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COMMUNITY VARIATION IN PROTECTED COASTAL LAGOONS USING AQUATIC INSECT ASSEMBLAGES

A. PÉREZ-BILBAO, C. J. BENETTI, J. GARRIDO*

Ecology and Animal Biology Department, Faculty of Biology, University of Vigo, Campus Lagoas-Marcosende, 36310 Vigo, Spain
** Corresponding author: amaiapb@uvigo.es*

COASTAL LAGOONS
AQUATIC INSECTS
COMMUNITY VARIATION
DIVERSITY INDICES
COEFFICIENT OF VARIATION
NORTHWEST SPAIN

ABSTRACT. – Coastal lagoons are high productivity ecosystems with high biodiversity, but very unstable systems. When assessing the ecological status of these ecosystems it is necessary to consider the influence of natural variations. In order to understand the community variation of coastal lagoons we studied spatial (among-lagoons) and temporal (among-years) changes in aquatic insect assemblages and variations in 23 measures potentially useful for bioindication purposes. Two series of data were examined: (a) aquatic insect families and (b) Coleoptera and Hemiptera species. Coefficients of variation were used to quantify the effect of among-lagoon and interannual variability on the selected metrics. Data analyses showed that within-lagoon variation (temporal) was higher than among-lagoon variation (spatial). Both aquatic insect families and Coleoptera and Hemiptera species provided similar information about among-lagoon similarity. According to the results, taxa richness, rarefied richness (ES200), species richness of Coleoptera and Hemiptera (%S CH), the Margalef diversity index (d), and richness and abundance of predators could be the most useful metrics when assessing ecological status in these coastal lagoons. Diversity metrics and fauna composition may be used together for a better understanding of the diversity patterns in these ecosystems.

INTRODUCTION

Coastal lagoons constitute a common coastal environment worldwide (Kjerfve 1994). Due to their special location at the end of a basin, their transitional character (between continental and marine environments), and their interaction with the terrestrial ecosystem, coastal lagoons are high productivity areas (Kjerfve 1994, Basset *et al*. 2006, Basset 2007, Esteves *et al*. 2008), but very unstable systems that tend to disappear due to the filling of the basin (Casado & Montes 1995, Soria & Sahuquillo 2009). However, not until very recently have they become the focus of conservation interest (Barnes 1999, Abbiati & Basset 2001) with the declaration of Special Areas of Conservation (SAC) as a consequence of their listing as a priority habitat type (1150*) in Annex I of the European Union Habitats Directive (Council of the European Communities 1992).

The conservation of these habitats depends largely on the assessment of their natural characteristics, especially biodiversity, which is one of the main criteria used when elaborating wetland protection policies (Ramsar Convention Bureau 2005). In this sense, the composition and abundance of benthic invertebrates is one of the most important criteria to be considered. These organisms include insects, which are one of the most common groups in these environments along with crustaceans. However, studies dealing with coastal lagoons often include data on brackish or marine taxa (e.g. crustaceans) and little is known of the communities of aquatic insects, especially when compared with freshwater ecosystems (Garrido & Munilla 2008). It is important to have basic data on all of the aquatic organisms inhabiting these ecosystems in order to have an idea of the biological processes occurring.

In many cases, it is difficult to separate the effects of natural changes from human-made disturbances, so in bio-assessment studies it is essential to understand natural variability and heterogeneity, particularly in such unstable ecosystems as coastal lagoons. Investigation and quantification of these changes is a necessary part of metric evaluation in the development of bio-assessment protocols according to the Water Framework Directive (WFD) (Council of the European Communities 2000). Spatial and temporal changes in aquatic communities lead to variations in metrics and may obscure the effects caused by anthropogenic disturbance (Trigal *et al*. 2006). The use of community metrics (for example taxa richness, diversity indices or functional feeding groups) as strong biomonitoring tools is common in biodiversity and ecological studies in lentic ecosystems (e.g. Trigal *et al*. 2006, Boix *et al*. 2008), including the development of multimetric indices (Boix *et al*. 2005, Solimini *et al*. 2008, Trigal *et al*. 2009).

Coastal lagoons are well represented in the Autonomous Region of Galicia (Northwest Spain). Although this region probably has one of the most important and well-conserved representations of sandbar-lagoon complexes in the Iberian Peninsula, most of the studies dealing with aquatic insects in this type of habitat have been developed in the Spanish Mediterranean region (e.g. Ribera *et al.* 1996, Boix *et al.* 2005, 2008, Martinoy *et al.* 2006). In view of the lack of information on aquatic insect assemblages in coastal lagoons in Northwest Spain, we carried out a study in seven coastal lagoons included in the Natura 2000 network.

The aim of the study was to analyze community variation in several coastal lagoons along spatial (among-lagoons) and temporal (within-lagoons) gradients using aquatic insect communities and to provide new data on a group of organisms usually neglected in these ecosystems. We also assessed the variability of different diversity measures (metrics) potentially useful for bioindication purposes. The following questions were addressed: (1) Are there any differences between the studied lagoons regarding diversity measures? (2) Are these metrics useful for assessing spatial and temporal changes in these assemblages in the context of biomonitoring? We tested 23 potentially useful metrics to assess the ecological condition of coastal lagoons, focusing particularly on spatial and temporal variations.

MATERIAL AND METHODS

Study area: The study area comprised seven coastal lagoons on the Atlantic coast of Galicia (northwestern Spain): Doniños, Traba, Louro, Muro, Vixán, Xuño & Bodeira (Fig. 1). All of them are located within SACs under the European Union Habitats Directive (Council of the European Communities, 1992) and are Special Protection Areas (SPAs) under the Birds Directive (Council of the European Communities 1979), except the Louro lagoon. Vixán and Bodeira are also protected by the Ramsar Agreement (Ramsar sites no. 598 and 452, respectively). The climate in the study area is warm temperate, with dry summers and mild temperatures (Kottek *et al.* 2006). The landscape consists of a mosaic of farmland, heathlands and forests near small villages located in very touristic areas.

According to the thermal classification of lakes proposed by Lewis (1983), these lagoons are warm polymictic, without a stable thermal stratification. Doniños, Bodeira and Xuño are freshwater systems, and Traba, Louro, Muro and Vixán are considered oligohaline water bodies, being all of them less than 3 m deep (Ramil *et al.* 2007), except Doniños which is 11 m deep.

The substrate of the lagoons is mostly composed of sand and mud. The structure of the aquatic vegetation differed between lagoons. In some of them, the bottom is covered by stands of submerged vegetation; in others, the vegetation is only present on shores. Aquatic plants consist mostly of submerged and floating hydrophytes and helophytes (Table I). Traba, Vixán and Muro presented a large reed bed (*Phragmites australis* (Cav.) Trin. ex Steud), while Doniños had the white waterlily *Nymphaea alba* L. and *Schoenoplectus lacustris* (L.) Palla. In Bodeira we can find the species *Polygonum amphibium* L., *Glyceria fluitans* (L.) R. Br. and *Myriophyllum* spp., and in Xuño the white waterlily, *Hydrocotyle vulgaris* L. and *Veronica* spp. Finally, Louro presented a reed bed and the species *Eleocharis parvula* (Roem. & Schult.) Link ex Bluff *et al.*, which is considered endangered in Spain.

Sampling: The seven coastal lagoons were sampled in spring (April-May) of 2007 and 2008, once each year. Each sample was taken following a multi-habitat time-limited sampling (Biggs *et al.* 1998). The three-minute total sampling time for each lagoon was split equally between different mesohabitat types of the shore using an entomological net (500 μm mesh, 30 cm diameter and 60 cm deep). We considered a sample each lagoon in each year, so we had 14 samples in total. The material was identified to family level, with the exception of Coleoptera and Hemiptera,

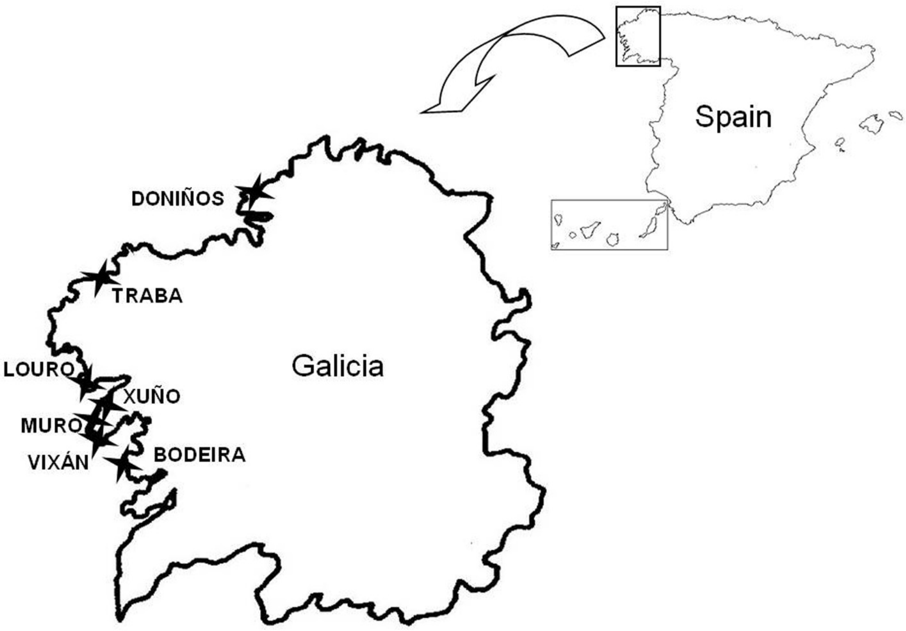

Fig. 1. – Location of the seven coastal lagoons on the Atlantic coast of Galicia (NW Spain).

Table I. – List of the seven lagoons with their respective coordinates (UTM), altitude, area dominant substrate, macrophyte cover and the dominant aquatic vegetation species.

Lagoon	Coordinates U.T.M.	Altitude (m. a.s.l.)	Area (ha)	Dominant substrate	Macrophyte cover (%)	Dominant aquatic vegetation
Bodeira	29T5079664703605	11	0.8	sand/mud	40-50	*Polygonum amphibium*, *Glyceria fluitans, Myriophyllum* spp.
Doniños	29U5559904815850	0	25	sand	40	*Nymphaea alba, Schoenoplectus lacustris*
Louro	29T4921424734006	13	24.8	sand	60	*Eleocharis parvula*
Muro	29T4964924719237	11	12.5	sand	20	*Phragmites australis*
Traba	29T4964944781705	2	3.8	sand/mud	15	*Phragmites australis*
Vixán	29T4980254709875	7	11.2	sand/mud	60	*Phragmites australis*
Xuño	29T4968184720144	14	2.3	sand/mud	95	*Nymphaea alba, Hydrocotyle vulgaris,Veronica* spp.

Table II. – List of the 23 calculated diversity metrics.

Metric	Description
Total richness	Total taxa (families)
ES(200)	Rarefied richness (families) for 200 individuals
S Coleoptera	Species richness of Coleoptera
S Hemiptera	Species richness of Hemiptera
% S CH	Percentage of the number of taxa in the orders Coleoptera and Hemiptera
% S ETO	Percentage of the number of taxa in the orders Ephemeroptera, Trichoptera and Odonata
% S Predators	Percentage of the number of taxa in the predator group
% S Collector-gatherers	Percentage of the number of taxa in the collector-gatherer group
% S Shredders	Percentage of the number of taxa in the shredder group
H'	Shannon-Wiener diversity index (log to base 2)
d	Margalef index = (S-1)/Log(N)
J'	Pielou's evenness = H'/Log(S)
1-Lambda	Simpson's index = 1-SUM(Ni*(Ni-1)/(N*(N-1))
N Total	Total number of individuals
N Coleoptera	Total number of individuals of the order Coleoptera
N Hemiptera	Total number of individuals of the order Hemiptera
% Chironomidae	Percentage of Chironomidae larvae
% ETO	Percentage of Ephemeroptera, Trichoptera and Odonata
% Dominant taxa	Percentage of the dominant taxa
% CH	Percentage of Coleoptera and Hemiptera
% Predators	Percentage of the predator group
% Collector-gatherers	Percentage of the collector-gatherer group
% Shredders	Percentage of the shredder group

identified to species level due to their high representativeness in the studied lagoons, in general over 50 % of identified taxa.

Metric selection: Spatial and temporal variations in macroinvertebrate assemblages were analyzed in terms of taxa richness and relative abundances. Due to the reduced number of studies focusing on macroinvertebrate communities as indicators of water quality in coastal lagoons, biotic metrics were chosen based on current bibliography (Barbour *et al*. 1995, Lewis *et al*. 2001, Blocksom *et al*. 2003, García-Criado *et al*. 2005, Trigal *et al*. 2006, 2009). In total, 23 metrics were selected (Table II). Numeric richness was the number of taxa in a sample. Rarefied richness was calculated for the most common number of individuals included in fixed count studies (ES200) (Somers *et al*. 1998). This metric was calculated for a sample size of 200 individuals. Diversity measures were calculated using PRIMER-E version 6 software.

Functional feeding groups were assigned for each taxon following Tachet *et al*. (2002) and Oscoz *et al*. (2011). Those taxa feeding on more than one food source were allocated according to their dominant type of food source.

Spatial and temporal variability for metrics: The coefficient of variation (CV) was used to assess natural changes in the calculated metrics. This is an analysis reported by different authors to evaluate the effects of spatial and temporal variability on several attributes (Johnson 1998, Kashian & Burton 2000, Trigal *et al*. 2006). CV, expressed as a percentage, was used to quantify the effect of among-lagoon (7 x lagoon) and interannual variability (2 x year) on the selected metrics. As a preliminary approach, metrics with a CV lower than 50 % were considered potentially useful in the assessment of water quality in the lagoons (Kashian & Burton 2000).

Among-lagoon variability (CVl) was calculated as the CV among the seven lagoons. This coefficient was calculated for each set of temporal data (2007, 2008 and "years" which is the mean value of metrics between 2007 and 2008). Interannual variability (CVi) was the CV among the two years (2007 and 2008). The CVi was estimated for each set of spatial data (each lagoon and "lagoons" which is the mean value of metrics between the seven lagoons).

RESULTS

Fauna composition

In total, more than 19,000 individuals from six orders were recorded. We identified 48 families of the orders Diptera, Hemiptera, Coleoptera, Odonata, Ephemeroptera and Trichoptera, as well as 62 species of Coleoptera and 14 species of Hemiptera (Appendix 1).

All of the lagoons presented more than 20 insect families, reaching 33 taxa recorded in Bodeira. The lagoon with fewer families was Louro, with 22 (Fig. 2). Regarding Coleoptera and Hemiptera species, marked differences among lagoons were found. Five lagoons presented more than 30 species and the richest lagoon was Xuño (40 species). On the other hand, Doniños presented the lowest number of species with 14 (Fig. 3).

Diptera and Coleoptera were the dominant groups, followed by Hemiptera and Odonata (Fig. 4). Flies were clearly dominant in 2007 (more than 50 % abundance). However, in 2008 it was not the highly dominant group. In this year, beetles were the most abundant, followed by flies and bugs. Chironomidae were highly represented in almost all lagoons. This family was the dominant group in seven samples followed by Hydraenidae, which was dominant in four samples, and Corixidae, dominant in only two.

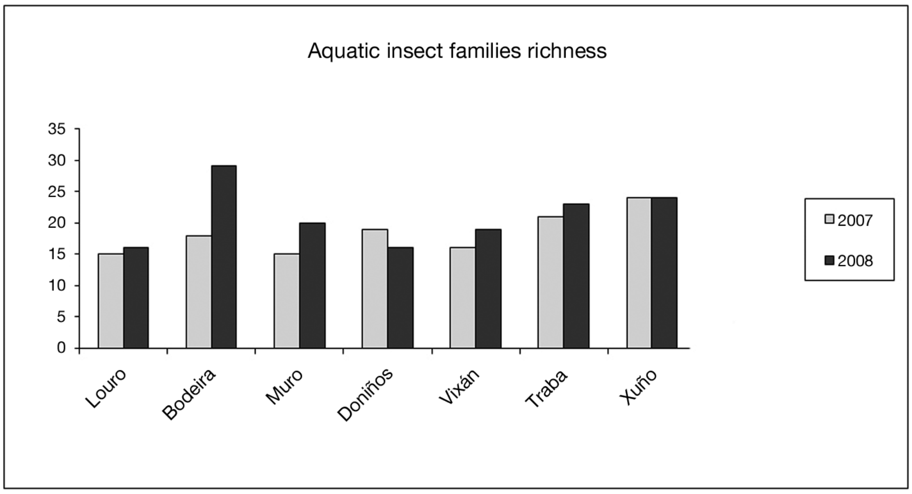

Fig. 2. – Family richness of the aquatic insects collected in the seven lagoons during 2007 and 2008.

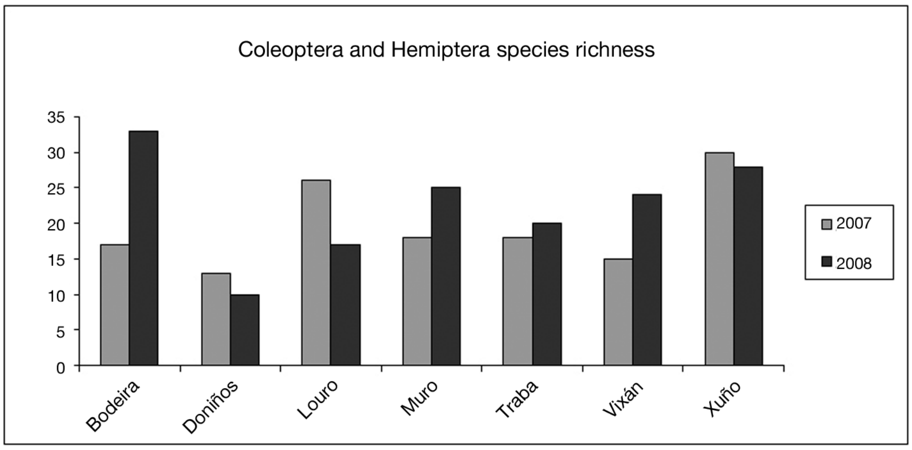

Fig. 3. – Species richness of Coleoptera and Hemiptera in the seven lagoons studied during 2007 and 2008.

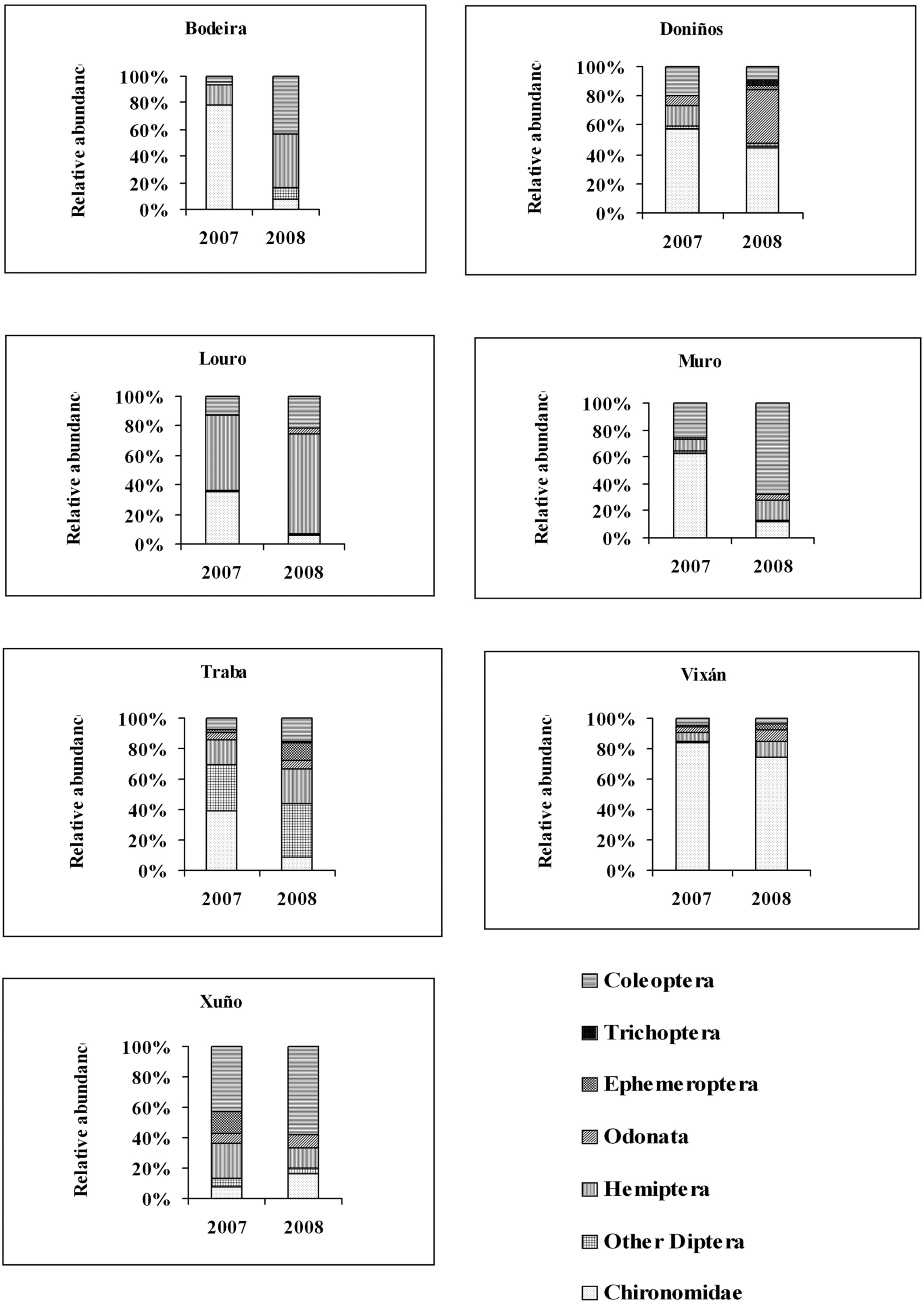

Fig. 4. – Relative abundance of the aquatic insect orders captured in the seven lagoons during 2007 and 2008.

Table III. – Values of the among-lagoons and interannual coefficients of variation of the selected metrics in the seven lagoons and the two years of study (2007 and 2008).

Metrics	Among-lagoons variability			Interannual variability							
	CV 2007	CV 2008	CV years	CV Bodeira	CV Doniños	CV Louro	CV Muro	CV Traba	CV Vixán	CV Xuño	CV lagoons
Total richness	18	22	17	33	12	5	20	6	12	0	10
ES(200)	22	18	20	16	8	26	3	29	15	7	15
S Coleoptera	37	31	34	53	7	31	17	0	34	3	21
S Hemiptera	29	52	44	28	71	20	47	35	28	16	32
% S CH	9	13	11	4	13	4	3	0	18	6	7
% S ETO	52	37	43	45	39	33	42	35	24	16	24
% S Predators	17	18	16	12	8	5	2	7	2	18	5
% S Collectors-gatherers	51	44	42	74	62	5	21	6	9	13	18
% S Shredders	26	33	9	3	96	15	1	20	11	24	9
H’	37	22	29	52	3	17	28	23	29	15	24
d	22	22	22	21	18	18	7	10	8	6	13
J’	32	18	25	43	1	16	20	21	26	15	20
1-Lambda	35	19	27	53	3	6	25	11	30	9	20
N Total	76	57	65	81	34	84	98	26	3	46	53
% Chironomidae	51	108	59	116	17	102	98	92	9	49	52
% ETO	116	114	92	106	102	134	61	63	67	60	51
% Dominant taxa	44	38	35	62	17	6	45	28	9	59	18
% CH	59	61	60	87	76	24	60	33	16	6	41
% Predators	32	35	33	43	3	0	8	21	5	29	14
% Collectors-gatherers	167	104	136	125	73	56	19	34	119	117	66
% Shredders	78	84	82	88	97	3	5	47	76	53	41
N Hemiptera	161	101	126	134	20	54	123	23	25	64	88
N Coleoptera	103	105	105	114	105	71	116	0	41	11	72

Among-lagoon variability for metrics

Among-lagoon variability was similar in the two years. The CVl was below 50 % for most of the taxonomic metrics, particularly low in total richness, rarefied richness, % S CH and % S predators (Table III). Low variations were also observed for all diversity metrics, most of them being below 30 %. On the other hand, among-lagoon variability in the relative abundance metrics was high and coefficients of variation exceeded 100 % on most occasions, with important increases in the relative abundance of Hemiptera, Coleoptera and % ETO. As for trophic metrics, CVl were high for collectors-gatherers and shredders, but low and stable for predators.

Interannual variability for metrics

In general, interannual variability was higher than among-lagoon variability. However, metrics that presented a low CVl also had a low CVi. In some lagoons the CVi was lower than in others. For example, in Traba CVi was below 50% in almost all metrics. On the other hand, the CVi in Bodeira was higher than 50 % in more than half of the metrics (Table III).

In general, CVi was below 50 % for most of the taxonomic and diversity metrics. The greatest decrease was observed in % S CH and % S predators, at below 18 in all lagoons. CVi was high for most of the relative abundance metrics, especially for % ETO, being greater than 50 % in all lagoons. In general, trophic metrics had a high interannual variability, especially for collectors-gatherers and shredders. But, as noted in among-lagoon variability, CVi was low for predators (below 50 %) in all lagoons, in some cases almost zero.

DISCUSSION

The studied coastal lagoons presented high diversity values, confirming the importance of aquatic insect assemblages in these ecosystems. This result agrees with other studies carried out in coastal lagoons of the Iberian Peninsula, like Martinoy *et al*. (2006) in Spain or Cancela da Fonseca *et al*. (1999) in Portugal, in which aquatic insects played an important role in the composition of the community. Lagoons reached similar values of abundance, family richness and diversity; thus, the difference between them is probably due to the replacement of some species by others and variations in the abundances of several taxa, for example Pleidae more abundant in Bodeira, Coenagrionidae much more abundant in Doniños, or Corixidae dominating in Louro. We want to highlight the dominance of the family Hydraenidae in four samples in 2008 because this group of aquatic beetles is typical of running waters. This dominance could be due to high number of individuals of the species *Ochthebius viridis fallaciosus* collected this year, confirming the preference of this species for coastal lagoons (Garrido & Munilla 2008).

In general, in our study among-lagoon variability was lower than interannual variability. This means that one lagoon was more different between years than all the lagoons between each other. This could be due to the instability of these ecosystems, which are subjected to strong environmental gradients (Basset 2007). Temporal variability may be responsible for marked changes in macroinvertebrate assemblages among years (Guerold 2000, Tangen *et al*. 2003, White & Irvine 2003, Jackson & Füreder 2006). In this study, we observed important differences between lagoons regarding community measures. For invertebrate communities, within-system variability is expected to be large in complex ecosystems, where there is a wide range of niches (Heino 2000, Harrison & Hildrew 2001). According to the CV values, Traba & Vixán were the most stable lagoons, while Bodeira was the most unstable. Coastal lagoons are exposed to large variations in environmental variables and climatic events (storms, drought, etc.), which affect water physical and chemical characteristics (salinity, nutrients, hydroperiod, etc.) and therefore determine the structure of biological assemblages (Kjerfve 1994). These climatic events differ from one year to another. For example, drought is not unusual in the Bodeira lagoon, the most unstable one, in very dry summers (Ramil *et al*. 2007).

The low spatial variation could also be influenced by the sampling methodology, since all the samplings were carried out in the vegetated lagoon shores. It is well known the positive relationship between aquatic vegetation and macroinvertebrate assemblages (Rodríguez-Gallego *et al*. 2010). Part of the low variation could be due to the different species that formed aquatic vegetation assemblages.

Feeding traits depend largely on habitat characteristics, because in stress conditions unstable food dynamics can result in an imbalance in feeding functional groups (Barbour *et al*. 1999). In this work, the percentage of richness and abundance of predators showed low spatial and temporal variation, and can be considered a good metric. Kashian & Burton (2000) proposed that the percentage of predators is likely to be a good quality indicator, based on lower values found in degraded wetlands rather than unpolluted sites. The influence of habitat on macroinvertebrate feeding traits is also related to their food-collecting strategies and to the distribution of their food sources among different habitats (Heino 2000, Lamoroux *et al*. 2004). In this sense, active predators (e.g. hemipterans and coleopterans) occurred in vegetated zones where predation pressure by fish was lower (Bennet & Streams 1986, Hornung & Foote 2006).

Richness and diversity indices presented lower spatial and temporal variation than those based on abundance values, and were better indices for assessing the ecological status of the lagoons (Johnson 1998, García-Criado *et al*. 2005, Trigal *et al*. 2006). The relative abundance of different groups can vary considerably depending on different factors such as phenological differences across groups, predation pressures and between-year differences in meteorological conditions (Diehl & Kornijów 1998, Batzer *et al*. 2000). On the contrary, taxonomic composition is expected to be maintained (Kornijów 1989). In this study, taxa richness, rarefied richness (ES200), species richness of Coleoptera and Hemiptera (% S CH), the Margalef diversity index (d), and richness and abundance of predators could be the most useful metrics. The potential use of % S CH for biomonitoring shows that beetles and bugs are good biological and ecological indicators (Abellán *et al*. 2005, Garrido & Munilla 2008, Gutiérrez-Cánovas *et al*. 2008).

In the studied lagoons it was observed that temporal variability was greater than spatial variability. On the other hand, aquatic insects richness and diversity indices can be considered good indices to assess the ecological status of these habitats. Future goals in Atlantic coastal lagoons in Spain should deal with the priority of identifying indicator species, not only insects, and also with assessing how changes in environmental factors due to the instability of coastal lagoons itself and to man-made changes can affect assemblages inhabiting these ecosystems.

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Appendix 1

	Bodeira		Doniños		Louro		Muro		Traba		Vixán		Xuño	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Diptera														
Anthomyidae					1									
Athericidae						1								
Ceratopogonidae		6	10	10	13	2		17	220	7	3		1	4
Chironomidae	602	221	325	417	1006	41	178	178	296	43	1800	1650	94	382
Culicidae		225			11	1	1		1				56	25
Dixidae		1						1	3	137	3		1	54
Dolichopodidae		1					3							
Empididae	1						2			2				
Ephydridae		2											1	5
Limoniidae				1						31			1	1
Psychodidae		1								6				
Rhagionidae			1							1				
Scathophagidae														1
Sciomyzidae		5											3	
Tabanidae			1	1				7				2	1	
Thaumaleidae														1
Tipulidae						3								
Odonata														
Aeshnidae	3	4	6	7		7		14	2	2	30	56	6	37
Coenagrionidae			24	328	1		3	11	30	26		80	78	
Cordulegastridae		1												
Cordullidae	2			11	1		2	4			4		4	
Lestidae	3	2	4					36	1		4		4	156
Libellulidae	6	1	5			23		4			47	18		12
Ephemeroptera														
Baetidae	1			29					16	58	2	99	165	1
Ephemerellidae									1					
Trichoptera														
Lepidostomatidae			1											
Limnephilidae				33	1				1	6				
Hemiptera														
Hebridae														

		Bodeira		Doniños		Louro		Muro		Traba		Vixán		Xuño	
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
	Hebrus pusillus										1				
Corixidae		60	249							1		72	61	1	236
	Hesperocorixa linnaei	1	3									1		73	
	Corixa panzeri		2	74	12				99				4		
	Sigara stagnalis					1184	326	14							
Gerridae															
	Gerris sp.	1	1			1									
	Gerris gibbifer					1									
Hydrometridae															
	Hydrometra stagnorum		12						1				1		
Naucoridae															
	Naucoris maculatus	10	36						6	10	4		1	20	
Nepidae															
	Nepa cinerea		1												
	Ranatra linearis			1							1				
Notonectidae															
	Anisops sardeus								8				1		1
	Notonecta sp.	19	239			5	55	3	94			53	58	1	83
	Notonecta meridionalis	2												2	
	Notonecta viridis viridis		1										1		1
Pleidae															
	Plea minutissima	28	562	7		270	103	6	20	109	107	11	122	181	4
Vellidae			14							2	8				
	Microvelia pygmaea		13							2	7				
Coleoptera															
Dryopidae															
	Dryops algiricus	2	78											2	6
	Dryops luridus						19		3	1	7		2		6
Dytiscidae															
	Hyphydrus aubei		6						2					8	1
	Hydrovatus clypealis		5	12	4								1	16	
	Graptodytes varius											1		11	
	Bidessus goudoti	10	20					4	76					36	51
	Stictonectes epipleuricus					1									

		Bodeira		Doniños		Louro		Muro		Traba		Vixán		Xuño	
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
	Stictonectes lepidus					1									
	Hygrotus inaequalis	1	40	7	1	12		4	26	1		1	6	2	4
	Hygrotus lagari						1	1						2	
	Hydroglyphus geminus				3										
	Hydroporus planus						1								
	Hydroporus vagepictus													1	
	Stictotarsus duodecimopustulatus			1	1										
	Liopterus haemorrhoidalis		1												
	Laccophilus minutus		2					1	58		1		1	51	15
	Rhantus hispanicus					1						1			
	Rhantus suturalis		2				1		4				8		1
	Agabus bipustulatus	1	1			6						2			
	Agabus conspersus						3		5						
	Agabus nebulosus					5		1							
	Colymbetes fuscus		1						3						
	Cybister lateralimarginalis					2									
Elmidae															
	Oulimnius rivularis		12										1		
Gyrinidae															
	Gyrinus caspius			6	7			1	2		2	2			7
	Gyrinus urinator										1				
Haliplidae															
	Haliplus guttatus													2	
	Haliplus heydeni			1						2	2				
	Haliplus lineatocollis		1							1					
	Peltodytes caesus	2											2	1	12
	Peltodytes rotundatus		2	11	3					3					
Helophoridae															
	Helophorus alternans			1		166						2			
	Helophorus flavipes					11									
	Helophorus minutus	1	1					2		1		1			2
Hydraenidae															
	Hydraena affusa					1									
	Hydraena testacea									1	5		4	13	1

		Bodeira		Doniños		Louro		Muro		Traba		Vixán		Xuño	
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
	Limnebius furcatus		25			2	3	4	12				2	85	97
	Ochthebius dilatatus												1		
	Ochthebius viridis fallaciosus		842			83	18	4	495			88	10	98	838
Hydrochidae															
	Hydrochus angustatus								1		8			25	1
	Hydrochus flavipennis													6	
	Hydrochus nitidicollis									1	1				
Hydrophilidae															
	Berosus affinis													13	6
	Berosus hispanicus							1	255						
	Berosus signaticollis						4	2	4						9
	Anacaena bipustulata					2				7	8				
	Anacaena globulus					2									
	Anacaena lutescens					13		14	1	3	3	8	10	35	9
	Paracymus scutellaris					1								6	
	Coelostoma orbiculare									1	6				
	Helochares punctatus	9	135			5				6	6			30	49
	Enochrus fuscipennis	1	2			13	18	25	36	4	2		3	3	179
	Cymbiodyta marginella					1	8		8				5	1	26
	Laccobius atratus					1									
	Laccobius sinuatus									1					
	Limnoxenus niger	2	25	5	4	14	49	7	13			4	13	10	29
	Hydrobius convexus						1								
	Hydrobius fuscipes		4												1
Noteridae															
	Noterus laevis	1	21	66	39		28		54	23	25	1	7	67	49
Paelobiidae															
	Hygrobia hermanni	3	1	1	22			1						3	
Scirtidae															
	Cyphon sp.		11										1		1
	Hydrocyphon sp.		15				1				1		1		