CHARACTERIZATION OF STONEFLIES (PLECOPTERA) AND MAYFLIES (EPHEMEROPTERA) IN THE ORBIGO BASIN (LEON, NW SPAIN).

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ABSTRACT

Along the rivers in the Orbigo basin (León, NW Spain) have been located forty-two sampling sites.

The arithmetic mean of the parameters physico-chemical was calculated for each specie, and an analysis of stoneflies and mayflies distribution has been done with these results.

Principal Components Analysis was applied to the information obtained. The axis I is correlated with the mineralization, chiefly with the alkalinity.

The axis II is correlated with the eutrophication and contamination. The phosphate is determining parameter of stoneflies and mayflies distribution.

INTRODUCTION

In the Orbigo basin (León, Spain) has been done several researches during 1.987. As a part of these works, it was studied the relationship between stoneflies and mayflies distribution and the physico-chemical characteristics of the water (Presa, *et al.*,1987 and 1988).

STUDY AREA

The Orbigo basin stretches from north to south along the province of León. The river orbigo is the most important tributary of the Esla by the right side. It is formed with the fusion of the rivers Luna and Omaña, to 900 m altitude. The river Luna come from Cabrillanes mountains (1.600 m). It receives the contributions of streams and the thaw. It is held in the reservoire of Luna Barrios, with a capacity of 108 Hm and in Selgas-Ordás (60 Hm3). The river Omaña born to 1700 m altitude. The river Orbigo make its way south and it receives the contributions of Tuerto subbasin and the rivers Jamuz and Eria.

The Orbigo basin drains a surface of 4972 km^2. It is settler over siliceous materials, the slates mix with the sandstones and quartzites. However, the

Luna subbasin is limestone.

The climate of the basin differs from mediterranean temperate cold damp in the upper zone (Luna and upstream Omaña), to mediterranean semiarid continental semiwarm in the downstream Orbigo, Jamuz and Eria, passing through mediterranean temperate dry in the rest of the basin. The hydrologic regimen is considered pluvioniveous, it has a pluvious feed during spring by the thaw of the upper zone.

MATERIAL AND METHODS

Along the Orbigo basin has been established forty-two sampling sites. They were sampled seasonaly during 1987.

The stoneflies and mayflies were collected using a hand-net of 500 μm mesh, in the lotic facies of the rivers.

The physico-chemical characteristics were determined in the river and laboratory. The pH (pHmeter WTW), conductivity (HACH DR-EL2) and temperature were estimated in each point. In the laboratory were analyzed the following parameters: chloride and calcium (electrode Orion 94-17D and 93-20); alkalinity (Golterman, *et al.*, 1987); magnesium (Standard Methods, 1980); sulphate (Standard Methods, 1980); phosphate Murphy and Riley, 1962); silica and nitrate (Standard Methods, 1980).

Principal Components Analysis (PCA) was applied to the information obtained. The physico-chemical values were transformed ($x = \log(x+0.01)$) for establish the variance, with the exception of pH.

RESULTS

Plecoptera from 7 families, represented by 19 species and Ephemeroptera from 9 families, represented by 17 species, were collected in the studied area. The species with low frequency (4 stations of sampling) have been excluded in this analysis. The species have an extensive distribution in Europe (Illies, 1987), such as: *Perla marginata* Panzer, *Perla grandis* Scopoli, *Dinocras cephalotes* Curtis , *Perlodes microcephala* Picteti, *Perlodes intricata* Picteti, *Isoperla acicularis* Despax, *Hemimalaena flaviventris* Picteti, *Xantoperla apicalis* Newman, *Siphonoperla torrentium* Picteti, *Protonemoura risi* Navas, *Amphinemoura sulcicollis* Stephens, *Capnia bifrons* Newman, *Eulectra geniculata* Illies, *Leuctra fusca* Linnaeus, *Leuctra hippopus* Kempny, *Taeniopteryx schoenemundi* Mertens, *Brachyptera auberti* Consiglio, *Rhabdiopteryx thienemanni* Illies, *Ecdyonurus venosus* Fabricius, *Epeorus torrentium* Eaton, *Rhithrogena loyolaea* Navas, *Rhithrogena diaphana* Navas, *Rhithrogena semicolorata* Curtis, *Baetis rhodani* Picteti, *Ephemerella ignita* Poda, *Serratella albai* G. Tánago, *Ephemera vulgata* Linnaeus, *Leptophlebia marginata* Linnaeus, *Paraleptophlebia submarginata* Stephens, *Habrophlebia fusca* Curtis, *Choroterpes picteti* Eaton, *Oligoneurella rhenana* Imhoff, *Caenis luctuosa* Burmeister, *Siphlonurus lacustris* Eaton, *Potamanthus luteus* Linnaeus.

The arithmetic mean of the physico-chemical parameters was calculated to reduce the temporal heterogeneity. Subsequently, a PCA was done (Table I).

In the table 2 are reflected the dependence coefficients of ten variables with regard to the first and second axi.The axis absorb a 81% of variance. The first component (56% of variance) establishes a gradient of mineralization, that it is associated to the alkalinity, calcium and conductivity, opposing to the silica.

The axi II (25% of variance) is correlated positively with the eutrophication and contamination, it is defined by nitrates, phosphates, chlorides and sulphates.

The representation of the species in the plane I-II reflects as the first component in its positive tract is shaped by *Rhithrogena semicolorata, Serratella albai, Dinocras cephalotes* and *Rhithrogena loyolaea*. These species are dominant in the Luna subbasin, which substrate is calcareous. In the opposite side are situated *Leuctra hippopus, Paraleptophlebia submarginata, Xantoperla apicalis* and *Capnia bifrons*. They are in less mineralized water. The second component is correlated positively with the species more tolerant to the eutrophication and contamination, such as: *Pothamanthus luteus, Leptophlebia submarginata, Caenis luctuosa, Choroterpes picteti* and *Siphlonurus lacustris*. However, in the negative tract are situated the species more intolerant: *Amphinemoura sulcicollis, Taeniopteryx schoenemundi* and *Siphonoperla torrentium*.

DISCUSSION

The axis I absorbs the major porcentage of variance. It is correlated with the mineralization, as reflected of the topografic, geological, edaphologic, vegetation and anthropogenic characteristics. It differentiates a range of typical species of more or less mineralization water. This is the first factor, it seems to be determined by the stoneflies and mayflies distribution in the Orbigo basin. *Rhithrogena loyolaea* and *Rhithrogena semicolorata* are the same tolerant to the mineralization, however *Rhithrogena diaphana* is less tolerant. Equally, it can talks about *Perla grandis* and *Perla marginata*, the last is less tolerant. *Dinocras cephalotes* has been found in sites where the mineralization concentration is high.

The second axis is associated to the eutrophication and contamination. It represents the zonation or the natural sucession of the species studied. The influence of a variety of factors such as the movement of the water, altitude and substrate control the distribution of stoneflies nymphs in some areas (Berthelemy, 1966). The temperature and food are considered more important than the others in the distribution (Kamler, 1965; Lillehammer, 1974; Ward, 1982). However all are correlated, it is associated to a increment of the eutrophication and contamination, and it synthesizes the different physicochemical parameters. Generally, in the river the eutrophic goes with a major distance of the origin, temperature of the water and concentration of nutrients, in the same way that a low altitude and speed of the water. These factors differentiate stoneflies and mayflies distribution along the river.

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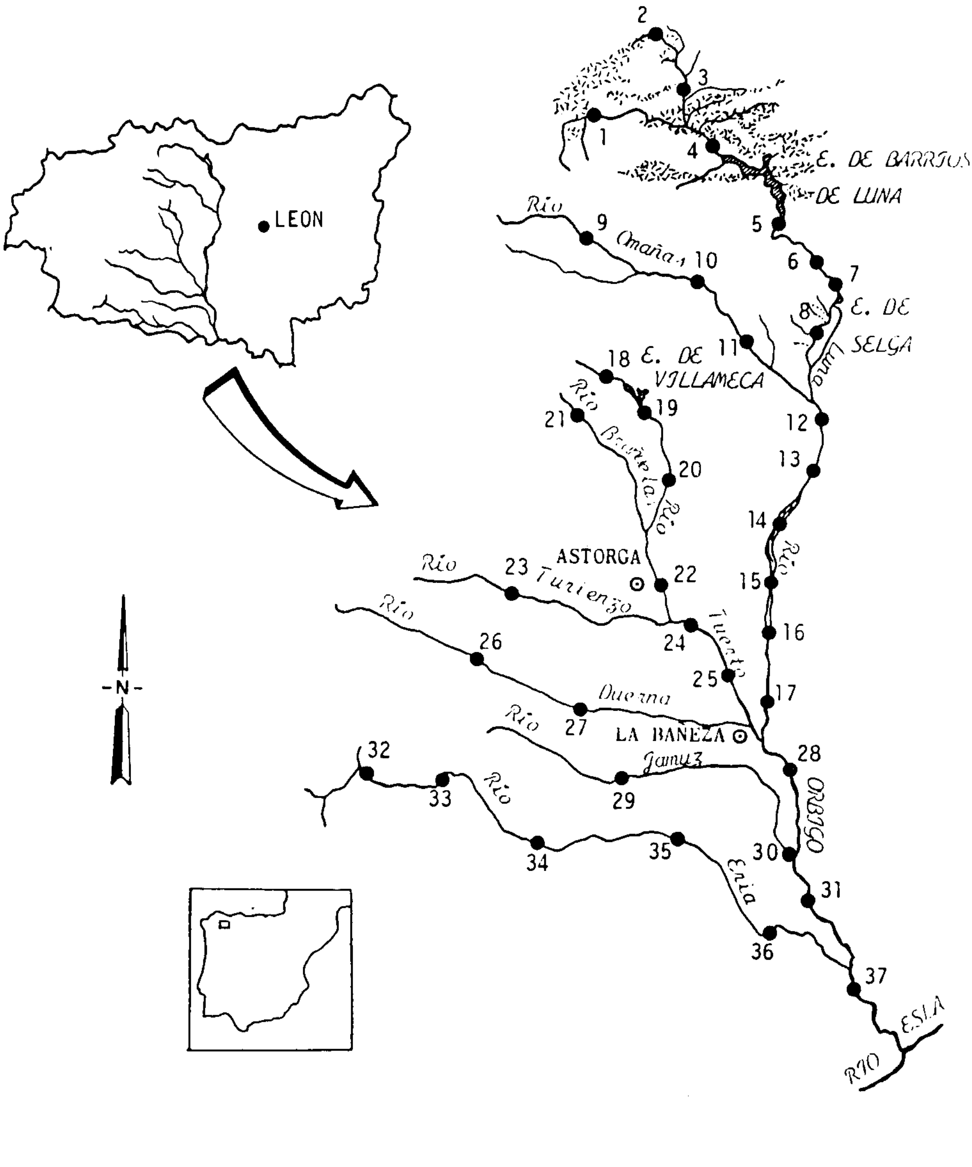

Fig. 1. Map of the river Orbigo basin with location of sampling points.

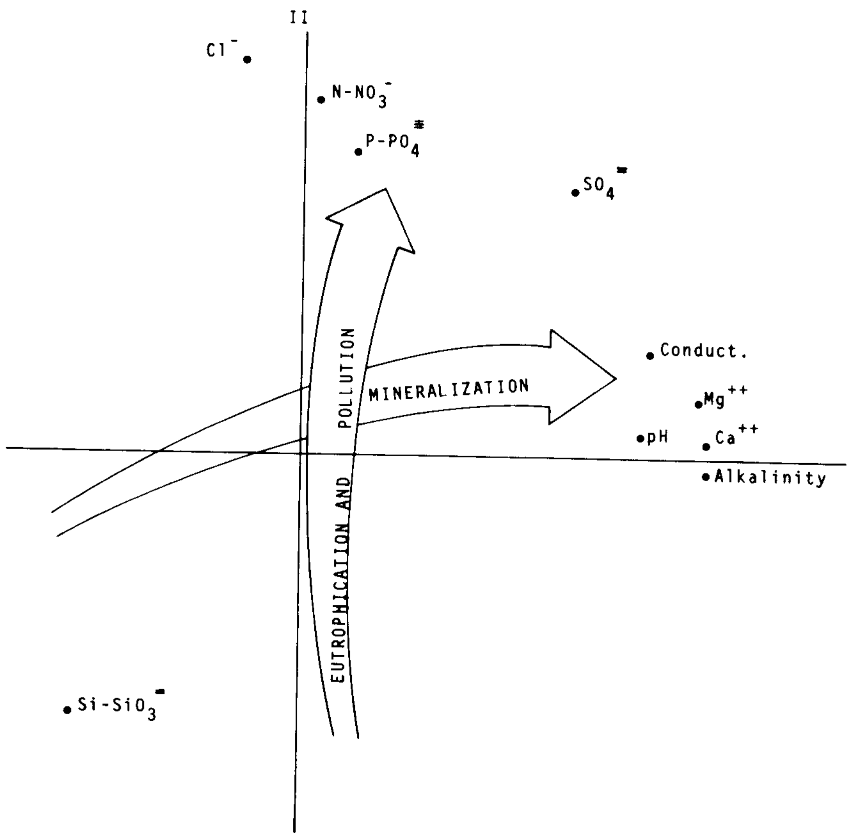

Fig. 2. Principal Components Analysis applied to the average values for the Orbigo basin. Distribution of the variables in the plane defined by the I and II components.

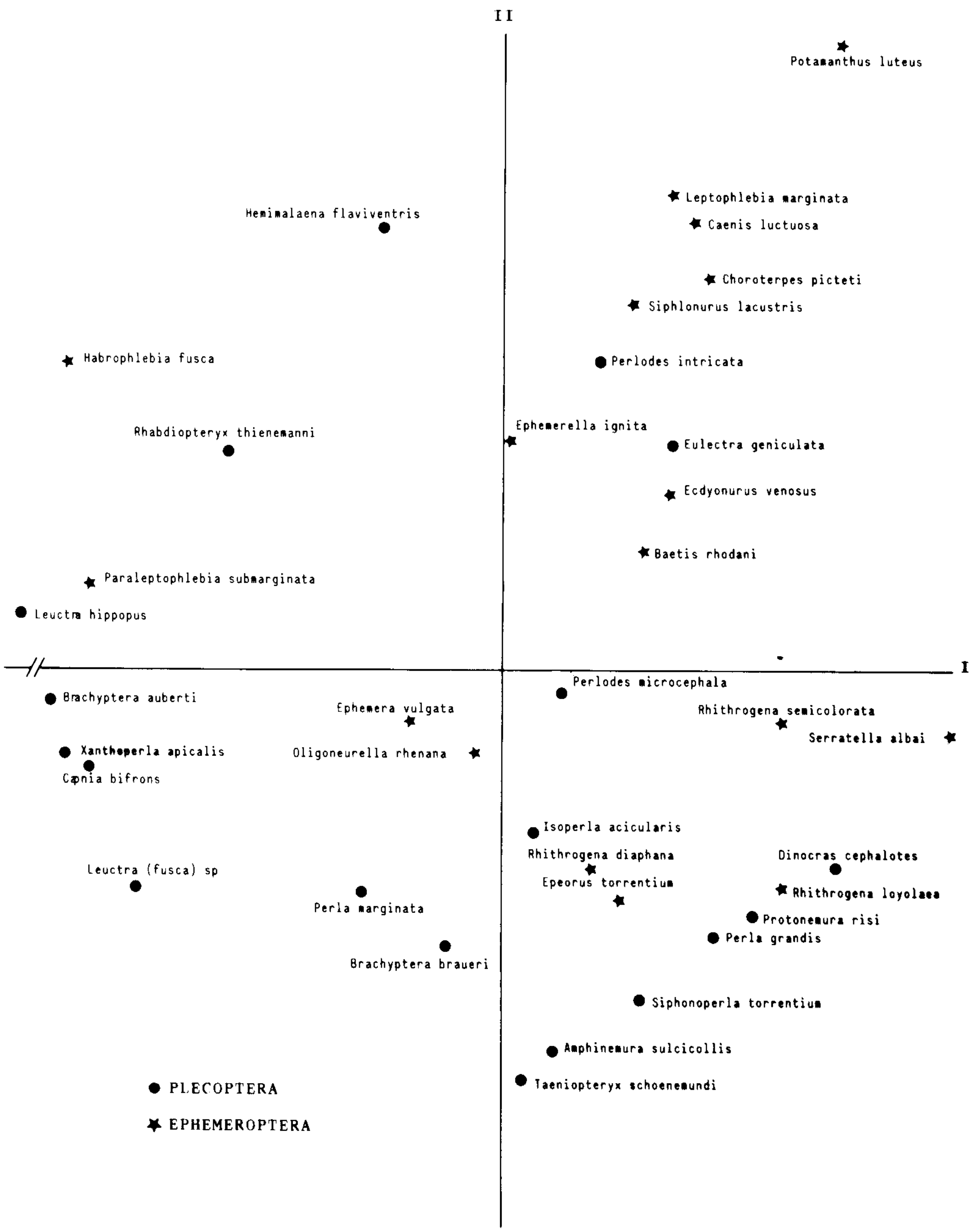

Fig. 3. Principal Components Analysis applied to the average values for the Orbigo basin. Distribution of the samples in the plane defined by the I and II components.

Table 1.- Factor loading of the variables for the I and II components obtained from the analysis applied to all species.

SPECIES	pH	cond.	alk.	$SO_4^=$	Cl^-	$N\text{-}NO_3^-$	$P\text{-}PO_4^{\equiv}$	$SiO_3^=$	Ca^{++}	Mg^{++}
Perla marginata	6,21	90,84	0,64	3,11	3,94	1407,50	37,43	2,94	9,98	2,59
Perla grandis	7,01	147,17	0,96	5,13	3,28	1138,70	31,89	2,48	20,37	4,49
Dinocras cephalotes	7,05	186,66	1,61	5,86	3,55	1184,29	36,91	2,28	26,40	5,50
Perlodes microcephala	6,60	129,84	0,94	5,85	5,55	1334,46	39,38	2,65	15,24	4,22
Perlodes intricata	6,55	123,42	0,95	5,34	2,80	974,95	36,93	2,72	16,28	3,42
Isoperla acicularis	6,38	114,73	0,99	4,21	3,78	1259,36	34,58	2,45	15,83	3,30
Hemimalaena flaviventris	6,48	120,42	0,65	8,34	8,34	1828,32	78,28	2,39	7,76	2,90
Xantoperla apicalis	5,78	60,87	0,31	3,53	5,19	1159,48	29,56	2,81	5,94	1,35
Siphonoperla torrentium	6,05	155,37	1,24	4,54	3,07	1114,37	28,66	2,57	21,48	4,41
Protonemura risi spinulosa	6,68	173,25	1,42	5,27	2,68	1358,73	35,60	2,77	24,50	5,10
Amphinemura sulcicollis	6,43	116,80	1,00	2,78	2,44	1183,40	31,53	2,73	14,87	3,37
Capnia bifrons	5,86	67,37	0,36	3,01	5,56	1354,77	23,38	2,72	5,60	1,53
Eulectra geniculata	6,74	173,55	1,15	8,68	6,36	1717,44	59,48	2,14	21,87	4,70
Leuctra hippopus	5,67	47,54	0,20	2,28	5,11	2130,87	26,14	2,90	3,14	1,17
Leuctra (fusca)sp	5,99	88,73	0,57	2,92	4,22	1259,65	30,67	3,04	9,59	2,58
Taeniopteryx schoenemundi	6,52	92,87	0,90	3,74	2,72	841,82	27,57	2,62	9,80	3,44
Brachyptera braueri	6,09	109,15	0,81	3,75	3,77	808,81	29,09	2,39	13,06	2,38
Brachyptera auberti	6,04	55,02	0,33	1,79	4,58	1689,36	33,97	2,38	4,48	1,19
Rhabdiopteryx thienemanni	6,47	106,25	0,40	4,38	6,03	1407,50	77,43	2,71	6,02	1,85
Ecdyonurus venosus	6,79	181,42	1,20	7,28	6,18	1736,58	50,27	2,23	20,17	4,45
Epeorus torrentium	6,68	139,06	1,02	4,51	3,17	1315,42	32,87	2,50	17,25	3,65
Rhithrogena loyolaea	6,76	191,67	1,30	6,42	2,40	1491,04	37,15	2,53	23,64	5,13
Rhithrogena diaphana	6,64	131,82	1,03	3,32	3,99	1383,44	37,41	2,48	17,57	3,92
Rhithrogena (semicolorata)sp	7,03	222,61	1,56	6,25	4,66	1393,97	42,06	2,24	30,23	5,99
Baetis rhodani	6,63	161,74	1,15	6,15	5,89	1472,42	48,89	2,15	19,36	4,20
Ephemerella ignita	5,76	150,16	1,12	6,98	6,35	1859,92	51,66	2,35	20,47	4,31
Serratella albai	7,68	230,42	1,87	7,05	5,21	1450,46	35,99	2,11	32,95	6,68
Ephemera vulgata	6,69	110,60	0,84	3,99	3,78	2478,82	31,35	3,08	6,68	3,30
Leptophlebia marginata	6,64	167,62	1,17	8,78	7,46	3308,42	31,14	1,29	20,18	4,57
Paraleptophlebia submarginata	5,82	65,47	0,35	3,03	5,08	1449,14	53,32	2,76	5,87	1,83
Habrophlebia fusca	5,76	70,73	0,28	4,63	6,67	1694,96	61,50	2,64	4,95	2,21
Choroterpes picteti	6,77	176,01	1,28	9,99	8,13	2137,67	49,45	1,79	23,97	4,94
Oligoneurella rhenana	6,42	132,97	0,67	5,32	4,88	1179,89	33,32	2,45	13,30	3,12
Caenis luctuosa	6,79	202,97	1,16	9,89	8,11	2215,81	68,40	2,09	22,49	5,28
Siphlonurus lacustris	6,54	187,39	1,27	8,21	7,67	2131,21	73,08	2,38	22,71	4,83
Potamanthus luteus	6,82	275,17	1,57	9,84	9,59	2841,98	55,48	1,33	31,49	6,76

Table 2.- Values of the mean annual concentrations of the physico-chemical parameters tally each taxon.

VARIABLES	COMPONENTS I	II
pH	0,851	0,039
Conductivity	0,825	0,256
Alkalinity	0,974	-0,007
$SO_4^{=}$	0,699	0,642
Cl^-	-0,091	0,942
$N\text{-}NO_3^-$	0,043	0,831
$P\text{-}PO_4^{\equiv}$	0,128	0,734
$Si\text{-}SiO_3^{=}$	-0,526	-0,632
Ca^{++}	0,960	0,046
Mg^{++}	0,959	0,132