EPHEMEROPTERA: ABUNDANCE AND DISTRIBUTION IN REGULATED STREAMS (SAN LUIS, ARGENTINA)

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ABSTRACT

The faunistic composition of the mayflies community was analized in Potrero y Chorrillo streams at 7 sampling sites. Six taxa which belong to three families were collected: *Tricorythodes popayanicus* Dominguez, *Leptohyphes* sp., *Baetis* sp., *Baetodes* sp., *Dactylobaetis* sp. and *Caenis* sp.. The cluster analysis among the study sites showed two well defined groups, the first one grouped the sites above dams and the second below dams. In the below dam sites a decrease of the species richness was observed. *Baetis* sp., was the only species that was present in the whole fluvial channel studied and it dominated downstream of impoundments. *Tricorythodes popayanicus* was dominant in the rest of the locations, except in one tributary, in which *Caenis* sp. predominated. *Dactylobaetis* sp. was completely eliminated downstream of the impoundment. Other species were also affected to varying degrees. The importance of the Ephemeroptera species varied along the longitudinal profile of the river system, mainly related to the effects of dams.

INTRODUCTION

The fluvial systems of the arid and semi-arid basins, like San Luis province's systems, are subject to natural variation (droughts and floods), causing an irregular flow regime. The water flow depends both on the pattern of rains, the precipitation/evaporation balance and groundwater level. The basins of the mountains of San Luis have uniform geological and hydrological features; they are endorrheic, have steep slopes, low flows and a short course, although some channels are permanent while others are temporary. Furthermore, some of the streams have been regulated by one or more dams.

River regulation invariably modifies both flow patterns and discharge, altering the structural and functional attributes of biotic communities (Ward and Stanford, 1987). Mayflies (Ephemeroptera) are a major order of benthic insects in running waters. They form an important link between primary production and the secondary consumers such as fish and

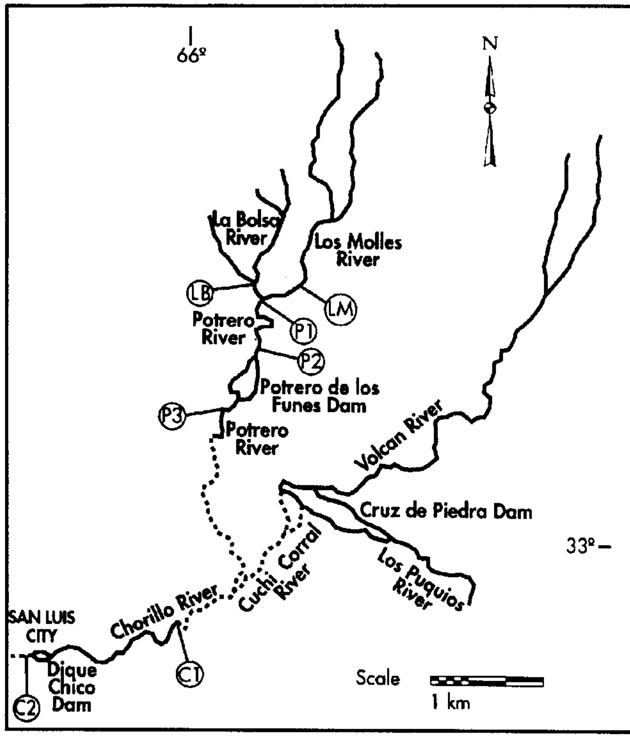

Fig. 1. Sampling sites along the Chorrillo and Potrero Rivers.

their potential as indicator of water quality and river regulation has attracted increasing attention (Brittain and Saltveit, 1989).

The aims of the present study were: a) to determine the distribution of the mayflies in Potrero and Chorrillo streams and b) to determine the effect of impoundment on mayfly composition and abundance.

Study Site

The Potrero river is a third order stream formed by the confluence of two second order streams; Los Molles and La Bolsa (Fig.1). Downstream of the confluence, the river is dammed. Dam releases are scarce and the river flow depends on groundwater infiltration, severely reducing flows. Chorrillo River, is formed by the confluence of the Potrero and Cuchi-Corral Rivers (Gez, 1938). This latter river comes from Cruz de Piedra dam and it is temporary, since it only contains water when the dam overflows. The Chorrillo channel which is temporary and fed by groundwater, runs a short distance above ground before running into Dique Chico Reservoir, used for irrigation. Below Dique Chico the stream flow depends on rainfall and the aquifer level.

MATERIALS AND METHODS

Samplings was carried out during the high and low water periods in 1993, at 7 stations: Los Molles (LM), La Bolsa (LB), Potrero 1(P1), Potrero 2 (P2), Potrero 3 (P3), Chorrillo 1 (C1) and Chorrillo (C2) (Fig. 1). A Surber sampler with mesh of 300 mm and 0,09 m^2 in area was

Table 1. Hydrological and physical - chemical characteristics of the sampling sites in the Chorrillo and Potrero Rivers

Sampling sites	LM	LB	P1	P2	P3	C1	C2
Wetted mean width (m)	6	2.8	9.63	8.5	2.66	7.41	9.76
Mean depth (m)	0.32	0.3	0.23	0.25	0.17	0.31	0.27
Distance from source (km)	8.3	4.4	9.3	10	13	23.1	25.8
Stream order	2	2	3	3	3	3	3
Altitude (m a.s.l.)	1000	1000	980	940	920	810	780
Dominant Substrate *	1	1	1	2	3	2	4
Temperature (°C)	18.5	19	18.5	17	16.5	18.5	14.5
pH	7.8	7.8	8.3	9	7.7	7.8	7.7

Dominant Substrate *: 1- Bedrock, coarse and median sand 2- Gravel, coarse and median sand 3- Bedrock, gravel, median sand and mud 4- Median and fine sand and mud.

used. Eight replicates were taken and integrated into single unit. A physicochemical water characterization was made at the sampling sites.

The organisms were identified using Domínguez et al. (1995). Each species was assigned to functional feeding group according to Merrit and Cummins (1984).

A cluster analysis was made using the Pearson correlation coefficient (median linkage method), in order to rank the similarity among the sampling sites (Fig. 2). The species distribution for each location was represented in a rank/abundance diagram. Species whose numbers were less than 5% of the most abundant were considered low density species. Those between 5-50% were considered intermediate, while those > 50% were considered high density species.

RESULTS

The hydrological, physical and chemical features are summarized in Table 1. The pH values always remain in alkaline range.

Mayflies were represented by six taxa: *Tricorythodes popayanicus* Domínguez, *Leptohyphes* sp., *Baetis* sp., *Baetodes* sp., *Dactylobaetis* sp. and *Caenis* sp. *T. popayanicus* with 8386 ind. m^2 at site P1 had the highest mean density while *Baetodes* sp. at C2 had the lowest with 24 ind. m^2. A decrease in species richness was observed at sites P3 and C2 (Table 2).

The cluster analysis (Fig. 2) showed a group by the sites LM, P1 and P2, to which C1 was associated with a lesser degree of similarity; and a second group formed by the sites P3 and C2. Station LB was clearly different from the others.

The rank/abundance diagram indicated that the mayfly community varied along the river, although the proportions of abundant, intermediate and rare species was different. *Baetis* sp., *T. popayanicus* and *Leptohyphes* sp. were present at all sites, but *Baetis* sp. dominated at the two stations below the dams (P3, C2) while *T. popayanicus* and *Leptohyphes* sp. were absent at P3. Codominance was observed among the following species: *Caenis* sp. (LB), *Baetodes* sp. (LB), *T. popayanicus* (LB, C1) and *Baetis* sp. (C1). *T. popayanicus* dominated at the other locations (LM, P1, P2) (Fig. 3).

Table 2. Mean density (ind.m^2), richness and percentage ocurrence. FG: functional group. CG: collector-gatherers and SCR: scrapers at sites in the Potrero and Chorrillo Rivers.

	Site						
Taxa/ FG	LM	LB	P1	P2	P3	C1	C2
T. popayanicus CG	6625	1313	8326	5711	0	3116	1430
Leptohyphes sp. CG	139	178	755	78	0	830	880
Baetis sp. CG/SCR	1055	35	157	35	104	1915	4460
Baetodes sp. SCR	542	836	781	0	0	24	0
Dactylobaetis sp. CG	94	0	521	69	0	0	0
Caenis sp. CG/SCR	209	1547	78	36	0	1551	0
Taxa Richness	6	5	6	5	1	5	3
Abundance %	1: >50% 2: 5-50% 3: < 5%	3: >50% 1: 5-50% 1: < 5%	1: >50% 3: 5-50% 2: < 5%	1: >50% 4: < 5%	1: >50%	2: >50% 2: 5-50% 1: < 5%	1: >50% 2: 5-50%

DISCUSSION

The non-impacted sites had higher species richness and grouped together. The sites below the dams have lower species richness. Site C1 could be considered as the beginning of a new more varied community, with an increase in species richness, not only among mayflies but also other macroinvertebrates (Medina et al, 1997).

The characteristic responses of the zoobenthos in regulated streams is a reduction in species diversity, alterations of community composition and feeding guilds. There is also often an increase (constant flow) or decrease (fluctuating flow) in abundance. Many species of benthic invertebrates are eliminated or reduced in numbers in regulated streams, but a few taxa flourish under the altered environmental conditions. These are sometimes present in lower numbers prior to impoundment (Ward and Stanford, 1987). According to Corigliano (1994), the studied mayfly communities showed a decrease in the species richness below dams. While *Dactylobaetis* sp. was eliminated, *Baetis* sp. showed an increase in their abundance. There were no changes in the trophic structure since collectors gatherers were dominant throughout the whole river system (Table 2).

Ward (1976) recognized four major types of flow regime in regulated rivers: reduced flow, seasonal flow constancy, increased flow and short-term flow fluctuations. Discharges from the present study reservoirs do not fit into with any of these categories, since they are interrupted and the downstream flow depends solely on groundwaters infiltration. However, our results are similar to the conclusions of Brittain and Saltveit (1989), for the stabilised flow conditions.

The two species of Tricorythidae persist after second impoundment. The occurrence of *Tricorythodes*, often a dominant mayfly genus, below North American dams has been related

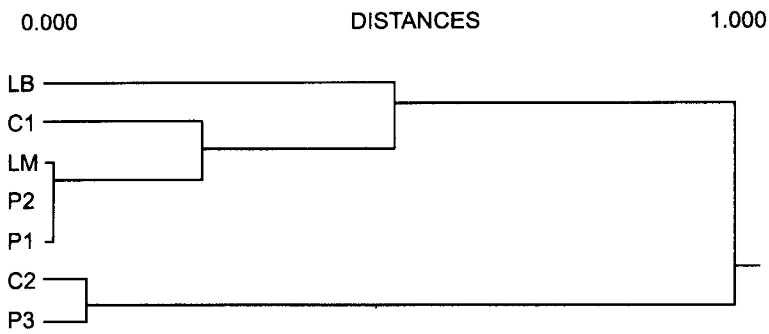

Fig. 2. Similarity cluster among sampling sites in the Potrero and Chorrillo Rivers.

to the distribution of well–developed submerged macrophytes (Ward, 1976; Ward and Short, 1978). Neverttheless, below a Córdoba (Argentine) impoundment, Corigliano (1994) found that *Tricorythodes* was eliminated. Brittain and Saltveit (1989), also mention other facets of this genus that are advantageous in impacted situations, like life cycle flexibility. Vallania and Corigliano (1990) reported that *T. popayanicus* was flexible in its voltinism, with two or more generations per year in the Chorrillo River.

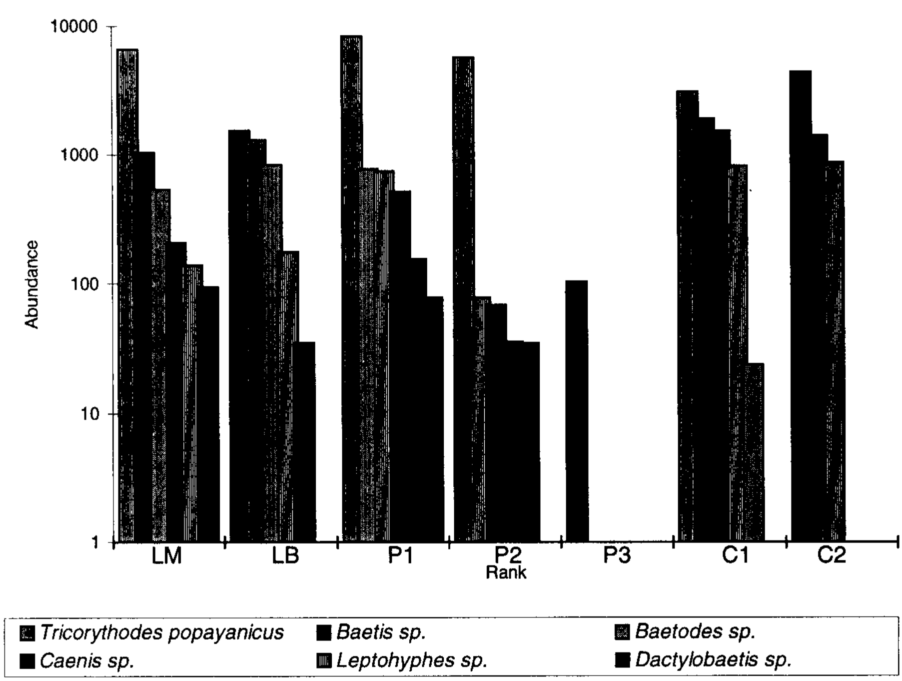

Fig. 3. Abundance of myflies in Potrero and Chorrillo Rivers for each location.

In a regulated river, an altered ecosystem, the species which are unable to adapt to the new environment conditions are eliminated, but generalists and opportunists species tend to dominate (Ward, 1976; Ward and Stanford, 1982).

The mayfly community may be greatly changed in terms of species composition and diversity as a result of river regulation (Brittain and Saltveit ,1989) Interrupted discharges for very long periods, low flows and the development of filamentous algae and macrophytes, contribute to the sucess of *Baetis* sp. in regulated rivers in semiarid zones. However, *T. popayanicus* is also able to adapt to new environmental conditions, which can probably be explained by the characteristics of its life cycle. Nevertheless, others factors are also important in determining a species response to man-made environmental disturbance and change (Brittain,1991).

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