;* the floating *Lemna minor* and *L. gibba;* the submersed *Potamogeton nodosus; Zannichellia palustris* and *Najas minor;* and the macroscopical algae *Chara vulgaris, Cladophora glomerata, Oedogonium capilliforme, Spirogyra* spp., *Pithophora oedogonia* and *Hydrodictyon reticulatum.* The flora evolution during the last years is analyzed and the present weed communities are studied. The contribution of the different phytosociological classes to the rice field weed flora is presented.

Keywords: flora, vegetation, rice fields, Spain.

Resumen

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De los 49 táxones registrados (29 emergentes y 20 flotantes o sumergidos) 11 son exóticos introducidos, de los cuales los más importantes son *Echinochloa oryzoides* y *E. oryzicola* en ambas zonas, además de *Cyperus difformis* y *Echinochloa hispidula* en Valencia, y el resto propios de la flora autóctona, predominando *Scirpus maritimus, Alisma plantago-aquatica, Echinochloa crus-galli* y *Paspalum distichum* como emergentes, *Lemna minor* y *L. gibba* como flotantes, *Potamogeton nodosus, Zannichellia palustris* y *Najas minor* como sumergidos y *Chara vulgaris, Cladophora glomerata, Oedogonium capilliforme, Spirogyra* spp., *Pithophora oedogonia* e *Hydrodictyon reticulatum* como algas macroscópicas. Se analiza la evolución experimentada por la flora en los últimos años, además de estudiar las comunidades vegetales presentes y de indicar la importancia de las distintas clases fitosociológicas en su contribución a la flora arvense del cultivo.

Palabras clave: flora, vegetación, arrozales, España.

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INTRODUCTION

Practically everything published on invasive plants in the rice fields of the provinces of Valencia (zona of La Albufera) and Tarragona (Ebro delta) refers to a few floristic observations (BORJA, 1950; BALADA & al., 1977; FERRER & COMÍN, 1979; BALADA, 1981; MARGALEF MIR, 1981; CARRETERO, 1982; BOLÒS & VIGO, 1984; BOIRA & CARRETERO, 1985), to monographs on the *Echinochloa* and *Ammannia* genera (CARRETERO, 1981 and 1983), or to the description of the main weeds (BATALLA, 1970 and 1975). No attention is paid to distribution.

The study of rice field vegetation along the Mediterranean coast of Spain carried out by BOLÒS & MASCLANS (1955) comprises eleven inventories, only three of which correspond to the Ebro delta (and growth after harvesting) and none to Valencia. My doctoral thesis (CARRETERO, 1972) on the rice growing zone of La Albufera is still unpublished.

It was the fragmentary nature of knowledge about rice field flora and vegetation in the provinces of Valencia and Tarragona that led us to undertake this research, which seeks to make a more detailed study of the distribution, abundance and evolution of the weed flora and plant communities present.

The authors of the names of the cormophytes mentioned are taken from Flora Europaea, except *Ammannia robusta* Heer & Regel, *Echinochloa hispidula* (Retz.) Nees ex Royle and *Echinochloa oryzicola* (Vasing.) Vasing. The names of algae are taken from the studies by VASCONCELLOS (1956), BOURRELLY (1966) and BOIRA & CARRETERO (1985).

ECOLOGICAL CONSIDERATIONS

The areas with which this study is concerned constitute, together with the Guadalquivir marshes (Seville), the foremost rice growing zones in Spain. Rice is also grown in Calasparra (Murcia) and various parts of the provinces of Badajoz, Huesca and Girona, but on a much smaller scale.

Both the Ebro delta and the zone around La Albufera have a thermo-mediterranean bioclimate, with somewhat higher temperatures in Valencia on account of its more southernly location. They form part of the climax area of *Querco-Lentiscetum* Br.-Bl. & col. 1935 em. A. & O. Bolòs 1950 of the *Oleo-Ceratonion* Br.-Bl. 1936 em. Rivas-Martínez 1975 alliance.

The rice fields are flooded throughout their cycle, except for about one week in July (know as the *aixugó* or "drying out") and just before harvesting.

Analysis of ten samples taken from each of the rice growing zones dealt with in this study reveals that the soil generally has a texture in which lime and/or clay are predominant, though some soils are sandy (including Sant Carles – Poble Nou and the eastern part of Els Muntells in Tarragona, and El Saler and El Palmar in Valencia). The pH is basic (7,60-8,20). The limestone content (total 10-55, active 1,25-15,50, expressed in percentages of CO_3Ca) and proportion of organic material (1,20-4,75 %) are usually high. The proportion of sulphates is generally low (0,06-0,35 % of SO_4Ca), though in some places it is higher (0,75 % 2 km, north of Poble Nou). The salinity ranges from negligeable to moderate in the La Albufera zone (conductivity 1,25-5,20 mmhos/cm, and SAR 0,50-5,05, both in saturation extract) and from low to moderate in the Ebro delta (cond. 2,25-5,40 mmhos/cm, and SAR 0,90-4,90). The samples we took showed some plots to be more saline: north of Poble Nou in Tarragona, and north east of Sollana and in El Saler (Luis Vives Parador and towards Pinedo) in Valencia.

The fifteen water samples analyzed in each province produced a slightly basic pH (7 to 8) and a low to moderate concentration in sulphates (traces to 0,60 g/l of $SO_4^=$). There is usually some salinity (conductivity between 0,60 and 2,30 mmhos/cm) and little chlorine (0,03-0,20 gr/l de Cl^-), though in some cases the values are higher. Thus to the north of Poble Nou a

conductivity of 4,5 mmhos/cm and a Cl^- concentration of 1,25 g/l were measured, while in El Saler, opposite the Parador Luis Vives, the values were 5 and 1,0 respectively.

I observed hardly any clear repercussions on the distribution of the main species present as a result of these variations in the soils and water analysed.

As for agricultural techniques, transplanting has mostly fallen into disuse and direct sowing takes place at the beginning of May. The *aixugó* last seven to ten days in July and the harvest is at the end of September. Herbicides are in general use, the main products being molinato (applied before the seedlings come up), or propanil (applied at the beginning of the cycle on seedlings with two to four leaves against *Echinochloa* spp.) and bentazon (during the *aixugó* mainly against *Alisma plantago-aquatica* and *Cyperaceae*). Hand weeding is also frequent and crops are very often treated with algicides a few days after sowing.

FLORA

The study was conducted during the summer of 1984. In order to determine the distribution and abundance of the weeds, I selected a hundred weed-ridden fields in each of the two provinces studied for emergent as well as floating and submerged flora. These fields were scattered throughout both the rice-growing areas. In each site an inventory of an area of 100 m^2 was compiled; the species present were listed and the number of 1 m^2 squares in which each species was found was specified.

Tables 1 and 2 show the presence (number of inventories in which the species is present), the degree of presence or constancy (proportion of inventories where the species grows: R < 5 %, I = 5 – 20 %, II 21 – 40 %, III = 41 – 60 %, IV = 61 – 80 %, V = 81 – 100 %), overall frequency (percentage of 1 m^2 squares in which the species is present out of all the squares in all the inventories) and partial frequency (percentage of squares in which the species is present out of all the squares belonging to those inventories containing the species).

Emergent flora

The sample was taken between mid-July and the end of August, when all the species (especially those belonging to the *Echinochloa* genus) had flowered and identification posed no problems.

In Table 1 we see a list of 28 taxa for the La Albufera zone and 22 for the Ebro delta. By eliminating those with a very low degree of presence (R), one obtains 16 and 10 species respectively. Though the rice fields of Valencia contain more species, the floristic composition of the emergent vegetation is similar in the two zones.

In the rice fields of La Albufera, the main weeds in decreasing order of overall frequency with a score over 8 % are: *Alisma plantago-aquatica, Scirpus maritimus, Echinochloa oryzoides, Cyperus difformis, Echinochloa hispidula, Paspalum distichum, Echinochloa oryzicola* and *Echinochloa crus-galli.* In the Ebro delta they are: *Echinochloa oryzicola, Echinochloa oryzoides, Scirpus maritimus, Paspalum distichum* and *Echinochloa crus-galli.* The most significant differences are the low frequency of *Alisma plantago-aquatica, Cyperus difformis* and *Echinochloa hispidula* in the province of Tarragona and the lesser importance of *Echinochloa oryzicola* and *Echinochloa oryzoides* in Valencia.

Species with lower constancy (< 25 %) and low overall frequency (< 8 %), *Typha angustifolia* (including subsp. *australis*), *Bergia capensis, Ammannia robusta, Scirpus supinus, Scirpus mucronatus, Ammannia coccinea* and *Lindernia dubia* are more plentiful in the La Albufera area than in the Ebro delta.

Though presence and frequency values may vary from year to year, according to enviromental conditions and the effectiveness of herbicides, the figures in Table 1 provide a good

Table 1. — Emergent rice field flora in the provinces of Valencia (V) and Tarragona (T). n = 100

Characteristic species	Presence (constancy) (V)	(T)	Degree of presence (V)	(T)	Overall frequency (V)	(T)	Partial frequency (V)	(T)
Echinochloa oryzoides	54	68	III	IV	20'60	38'00	38'15	55'88
Echinochloa oryzicola	32	84	II	V	11'21	55'21	35'03	65'73
Cyperus difformis	47	6	III	I	20'32	2'15	43'23	35'83
Echinochloa hispidula	46	2	III	R	18'48	0'20	40'17	10'00
Bergia capensis	23	3	II	R	6'33	0'41	27'52	13'67
Ammannia robusta	20	4	I	R	4'79	0'22	23'95	5'50
Ammannia coccinea	13	2	I	R	2'38	0'12	18'31	6'00
Lindernia dubia	10	1	I	R	1'00	0'03	10'00	3'00
Ammannia aegyptiaca	1	—	R	—	0'08	—	8'00	—
Phragmitetea								
Scirpus maritimus	64	62	IV	IV	28'91	30'05	45'17	48'47
Alisma plantago-aquatica	66	22	IV	II	31'82	6'23	48'21	28'32
Typha angustifolia	23	10	II	I	6'70	2'82	29'13	28'20
Scirpus mucronatus	17	6	I	I	3'89	0'84	22'88	14'00
Phragmites australis	2	7	R	I	0'08	0'62	4'00	8'86
Nasturtium officinale	2	2	R	R	0'08	0'09	4'00	4'50
Apium nodiflorum	2	1	R	R	0'09	0'02	4'50	2'00
Ludwigia uruguayensis	1	—	R	—	0'05	—	5'00	—
Eleocharis palustris	1	—	R	—	0'02	—	2'00	—
Veronica anagallis-aquatica	1	—	R	—	0'02	—	2'00	—
Bidentetea								
Echinochloa crus-galli(1)	39	32	II	II	11'12	8'37	28'51	26'16
Paspalum distichum(1)	34	29	II	II	11'30	9'31	33'23	32'10
Eclipta prostrata	6	2	I	R	0'36	0'04	6'00	2'00
Polypogon monspeliensis	3	1	R	R	0'06	0'03	2'00	3'00
Polygonum lapathifolium	1	—	R	—	0'04	—	4'00	—
Ranunculus sceleratus	—	1	—	R	—	0'02	—	2'0
Isoeto-Nanojuncetea								
Scirpus supinus	19	1	I	R	4'32	0'05	22'74	5'00
Cyperus fuscus	1	2	R	R	0,02	0'10	2'00	5'00
Plantaginetea								
Panicum repens	2	—	R	—	0'07	—	3'50	—
Rumex conglomeratus	1	—	R	—	0'03	—	3'00	—

(1) Could also be considered to belong to *Panico-Setarion* and *Plantaginetea* respectily.

picture of the distribution and abundance of emergent weeds in the rice fields of the provinces of Valencia and Tarragona. There may also be some variation according to the period of the rice cycle in which the sample is taken: for instance, the proportion of *Alisma plantago-aquatica* and *Scirpus maritimus* is usually greater before the fields are subjected to the *aixugó*.

Some species recorded in earlier studies, albeit on a very small scale, were not found in the rice fields on this occasion. These include *Ludwigia uruguayensis* (TORRES, 1968:1160) and *Cyperus serotinus, Samolus valerandi* and *Chenopodium glaucum* (BOLÒS & MASCLANS, 1955: 418-419, in already harvested fields) in the Ebro delta, and *Aster squamatus* and *Ranunculus sceleratus* (CARRETERO, 1972) in La Albufera.

Floating and submerged flora

The sample, much of which comes from different sites from the emergent flora, was taken between mid-June (well-developed floating and submerged vegetation) and mid-August (when in some fields the rice is not yet too thick).

Table 2. – Floating and submerged rice field flora in the provinces of Valencia (V) and Tarragona (T). n = 100

	Presence (constancy)		Degree of presence		Overall frequency		Partial frequency	
	(V)	(T)	(V)	(T)	(V)	(T)	(V)	(T)
Lemnetea								
Lemna minor	62	64	IV	IV	41'05	45'55	66'21	71'77
Lemna gibba	42	41	III	III	26'90	26'01	64'05	63'44
Potametea								
Potamogeton nodosus	35	30	II	II	13'38	10'50	38'23	35'00
Zannichellia palustris s.l.	29	25	II	II	16'00	12'63	55'17	50'52
Najas minor	7	44	I	III	2'35	25'62	33'57	58'23
Marsilea quadrifolia	1	–	R	–	0'12	–	12'00	–
Ceratophylletea								
Ceratophyllum demersum	3	12	R	I	0'82	7'58	27'33	63'17
Utricularietea								
Utricularia vulgaris	1	–	R	–	0'18	–	18'00	–
Charetea								
Chara vulgaris	33	52	II	III	13'82	36'65	41'89	70'48
Chara braunii	3	7	R	I	0'80	3'64	26'67	52'00
Chara globularis	2	–	R	–	0'25	–	12'50	–
Filamentous, reticular and laminarian algae								
Cladophora glomerata	36	42	II	III	14'58	16'52	40'50	39'33
Oedogonium capilliforme	31	41	II	III	11'42	15'77	36'84	38'46
Spirogyra spp.	18	26	I	II	3'80	5'33	21'11	20'50
Pithophora oedogonia	15	23	I	II	4'65	7'28	31'00	31'65
Hydrodictyon recticulatum	11	22	I	II	1'83	5'82	16'64	26'45
Enteromorpha intestinalis	4	5	R	I	0'62	0'80	15'50	16'00
Cladophora fracta	–	8	–	I	–	1'85	–	23'13
Zygnema sp.	–	3	–	R	–	0'50	–	16'67
Monostroma oxyococcus	1	–	R	–	0'06	–	6'00	–

Table 2 contains a list of eight vascular taxa and ten macroscopic algae for the province of Valencia and six and ten respectively for the province of Tarragona. Though the floristic composition is similar in the two rice growing zones, floating and submerged vegetation is more plentiful in the Ebro delta.

Predominant vascular plants, in decreasing order of overall frequency, are: *Lemna minor, Lemna gibba, Zannichellia palustris** and *Potamogeton nodosus* in the La Albufera zone, and the same species, but with *Najas minor* in third position, in the Ebro delta. Species not found in the samples but reported in the literature are *Marsilea quadrifolia* in Tarragona (BALADA, 1981: 6) and *Callitriche stagnalis* and *Ranunculus baudotii* in Valencia (CARRETERO, 1972).

Of the algae, *Cladophora glomerata, Chara vulgaris, Oedogonium capilliforme, Spirogyra* spp., *Pithophora oedogonia* and *Hydrodictyon reticulatum* are those with the greatest presence and frequency in both rice-growing zones. I have no references of any earlier report of *Chara braunii* in the Ebro delta: it was found in Sant Jaume, between Jesús i Maria and Amposta, in grid squares CF 00 and CF 01.

Evolution of the flora

Progress in agricultural techniques over the last few years, especially direct sowing and widespread use of herbicides, has led to certain changes in arvicolous flora in the rice fields in both zones under study. While the species present remain virtually unchanged, there have been substantial changes in the extent to which many are present.

Though most of the eleven inventories by BOLÒS & MASCLANS (1955) come from the provinces of Barcelona and Girona, and only three from the Ebro delta, they can be used to draw at least approximate comparisons with the present inventory, as far as emergent flora is concerned (Table 1). A sharp drop is observed in characteristic (exotic) species with broad leaves *(Ammannia coccinea, Bergia capensis* and *Lindernia dubia)* and in *Cyperus difformis.* In contrast, species belonging to *Echinochloa* have increased. The most striking changes in the accompanying taxa, are the decline of *Alisma plantago-aquatica* and the greater profusion of *Scirpus maritimus,* which is now one of the commonest weeds.

Comparison of the inventories drawn up in Valencia in 1970 and 1971 (CARRETERO, 1972) with those in Table 1, shows, that *Ammannia coccinea* and *Bergia capensis* have declined but less than in Tarragona. The presence of *Cyperus difformis* remains about the same. In the *Echinochloa* genus, *E. oryzoides* and *E. hispidula* are more plentiful, to the detriment of *E. oryzicola.* Among accompanying species, *Alisma plantago-aquatica* is as widespread as before while *Scirpus maritimus* and *Typha angustifolia* have increased considerably.

VEGETATION

Information provided by the sample taken for the study of the flora also served for the analysis of the vegetation, Braun-Blanquet's phytosociological methodology was followed.

Emergent vegetation

While awaiting the conclusions of a comparative study of rice field vegetation in Western Europe which is shortly to appear, we continue for the time being to consider that the emergent vegetation corresponds to the association *Cypero–Ammannietum coccineae* O. Bolòs & F. Masclans 1955.

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*Note: We have included in *Zannichiella palustris* another species of *Zannichiella, Z. peltata* and *Z. pendunculata* In fact, most of specimens studied must correspond to the two later.

Table 3. — Percentage of the sums of presences and overall frequencies of each phytosociological group

	% of the sum of presences				% of the sum of overall frecuencies			
	(V)	(T)	(V)	(T)	(V)	(T)	(V)	(T)
Emergent vegetation	(1)		(3)		(1)		(3)	
Oryzetea	46'33	48'85	28'44	21'44	46'26	62'18	24'57	25'62
Phragmitetea	33'71	31'61	20'69	13'87	38'91	26'25	20'66	10'82
Bidentetea	15'63	18'68	9'60	8'20	12'42	11'47	6'60	4'73
Isoeto-Nanojuncetea	3'77	0'86	2'31	0'38	2'36	0'10	1'25	0'04
Plantaginetea	0'56	—	0'35	—	0'05	—	0'03	—
Floating and sumerged vegetation	100	100	61'39	43'89	100	100	53'11	41'21
	(2)		(3)		(2)		(3)	
Lemnetea	31'14	23'60	12'02	13'24	41'78	32'37	19'59	19'03
Potametea	21'55	22'24	8'32	12'48	19'59	22'05	9'18	12'97
Ceratophylletea	0'90	2'70	0'35	1'51	0'50	3'43	0'24	2'02
Utricularietea	0'30	—	0'12	—	0'11	—	0'05	—
Charetea	11'38	13'26	4'39	7'44	15'29	18'23	7'17	10'71
Filamentous, reticular and laminarian algae	34'73	38'20	13'41	21'44	22'73	23'92	10'66	14'06
	100	100	38'61	56'11	100	100	46'89	58'79

(1) With respect to emergent vegetation.
(2) With respect to floating and submerged vegetation.
(3) With respect to all vegetation.

The characteristic taxa are exotic therophytes. Some are of American origin *(Ammannia coccinea, Ammannia robusta* and *Lindernia dubia)*, others of Asiatic origin *(Echinochloa oryzoides, E. oryzicola, E. hispidula* and *Cyperus difformis)* and still others are of Afro-Asiatic origin *(Bergia capensis* and *Ammannia aegyptiaca).* In our latitudes they reach optimum development in the aquatic biotope of ricefields. As can been seen in Table 3, these species constitute the largest and most widespread group of weeds in the rice fields of both zones, especially in Tarragona, where the presence and frequency of *Echinochloa oryzicola* and *E. oryzoides* are particularly marked.

The accompanying flora (except *Ludwigia uruguayensis* and *Eclipta prostrata,* whose presence is slight) is made up of autochtonous cormophytes found in flooded or muddy stations. The commonest plants in this group are the generally hardy *Phragmitetea* R. Tx. & Preising 1942, especially *Scirpus maritimus* and *Alisma plantago-aquatica.* The fact that the latter species is less frequent in Tarragona causes the percentage of overall frequency of the *Phragmitetea* class to be substantially lower in this province than in Valencia.

Of the other accompanying species (belonging to *Bidentetea tripartiti* R. Tx., Lohmeyer & Preising 1950, *Isoeto–Nanojuncetea* Br.-Bl. & R.Tx. 1943 or *Plantaginetea majoris* R. Tx. & Preising 1950), *Echinochloa crus-galli* and *Paspalum distichum* (and *Scirpus supinus* in Valencia) are the most frequently represented.

Floating and submerged vegetation

This consists mainly of autochtonous plants which invade the 10-30 cm of water covering the bottom part of the crop: cormophytes belonging to *Lemnetea, Potametea, Ceratophylletea,*

and, occasionally, *Utricularietea,* as well as talophytes belonging to *Charetea* and various communities of reticular or laminarian filamentous algae. The importance of each group (in terms of percentages of presence and overall frequency) is indicated in Table 3.

Since the submerged species characteristic of different syntaxa usually intermingle, it is impossible to decide to which plant community many of the species documented should be attributed. Nevertheless there are many which, on account of the great predominance of some of the taxa, can perfectly well be included in associations already described.

Table 4 (the degree of presence of the species is reflected much more clearly in Tables 1 and 2) has been compiled from those inventories which reveal the presence among floating and submerged vegetation of the following associations (in addition to the main emergent vegetation):

Lemnetum gibbae

Community of floating cormophytes (acropleustophyts of the aepipleon), very common throughout the Iberian Peninsula and plentiful in the rice fields of the two zones under study. *Lemna gibba* is found as a characteristic species, accompanied by *Lemna minor,* and its presence is accentuated by the fact that the aquatic medium in many of the fields is not too eutrophic.

Potametum denso–nodosi

Community of rooted cormophytes made up of magnopotamyds belonging to the genera *Potamogeton (P. nodosus, P. pectinatus, P. pusillus, P. cripsus), Groenlandia (G. densa)* and *Myriophyllum (M. spicatum* and *M. verticillatum).* Very widespread in irrigation channels in Catalonia and the Valencian Country.

In the rice fields of the provinces of Valencia and Tarragona this community is much impoverished, consisting only of *Potamogeton nodosus* which, though it sometimes manages to cover the entire surface of the water, is usually confined to small areas.

Parvopotamo – Zannichellietum tenuis

Vegetation belonging to *Zannichellia palustris* s.l. (an annual parvopotamyd cormophyte which roots in the sediment/silt), found in shallow alcaline, mineralized fresh or slightly salt waters and sometimes in polluted water.

It is plentiful in the rice fields of the zone under study, especially in the first phases of the crop cycle, when it forms a sometimes continuous blanket layer at the bottom of the water.

Najadetum minoris

Community made up of *Najas minor,* a species similar in appearance and behaviour to *Zannichellia palustris,* but less widespread in the Iberian Peninsula.

In the Valencian rice fields *Najas minor* is somewhat uncommon and is always accompanied by other plant groups. In the Ebro delta it is plentiful, forming sufficiently large masses to constitute a plant association.

Ceratophylletum demersi

Community of submerged un-rooted cormophytes (mesopleuston) consisting exclusively of *Ceratophyllum demersum* as a characteristic species, accompanied by taxa belonging to *Potametea.*

This association, which is pollution-resistant and is plentiful in irrigation ditches in rice growing areas, is uncommon inside rice fields, especially in the province of Valencia where it is extraordinarily fragmented.

Community of *Utricularia vulgaris*

Inventory No. 16 in Table 4, which was compiled between La Meta dels Sants and El Perelló (Sueca, Valencia), may be assimilated to the formations of *Utricularia vulgaris* (a

Table 4. – Plant associations in the rice fields of Valencia and Tarragona

Serial number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Área in m²	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% of coverage	100	100	100	100	100	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Oryza sativa	4.4	5.5	5.5	3.2	5.5	1.1	4.4	5.5	5.5	4.4	5.5	5.5	4.4	5.5	1.2	5.5	5.5	4.4	5.5	5.5	4.4	4.4	1.1	3.3
Cypero-Ammannietum coccineae																								
Characteristics:																								
Echinochloa oryzicola		2.1		1.1		1.1		1.1	1.2	2.2	1.1	2.1	2.2	1.1		1.2			1.1	1.1	1.1			
Echinochloa oryzoides		1.1	+						2.2	1.1	2.2	1.2	1.1	+		2.2		1.2	1.1		2.2	1.1		3.3
Echinochloa hispidula						1.1	1.1										1.1					1.2		
Cyperus difformis						1.1	1.1						1.1			1.1								
Bergia capensis							1.1													1.1				
Ammannia cocinea							1.1																	
Ammannia robusta													+											
Phragmitetea:																								
Scirpus maritimus	2.3			1.2	1.1			1.1	1.1	2.2	1.1			1.1			1.1	2.2			1.1	1.1		2.2
Alisma plantago-aquatica			1.1	1.1		2.1	1.1	1.1					1.1			1.1				1.1		1.1	1.1	1.1
Typha angustifolia	+					1.1			1.1															
Scirpus mucronatus							1.1																1.1	
Phragmites australis														+						+				
Other species																								
Paspalum distichum	+	1.1							1.1		1.1		1.1						+		1.1			
Echinochloa crus-galli			+							1.1	1.1		1.1				1.1		+					
Scirpus supinus																1.1							1.1	
Lemnetum gibbae																								
Lemna minor	2.3	4.4	2.3					2.3				3.3	4.4	2.3	2.2			2.2	2.3			1.2		1.2
Lemna gibba	3.3					1.2				3.3		3.3		4.4	3.3					+	2.2			
Potametum denso-nodosi																								
Potamogeton nodosus	1.2	+	2.3	3.3	3.3										1.2	1.2	1.2		+					1.2

Parvopotamo-Zannichellietum																						
Zannichellia palustris s.l.			1.2		4.3	3.3	3.4	3.3							2.2					2.3		
Najadetum minoris																						
Najas minor				1.2				2.2	3.3	4.4	4.4				1.2		1.2	1.2	1.2			2.2
Ceratophylletum demersi																						
Ceratophyllum demersum	1.2											4.4	3.3	5.5								
Community of																						
Utricularia vulgaris															2.2							
Charetum vulgaris																						
Chara vulgaris			1.2	2.3	1.1										2.2	3.3	4.4	4.4	4.4	3.3		1.2
Chara globularis															2.2							
Chara braunii																		2.2				
Filamentous algae																						
Cladophora glomerata	1.2	2.2					2.2				2.3		1.2					2.2	+	2.3	3.3	4.4
Oedogonium capilliforme							2.2	1.2			1.2	1.2	1.2		1.2				+	3.3	3.3	
Pithophora oedogonia							1.2			2.2			1.2						1.2		1.2	1.2
Spirogyra sp.				1.2			1.2								1.2				+			2.2
Hydrodictyon reticulatum	+									1.2											1.2	4.4
Enteromorpha intestinalis									2.3												1.2	
Cladophora fracta																				1.2		

LOCATIONS AND DATES

Valencia: 1. Mareny Blau-Sueca, 11-7-84; 3. Cullera-Favara, 7-8-84; 4. Cullera-M.ª dels Sants, 15-7-84; 6. Puerto de Silla, 19-6-84; 7. Cullera, 15-7-84; 15. Mareny Barraquetes, 20-8-84; 16. M.ª dels Sants-El Perelló, 7-8-84; 17. El Romaní, 8-8-84; 18. Sollana-Sueca, 10-8-84; 22. El Saler-Pinedo, 8-8-84; 23. Sollana, 19-6-84:

Tarragona: 2. El Muntells, 16-8-84; 5. Riomar, 17-8-84; 8. Poble Nou, 16-8-84; 9. Sant Carles, 16-8-84; 10. Poble Nou-Sant Jaume, 16-8-84; 11. Amposta, 17-8-84; 12. Sant Jaume, 16-8-84; 13. Sant Carles-Poble Nou, 16-8-84; 14. La Cava, 17-8-84; 19. Sant Jaume, 16-8-84; 20. Camarles-La Cava, 17-8-84; 21. La Cava, 17-8-84; 24. Sant Carles-Poble Nou, 16-8-84.

mesopleustophyte with trophic vesicles and emergent flowers) described by COSTA & al. (1986) in the bogs of Xeresa (Valencia) and Nules (Castellón).

Charetum vulgaris

In the rice fields of Valencia and Tarragona, this association made up of carophytes (specially *Chara vulgaris*) occupies an ecological slot similar to *Parvopotamo-Zannichellietum tenuis* and *Najadetum minoris* (totally submerged, little developed therophytic rooted vegetation) with which it frequently mingles. It is somewhat sensitive to water pollution.

Filamentous, reticular or laminarian algae

These usually constitute intermingled communities, the most representative of which in both areas is *Cladophoretum glomeratae* while *Hydrodictyetum reticulati* is fragmentary in Valencia but more widespread in Tarragona. In addition to the species from which these associations take their names, *Oedogonium capilliforme, Spirogyra* spp. p. and *Pithophora oedogonia* are also plentiful. At the beginning of the crop cycle, prior to the period when the samples were taken, *Rhyzoclonium hieroglyphicum* is found in some fields that are not treated with algicides. The *Vaucherietum* found in Italian rice fields (PIGNATTI, 1957; CIFERRI, 1960) can be observed, at least in Valencia, in fields that remain flooded after the rice is harvested.

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SYNTAXONOMIC OUTLINE

Cl. *Oryzetea sativae* Miyawaki 1960.
Ord. *Cypero-Echinochloetalia oryzoidis* O. Bolòs & Masclans 1955.
Al. *Oryzo-Echinochloion oryzoidis* O. Bolòs & Masclans 1955.
Ass. *Cypero-Ammannietum difformis* O. Bolòs & F. Masclans 1955.
Cl. *Lemnetea minoris* W. Koch & R. Tx. in R. Tx. 1955.
Ord. *Lemnetalia minoris* W. Koch & R. Tx. in R. Tx. 1955.
Al. *Lemnion gibbae* R. Tx. & Schwabe in R. Tx. 1974.
Ass. *Lemnetum gibbae* (W. Koch, 1954) Miyawaki & R. Tx. 1960.
Cl. *Potametea* R. Tx. & Preising 1942 em. Den Hartog & Segal 1964.
Ord. *Magnopotametalia* (W. Koch 1926) Den Hartog & Segal 1964.
Al. *Magnopotamion* (W. Koch 1926) Den Hartog & Segal 1964.
Ass. *Potametum denso–nodosi* O. Bolòs 1957.
Ord. *Parvopotametalia* Den Hartog & Segal 1964.
Al. *Parvopotamion* Vollmar 1947.
Ass. *Parvopotamo–Zannichellietum tenuis* W. Koch 1926.
Ass. *Najadetum minoris* Ubrizsy 1948.
Cl. *Ceratophylletea* Den Hartog & Segal 1964.
Ord. *Ceratophylletalia* Den Hartog & Segal 1964.
Al. *Ceratophyllion* Den Hartog & Segal 1964.
Ass. *Ceratophylletum demersi* (Hild 1956) Den Hartog & Segal 1964.
Cl. *Utricularietea intermedio-minoris* Den Hartog & Segal 1974 em. Pietsch 1965.
Ord. *Utricularietalia intermedio-minoris* Pietsch 1965.
Al. *Sphagno-Utricularion* Th. Müller & Görs 1960.
Community of *Utricularia vulgaris.*
Cl. *Charetea* Fukarek 1961.
Ord. *Charetalia* Sauer 1937.
Al. *Charion fragilis* Rübel 1933 em. Krausch 1964.
Ass. *Charetum vulgaris* Margalef 1949.
Communites of filamentous and reticular algae.
Ass. *Cladophoretum glomeratae* Sauer 1937.
Ass. *Hydrodictyetum reticulati* Pignatti 1957.
Formations of *Oedogonium capilliforme, Spirogyra* spp., *Pithophora oedogonia, Rhizodonium hieroglyphium.*