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LARVAL ODONATA DISTRIBUTION AS A DESCRIBER OF FLUVIAL ECOSYSTEMS : THE RHÔNE AND AIN RIVERS, FRANCE

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Odonata larval populations have been sampled during spring and summer in 8 old beds of the Rhône River and in 8 old beds of its tributary, the Ain River, upstream of Lyon (France). The method consists of a series of hand-net samples evenly distributed along the old beds. It does not provide high numbers of larvae in each sample, but the great number of samples allows the comparison of numerous environments in the study area. This research reveals how Odonata larval populations may describe some features of the hydrosystem functioning, e.g. links with the main stream, the rate of groundwater supply, the astaticism of the water bodies and the succession of the old riverbeds toward semi-aquatic and terrestrial conditions.

INTRODUCTION

The alluvial plains of large rivers generally abound in aquatic or semi-aquatic biotopes, which result from the abandonment of old riverbeds by the main river channel. This paper deals with the larval populations of Odonata inhabiting some old beds along a stretch of the Upper-Rhône River and of the lower part of its tributary, the Ain River.

Several authors have emphasized the "environmental monitoring potential" of Odonata, especially of the larval stages (CARLE, 1979 ; WATSON *et al.* 1982 ; SCHMIDT, 1983 ; MOORE, 1984) as well as their ability to describe the temporal succession of aquatic environments (VOSHELL & SIMMONS, 1978) and the degree of astaticism of the water bodies (FISCHER, 1961 ; WIGGINS *et al.* 1980).

Subsequent to these previous research, this paper will discuss the information that can be derived about the functioning of a hydrosystem from studies of Odonata larvae. We did not try to obtain a complete faunal list of the area prospected, but rather to assess the hydrobiological relevance of data obtained from Odonata larvae, which were collected from old riverbeds using a simple sampling method. We strove to assess the role of Odonata larvae as "describers" (BOURNAUD & AMOROS, 1984) of the overall fluvial system, for comparison of old riverbeds, rather than to attempt the description of all microhabitats.

In addition to this purpose, the Odonata associated with wetlands of large rivers, which maintain rich populations (MIELEWCZYK, 1973), are of great interest, especially in France where little is known of their Odonata populations (DEGRANGE, 1981 ; RICHARDOT-COULET *et al.*, 1983).

STUDY AREA

The study area (Fig. 1), 20 km upstream from Lyon, includes the lower course of the Ain River and a stretch of the Rhône River between the confluence with the Ain River and the Jons Bridge. This area has been chosen for three reasons : (1) the abundance of abandoned riverbeds of varying morphology (meanders, i.e. typical "oxbow lakes", or braided channels) ; (2) the, different ages of the abandoned riverbeds. The older meanders were cut off from the Rhône River in the 17th century while the younger meanders on the Ain River were still connected with the main channel between 1972 and 1980 (BRAVARD, 1985) ; and (3) the differing hydrological regimes. Some of the abandoned riverbeds are still connected with the river downstream or are directly influenced by floods, while others are only subjected to extremely high floods or already have semi-aquatic conditions. Another important characteristic of the old beds is their type of water supply other than pluvial or fluvial ; the old beds can be provided with important groundwater supplies from the lateral river underflow or from other underground aquifers.

The Rhône River has been greatly regulated (e.g. by embankments or dams) and no longer creates new biotopes. On the other hand, the Ain River, unregulated in its lower course, still maintains its natural dynamics with sudden and strong floods ; it still creates and abandons meanders, which represent new biotopes where pioneer communities can settle.

Table I summarizes the main features of the 16 old beds studied (8 along the Rhône River from R1 to R8, and 8 along the Ain River from A1 to A8), though each one is generally heterogeneous with a longitudinal zonation.

METHODOLOGY

The principal aim of this study was to sample systematically the larval populations of Odonata on the whole length of many old beds. Hence, for reasons of time and cost, we focused on the size of the area prospected and the number of samples, rather than on the size of each sample. During two periods in 1983 (25 April to 6 May and 16 June to 1 July), 362 samples were collected from the 16 old beds.

A sample consisted of three (0.5-mm meshed) hand-net sub-samples taken in transect across the water body. Transects were carried out regularly each 50 or 70 metres (some times each 100 m). Hand-net sampling (limited to 2 m deep), provides a good picture of the fauna and is well adapted to use in the old riverbeds, which are frequently choked with aquatic vegetation (CASTELLA *et al.* 1984). The gathering of three sub-samples (one near each bank

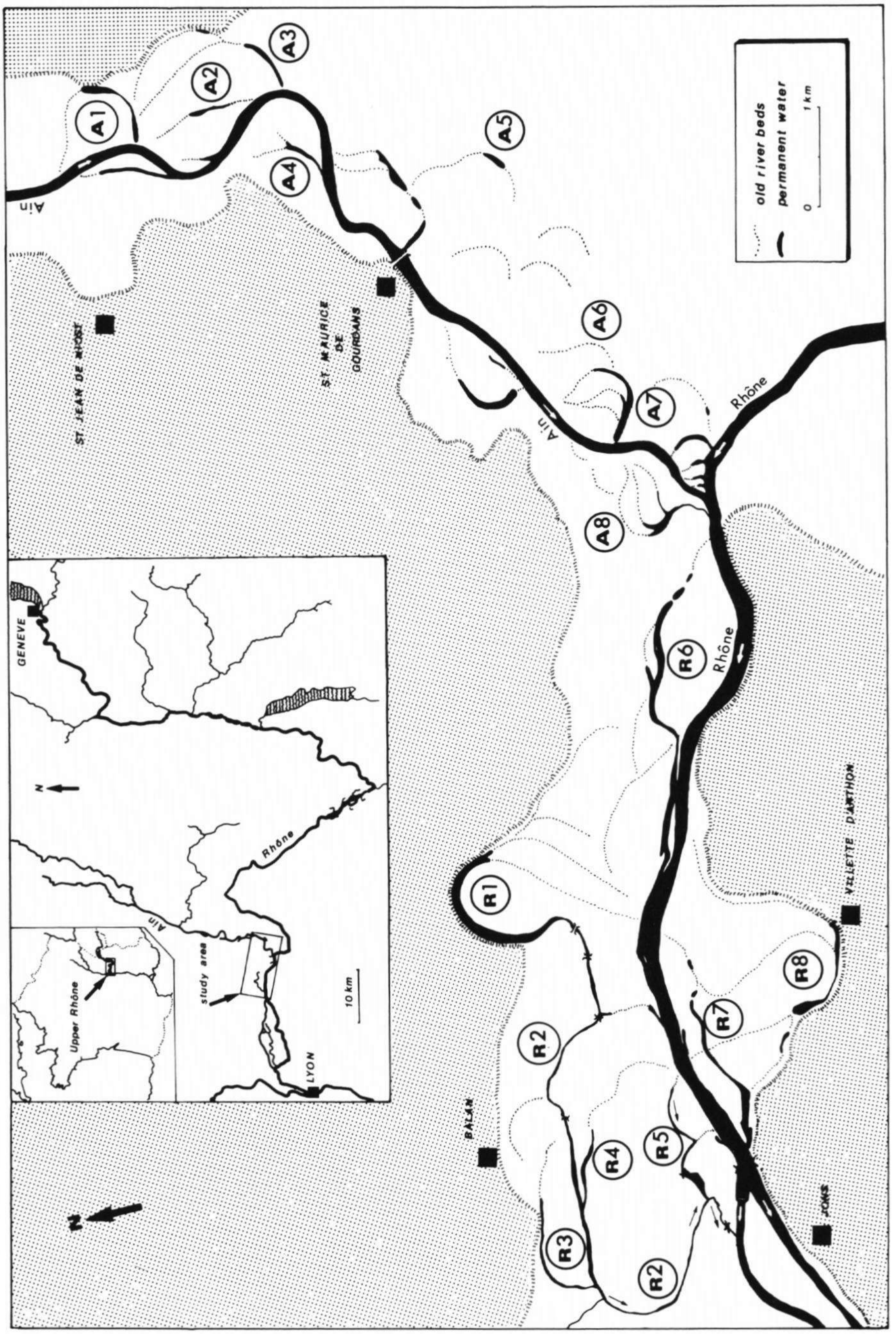


Fig. 1. The study area and the old riverbeds sampled. The 16 old riverbeds studied are indicated by codes: from A1 to A8 for the Ain River, from R1 to R8 for the Rhône River.

Table I

Main features of the old riverbeds studied. From R1 to R8 : old beds of the Rhône River. From A1 to A8 : old beds of the Ain River.

CODE	LOCAL NAME OF THE OLD BEDS	DATE OF UPSTREAM CLOSING	CONNECTION WITH THE MAIN CHANNEL	CURRENT	GROUNDWATER SUPPLY	MAIN AQUATIC MACROPHYTES
R1	Le Grand Gravier	XVII Century	none	null upstream, moderate in the outlet	natural drainage for the northern aquifer of the alluvial plain	*Nuphar lutea*, *Nymphea alba*, *Cladium mariscus*.
R2	La Chaume	XVIII Century	downstream permanently with the Rhône	slight to rapid	outlet of R1, local resurgences from the aquifer	*Berula erecta*, *Mentha aquatica*, *Nuphar lutea*, *Nasturtium officinale*, *Elodea canadensis*, *Potamogeton spp.*
R3	Le Platéron	XVIII Century	none	null to rapid	local resurgences from the aquifer	*Phragmites australis*, *Nasturtium officinale*, *Callitriche sp.*
R4	Bras Sud de la Chaume	XVIII Century	none	null	upstream temporary resurgences	*Phragmites australis*, *Carex sp.*, Characeae.
R5	Les Iles Nouvelles	near 1800	during floods	slight to rapid	drainage of the Rhône underflow	*Carex sp.*, Characeae, *Berula erecta*, *Nasturtium officinale*
R6	Le Méant	1940	upstream with the Ain during floods downstream permanently with the Rhône	null to rapid	numerous resurgences of the river underflow	*Potamogeton spp.*, *Callitriche sp.*, *Berula erecta*, *Elodea canadensis*, *Mentha aquatica*, *Hippuris vulgaris*.
R7	La Lône des Pêcheurs	1890	downstream permanently with the Rhône	null to slight	upstream inputs from the Rhône underflow	*Potamogeton spp.*, *Myriophyllum spicatum*, *Ceratophyllum demersum*, *Phragmites australis*, *Carex sp.*
R8	La Mégris et la Grande Lône	1830	none	null	none	*Nymphea alba*, *Nuphar lutea*, *Ceratophyllum demersum*, *Phragmites australis*, *Lemna minor*.
A1	Le Planet	?	downstream permanently upstream during floods	null to slight	upstream inputs from the Ain underflow	*Scirpus lacustris*, *Carex sp.*, *Potamogeton sp.*, *Nuphar lutea*. Characeae, *Berula erecta*, *Hottonia palustris*.
A2	Ricotti	?	only during floods	null to moderate	upstream inputs from the Ain underflow	Characeae, *Potamogeton sp.*, *Berula erecta*, *Mentha aquatica*, *Carex sp.*
A3	Sous-Bresse	?	progressive closing of the downstream connection with the Ain	null to slight	natural drainage for the surrounding groundwater	Characeae, *Potamogeton spp.*, *Nymphea alba*, *Nuphar lutea*, *Carex sp.*
A4	Gourdans	?	only during floods	null to moderate	upstream inputs from the Ain underflow	Characeae, *Potamogeton spp.*, *Carex sp.*, *Berula erecta*, *Mentha aquatica*, *Myriophyllum spicatum*.
A5	Les Echanots	XVI Century	none	null	?	*Nuphar lutea*, *Nymphea alba*, *Myriophyllum verticillatum*, Characeae, *Potamogeton spp.*
A6	Les Vieux Brotteaux	1940	none temporary biotope	null to slight	upstream temporary inputs from the Ain underflow	*Carex sp.*, *Phragmites australis*.
A7	Les Brotteaux	1956	progressive closing of the downstream connection with the Ain	null to slight	upstream inputs from the Ain underflow	Characeae, *Potamogeton spp.*, *Ranunculus spp.*, *Scirpus lacustris*, *Mentha aquatica*, *Carex sp.*, *Berula erecta*.
A8	Puits Novet	1965–1980	completely overflooded when the Ain River is in spate	null to moderate	upstream temporary inputs from the Ain underflow	*Phalaris arundinacea*, *Ranunculus sp.*, *Potamogeton spp.*,

and one in the central part of the transect) complied with the scale of our study, which was not to describe microhabitats but to compare several old beds. All samplings were carried out by the same operator and provided semi-quantitative data. The number of Odonata per sample was relatively small but this was equalized by the number of samples.

The taxonomical identification of Odonata larvae in this region, though more ambiguous than that of adults, became more reliable with the aid of the recent publication by CARCHINI (1983), especially with regard to Coenagrionidae. Nevertheless, the identification of some species remains quite uncertain, e.g. the distinction between *Coenagrion puella* (L.) and *C. pulchellum* (V.d.L.), between the species of the *Sympetrum striolatum-sanguineum-vulgatum* complex, and the identification of the young *Aeshna* instars.

RESULTS AND DISCUSSION

Table II presents the occurrence of the taxa found in the 16 old beds. The precise localization and abundance of each taxa are shown on maps (Fig. 2 to 6) drawn using computer programmes. These maps are simplified illustrations of the geographic area with sampling transects represented as dots along the old beds and the surface of squares being proportional to the abundance of the taxa. For the theoretical basis of such graphical technics, and for the computer methods and technical realization see AUDA (1983, 1985).

LIMITS OF THE SAMPLING METHOD

The 22 taxa sampled represent a part of the total species living in the environments observed. Owing to the sampling method, to the amount of aquatic vegetation and to the different types of concealment among the species (CORBET, 1962), the "weed-dwelling larvae" (e.g. most of Coenagrionidae, *Sympetrum* and the Aeshnidae) were most certainly overestimated with respect to burrowing species. Some clues for this assertion were the presence of adults that have burrowing larvae, such as the Libellulidae *Orthetrum albistylum* (Selys) near R7 and A8 and the Corduliidae *Somatochlora flavomaculata* (V.d.L.) near R4.

ODONATA IN THE MAIN CHANNEL OF THE TWO RIVERS

Larval studies on the Odonata in the main courses of the two rivers have not been included in this study. Previous research carried out in the active channel, mostly using artificial substrates, provided some larval data. Until now, *Calopteryx splendens* (Harris) was the only species found in the main channels of both the Rhône River (BOURNAUD *et al.* 1978 ; PERRIN, 1978 ; CELLOT, 1982) and the Ain River (PERSAT, 1976). More recently, COGERINO

Table II

Occurrence of the taxa sampled. From R1 to R8 : old beds of the Rhône River.
From A1 to A8 : old beds of the Ain River.

code name of the old riverbeds :	R1		R2		R3		R4		R5		R6		R7		R8		Main channel	A1		A2	A3		A4		A5		A6		A7		A8	Main channel
sampling period (A: April, J: June) :	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	of the Rhône (4)	A	J	J	A	J	A	J	A	J	A	J	A	J	J	of the Ain (5)
Total number of samples (transects)	23	16	17	15	8	5	7	4	9	5	35	35	17	13	8	6		11	13	4	12	11	4	4	3	3	2	2	24	24	22	
Number of samples with Odonata	20	15	8	10	2	1	1	3	4	4	18	16	13	11	5	2		9	13	4	9	11	4	4	3	3	1	1	19	24	15	
CALOPTERYGIDAE																																
Calopteryx virgo (L.)									*			*					*															
Calopteryx splendens (Harris)	*	*									*			*			*															*
LESTIDAE																																
Lestes viridis (Vander Linden)		*		*		*		*				*		*					*	*		*				*				*	*	
PLATYCNEMIDIDAE																																
Platycnemis pennipes (Pallas)		*	*	*				*					*	*	*	*																
COENAGRIONIDAE																																
Ischnura elegans (Vander Linden)	*	*	*	*						*	*		*	*	*	*		*	*	*	*	*	*	*		*			*	*		
Ischnura pumilio (Charpentier)			*	*										*		*						*										
Pyrrhosoma nymphula (Sulzer)		*					*		*			*							*	*			*	*					*	*		
Enallagma cyathigerum (Charpentier)	*	*										*						*	*	*	*	*	*	*					*	*	*	
Coenagrion mercuriale (Charpentier)	*		*	*							*	*																				
Coenagrion (scitulum)? (1)																														*		
Coenagrion puella/pulchellum (2)	*	*	*	*					*	*	*	*	*	*		*		*	*	*	*	*	*	*	*	*			*	*	*	
Cercion lindenii (Selys)										*			*				*													*	*	
Erythromma najas (Hansemann)		*																				*										
Erythromma viridulum (Charpentier)													*	*		*			*			*				*				*	*	
Coenagrionidae, early instars	*	*	*	*	*				*		*	*	*	*	*			*	*	*	*	*	*	*	*	*			*	*		
GOMPHIDAE																																
Gomphus sp. early instars																		*														
AESHNIDAE																																
Brachytron pratense (O.F. Müller)													*																			
Aeshna sp. early instars		*		*				*				*		*					*	*		*									*	
Anax imperator Leach																			*	*		*		*					*	*		
Aeshnidae, early instars	*		*											*						*	*											
CORDULEGASTRIDAE																																
Cordulegaster boltonii (Donovan)				*						*																						
LIBELLULIDAE																																
Libellula depressa L.					*																											
Libellula fulva O.F. Müller	*	*											*								*											
Orthetrum sp. early instars																													*			
Crocothemis erythraea (Brullé)																			*										*			
Sympetrum sp. *sanguineum*-complex (3)	*	*																*	*		*					*	*	*	*	*	*	
Libellulidae, early instars			*										*					*									*		*			

(1) The identification of this species based only on larval stages, remains dubious
(2) The taxonomic separation of the larvae of these two species remains quite uncertain (CARCHINI, 1983)
(3) The taxonomic separation of the three species (*Sympetrum sanguineum, S. striolatum* and *S. vulgatum*) remains dubious (CARCHINI, 1983). Adults of both *S. striolatum* and *S. sanguineum* have been collected in the study area
(4) Data from BOURNAUD *et al.* (1978), PERRIN (1978) and COGERINO (1985).
(5) Data from PERSAT (1976).

(1985), sampling the riparial fauna of the Rhône River near Jons, found *Calopteryx virgo* (L.) and *Cercion lindenii* (Selys) together with *Calopteryx spendens.* The difference in taxonomic richness between the main channels and the abandoned beds (Tabl. II) fits well with the findings of MIELEWCZYK (1973) in the study of a Polish fluvial system, which included riverine water bodies.

SEASONAL OCCURRENCE

In the old beds, the occurence of some species is strongly seasonal. The main example is *Lestes viridis* (V.d.L.), a late species (AGUESSE, 1968) completely absent from the first sampling period ; the pro-larvae just begin to fall down in the water during late April and early May (GEIJSKES & VAN TOL, 1983). Among the frequently occurring larvae, *Erythromma viridulum* (Charpentier) (in the Ain area) and *Aeshna* sp. are also found only during the June-July period. On the other hand, old larvae of the early *Brachytron pratense* (Müller) (AGUESSE, 1968 ; d'AGUILAR *et al.* 1985), have only been found during the April-May period.

BACKGROUND COMPOSITION OF THE ODONATA POPULATIONS IN THE STUDIED SYSTEM

The most common taxa in the old beds studied are shown in Fig. 2. *Ischnura elegans* (V.d.L.), *Coenagrion puella/pulchellum* (probably dominated by *C. puella* (L.) as it is the only species to date collected as an adult) and *Lestes viridis* (V.d.L.) are exceedingly ubiquitous species that are usually characteristic of lentic systems with large amounts of aquatic and riparial vegetation ; they all, especially *Lestes viridis,* also tolerate fluvial conditions. Besides the information on these "background species", data on Odonata populations help characterize the two subsystems of the study area : the Rhône and the Ain.

ODONATA SPECIES OF THE RHÔNE RIVER

The old beds of the Rhône River are generally differentiated by a group of species that are found in running or slow-moving waters (Fig. 3). The occurrence of *Platycnemis pennipes* (Pallas), particularly abundant in R7, is associated with the slight water movements present in this old bed, which is still connected downstream with the Rhône and influenced by the hydraulic

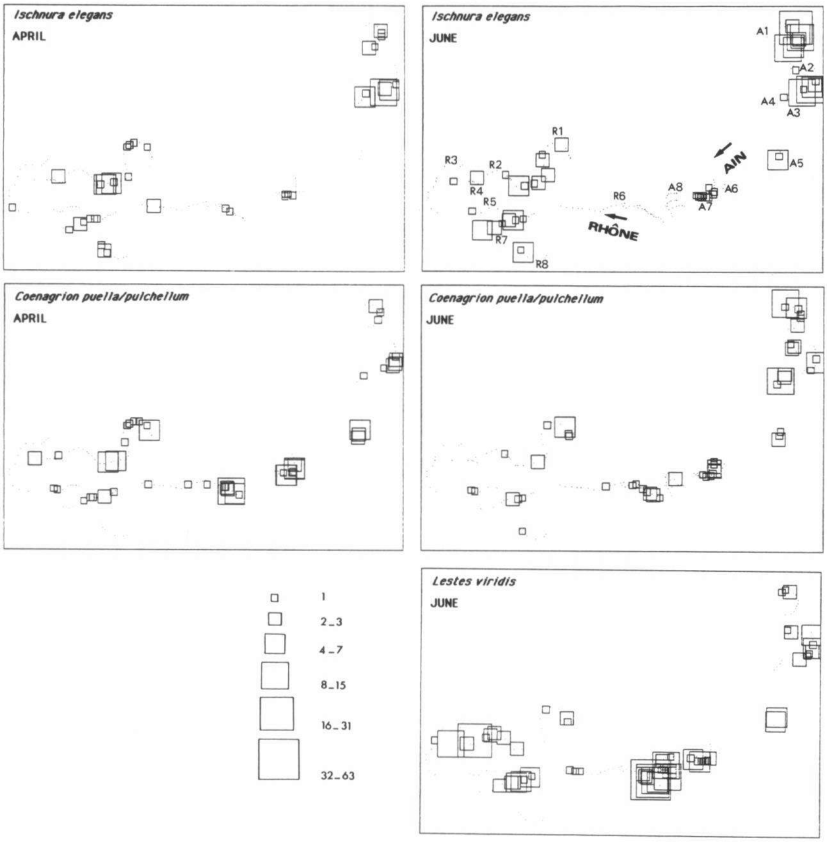


Fig. 2. Background composition of the Odonata populations in the old beds studied. Each map is a simplified illustration of the geographic area with sampling transects represented as dots along the old beds and the surface of squares being proportional to the number of individuals in one sample. From A1 to A8 : old beds of the Ain River ; from R1 to R8 : old beds of the Rhône River.

variations (JUGET & ROUX, 1982). The other species of this Rhône group occur in the old beds where water movements are caused by an important groundwater flow. These old beds are drainage systems for the lateral riverine underflow (R5, upstream part of R6) or for the aquifer on the north side of the alluvial plain (R1,R2) (REYGROBELLET & DOLE, 1982). The downstream outlet of R1 and the upstream part of R2 harbour an association including *Calopteryx splendens* (Harris), *Coenagrion mercuriale* (Charpentier) and *Libellula fulva* Müller. The swifter and more oligotrophic sites harbour *Calopteryx virgo* (L.) together with *Cordulegaster boltonii* (Donovan) in R5 or with *Coenagrion mercuriale* (Charpentier) in R6. The stretches of R1, R2

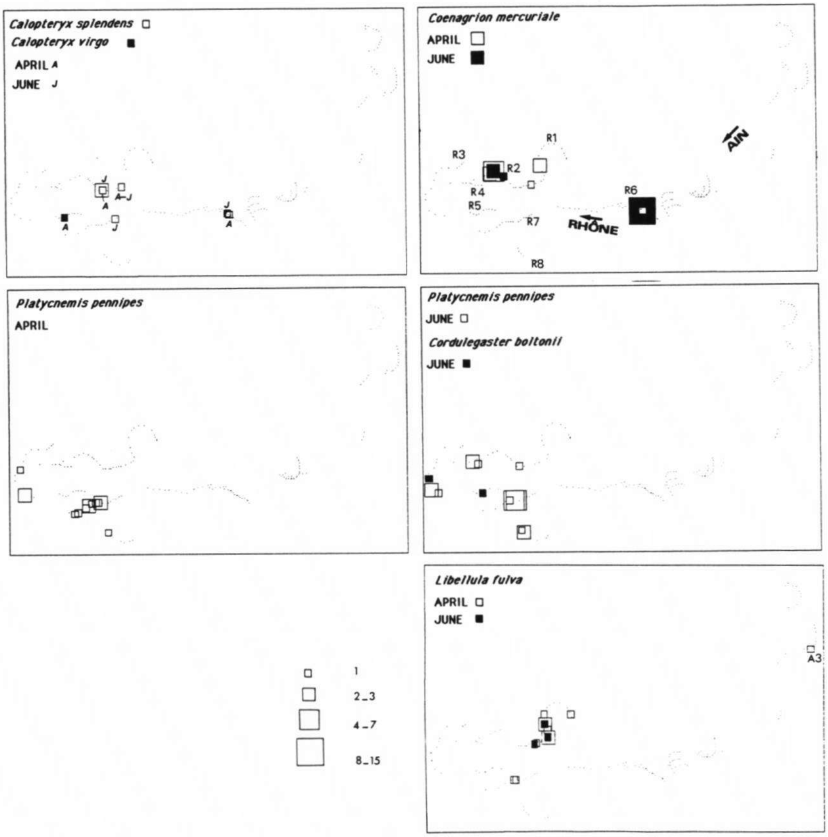


Fig. 3. Odonata species of the Rhône old beds. Each map is a simplified illustration of the geographic area with sampling transects represented as dots along the old beds and the surface of squares being proportional to the number of individuals in one sample. From R1 to R8 : old beds of the Rhône River ; A3 : old bed of the Ain River.

and R6 where *C. mercuriale* occurs show many resurgences of calcium-rich groundwater and, because of the slow decomposition of the aquatic vegetation in oligotrophic conditions, the sediment in R1 is very peaty. *C. mercuriale*, which is known to inhabit peat-bog runnels or seepage springs (CORBET, 1955 ; KNIGHTS, 1983 ; WILDERMUTH & SCHIESS, 1983), finds suitable larval biotopes in this fluvial system.

ODONATA SPECIES IN THE AIN RIVER

The old beds of the Ain River are characterized by three taxa that are almost completely absent from the Rhône system (Fig. 4). Although known

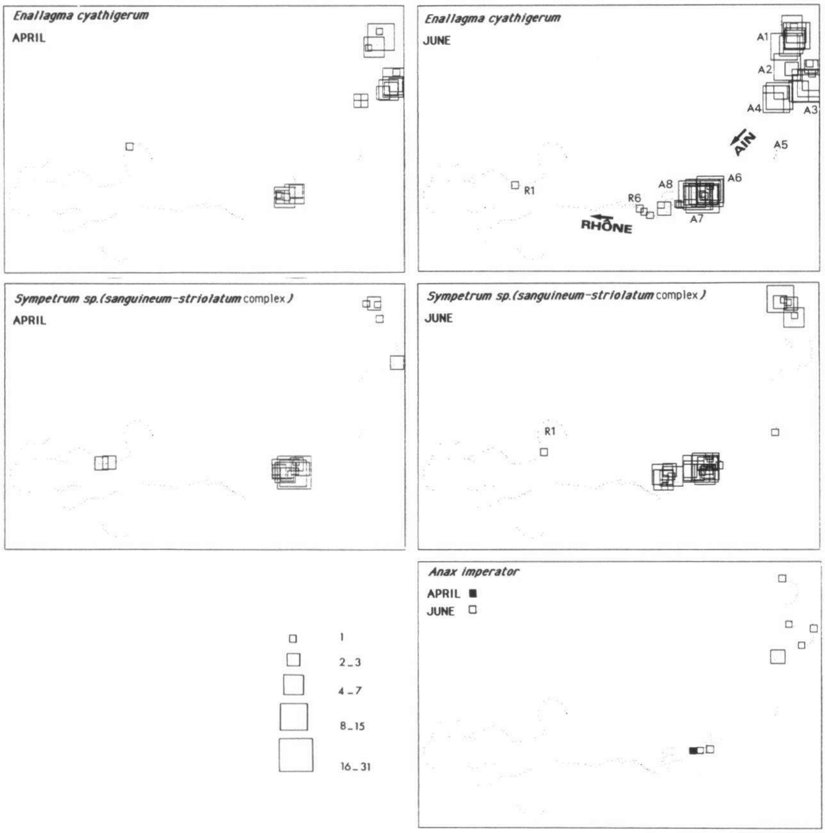


Fig. 4. Odonata species of the Ain old beds. Each map is a simplified illustration of the geographic area with sampling transects represented as dots along the old beds and the surface of squares being proportional to the number of individuals in one sample. From A1 to A8 : old beds of the Ain River ; R1 : old bed of the Rhône River.

as "exceedingly adaptable" (CORBET *et al.* 1960), *Enallagma cyathigerum* (Charpentier) is clearly distinctive for the old beds of the Ain River. This very eurytopic species is frequently reported as typical for mountain lakes (AGUESSE, 1968 ; COUTIN & DOMMANGET, 1980) and for artificial, newly-created habitats such as gravel pits (MOORE, 1976 ; DONATH, 1983) ; and, GEIJSKES & VAN TOL (1983) have cited *E. cyathigerum* as a dominant species in oligotrophic stagnant waters. *Anax imperator* Leach and *Sympetrum striolatum* (Charpentier) are also known as pioneer species (GARDNER, 1954 ; AGUESSE, 1968 ; WILDERMUTH & SCHIESS, 1983 ; d'AGUILAR *et al.* 1985). The *Sympetrum* of the *sanguineum*-complex (*S. striolatum* (Charpentier) and *S. sanguineum* (Müller) have both been collected as adults near the old beds of the Ain) are clearly linked with astatic zones that are in transition towards semi-aquatic and terrestrial conditions (MIELEWCZYK, 1973 ; WIGGINS *et al.* 1980 ; DEGRANGE, 1981 ; GEIJSKES & VAN TOL, 1983) such as the upstream part of A1 and both A6, A7 and A8. *Erythromma viridulum* (Charpentier) can also be added to the faunal characterization of the Ain's old beds (Fig. 5). This little-known species has also been collected in new artificial biotopes (FRANCEZ, 1982) or from pools created by river overfloods (GEIJSKES & VAN TOL, 1983). Its occurrence in the downstream part of some old beds (A1, A3, A7, and also R7 on the Rhône) could be linked with the influence of the main river flow on these zones. This characterization of the Ain's old beds is strongly relevant with regard to the hydrosystem's functioning ; the old beds of the Ain River can be considered as "young ecosystems", which succeed on a decade time scale, with regard to the Rhône ecosystems, which succeed on a century time scale. Owing to their rapid evolution, which is linked with the progressive subsiding of the lower course of the river (BRAVARD, 1985), the old beds of the Ain are sites of important successional processes that lead to a terrestrial habitat. The influence of groundwater from the Ain's lateral underflow is strong ; it maintains the water at a certain level of renewal and oligotrophy, but does not create such superficial permanent flows as in the Rhône system.

ODONATA AS INDICATORS OF LOCAL FEATURES OF THE HYDROSYSTEM

Besides the characterization of the Rhône and the Ain, some species or groups of species can be regarded as indicators for some local aspects of the old riverbeds. Among these species, *Coenagrion mercuriale* (Fig. 3) has already been mentioned as linked with zones of flowing resurgences of groundwater ; *Cercion lindenii* (Selys) (Fig. 5) also appears to be associated with zones of slight flow, due to groundwater inputs (R5, A7, A8), or to the proximity of the main channel (downstream part of R7). The distribution of *Pyrrhosoma nymphula* (Sulzer) (Fig. 5) corroborates the observations of RUDOLPH (1978) ; though very adaptable (CORBET *et al.* 1960) and not confined to narrow ecological limits, this species' distribution can be very limited in a given system. In the fluvial system studied, *P. nymphula* appears to be restricted to the upstream part of some old beds (R4, R5, A1, A2, A4, A7) where important water level fluctuations or desiccation can occur ; these sites, and the others where the species is found (R1, R6) are also renewed with important groundwater inputs. DUMONT (1971) stressed the possible

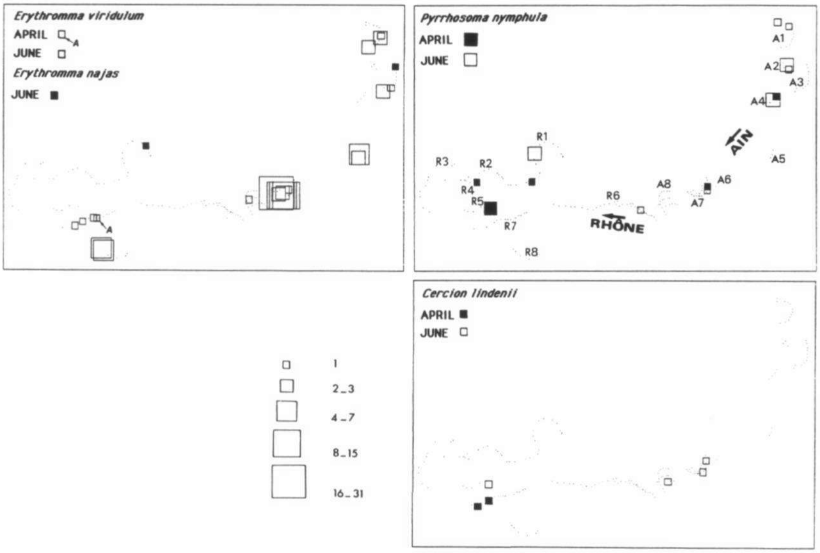


Fig. 5. Odonata species associated with some local features of the old beds functioning (upstream zones of resurgences, zones influenced by the main channel). Each map is a simplified illustration of the geographic area with sampling transects represented as dots along the old beds and the surface of squares being proportional to the number of individuals in one sample. From A1 to A8 : old beds of the Ain River ; from R1 to R8 : old beds of the Rhône River.

expulsion of *P. nymphula* from potential habitats by competition with other Coenagrionidae ; the absence of other Coenagrionidae in sites such as the upstream parts of R4 or R5 can be considered as evidences for this assertion ; but, the ecological tolerance of *P. nymphula* to water level fluctuations (RUDOLPH, 1978 ; WELLINGHORST & MEYER, 1982) could also certainly interfere.

The Ain River with its lower course in constant morphological modification, due to its active dynamics and sudden floods, provides the opportunity to verify the observations of FISCHER (1961) concerning the dominance of Lestidae over Coenagrionidae in astatic environments. Owing to their relative distance toward the Ain confluence, which is the point of maximum geomorphological instability, a gradient of increasing astaticism exists between the three typical old meanders A1, A7 and A8. A1 could be regarded as the most "stable" riverbed with low impacts of floods and relative stability of the water level, contrastingly, A8 is the most "astatic" bed, being annually overflooded and submitted to high summer desiccation. In A1, *Enallagma,*

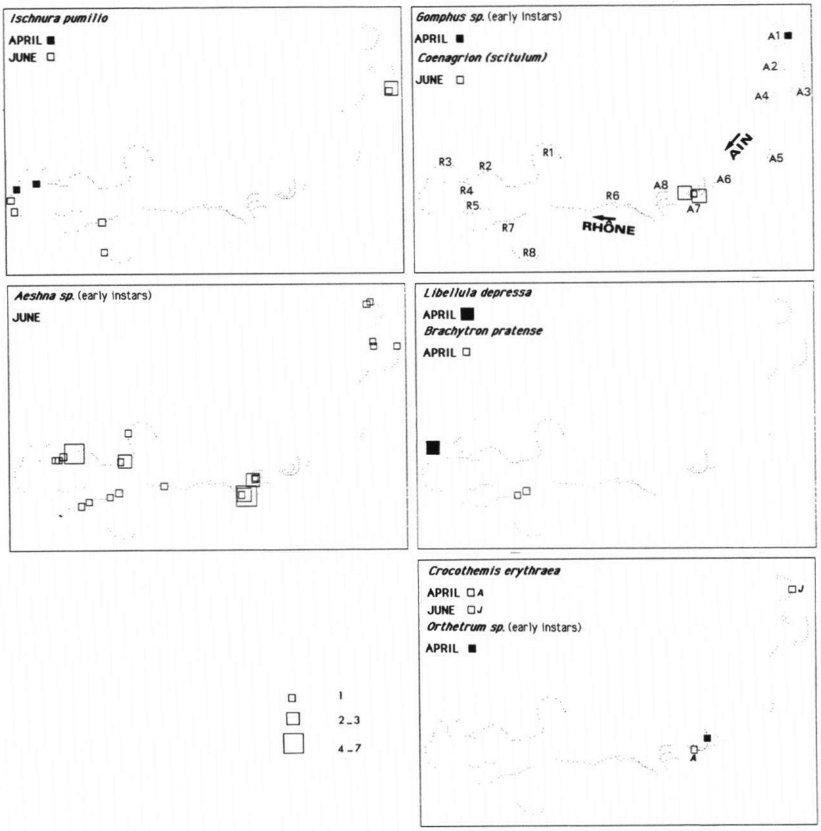
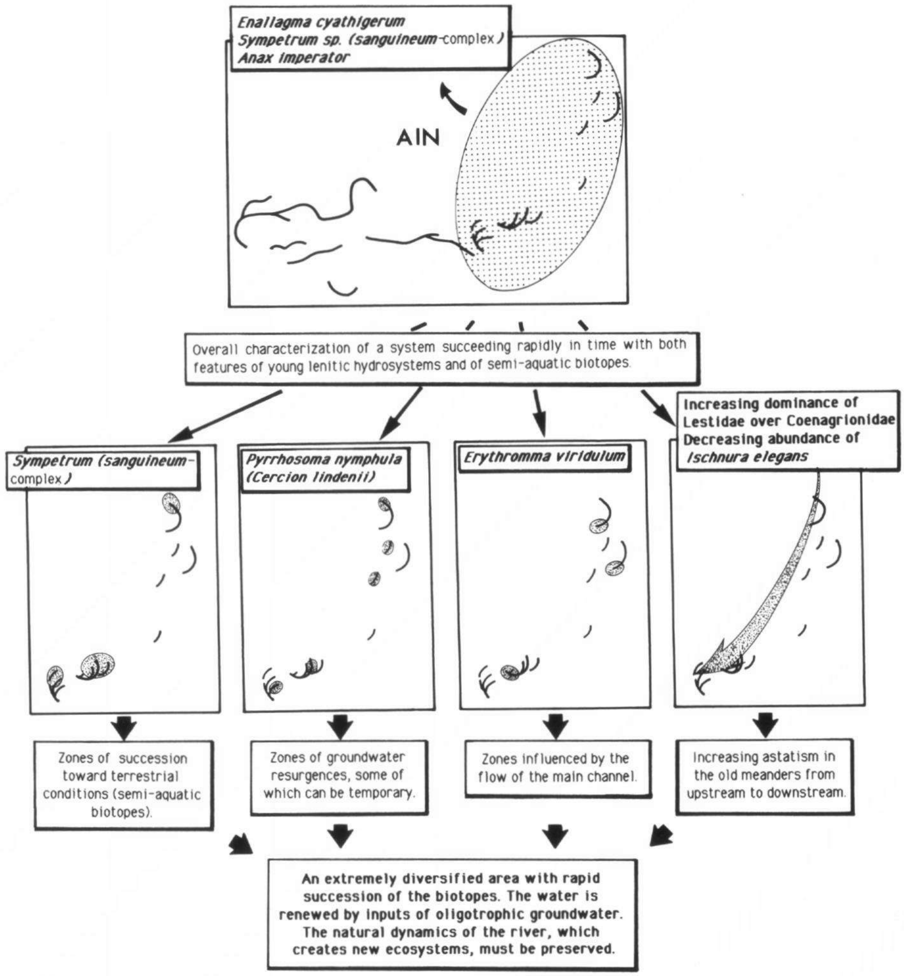


Fig. 6. Rare or localized taxa. Each map is a simplified illustration of the geographic area with sampling transects represented as dots along the old beds and the surface of squares being proportional to the number of individuals in one sample. From A1 to A8 : old beds of the Ain River ; from R1 to R8 : old beds of the Rhône River.

cyathigerum, Coenagrion puella/pulchellum and *Ischnura elegans* joined together, largely outnumber *Lestes viridis* ; in A7, the three Coenagrionidae always exceed *L. viridis*, but it appears more numerously than in A1 ; reversly, in A8, *L. viridis* outnumbers the very few Coenagrionidae (of which *I. elegans* is absent). The upper part of R6, very close to the Ain confluence, shows the same kind of astaticism as that of A8 and also the same ratio between Lestidae and Coenagrionidae (dominance of *L. viridis*, absence of *I. elegans*). These data confirm the findings of FISCHER (1961) and show the relevance of the Lestidae-Coenagrionidae ratio in the assessment of the degree of astatism in aquatic environments.

CONCLUSION

The extensive overview developed in this work provides an insight concerning some autecological problems in Odonata that demand study. From existing knowledge of species ecology, the data obtained from Odonata larvae sampled during a precise period (which are only a fraction of the species actually present) provide useful information for working out an



ecological diagnosis of the hydrosystems in question. The data provided by the June-July samplings were sufficient to make our diagnosis and eliminated the need for a more exhaustive inventory. Figure 7 summarizes such a diagnosis, which provides two levels of information : 1) the overall functional characterization of two sub-systems (Ain River and Rhône River) ; and, 2) more detailed functional information on local aspects of the old riverbeds (flows, astaticism, succession toward terrestrial conditions). In conjunction

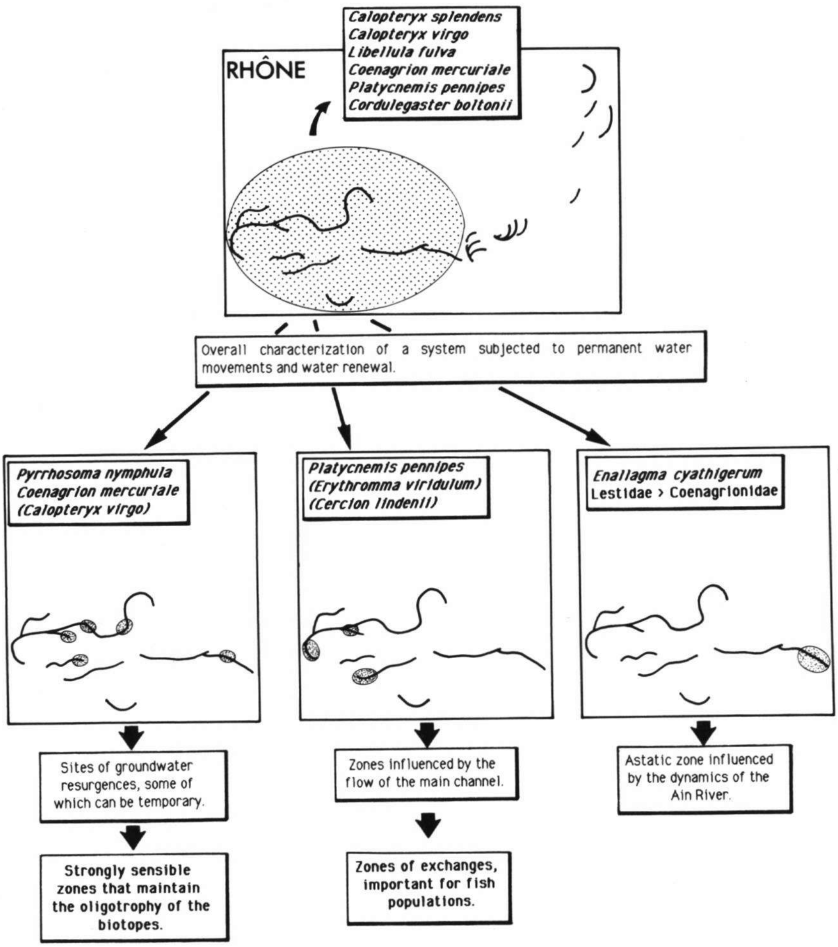


Fig. 7. Ecological diagnosis of the old riverbeds studied, based upon data concerning the Odonata larvae. The potential utilization of this functional diagnosis for the management of the riverine wetlands is stressed.

with the current knowledge of the geomorphological and hydraulic functioning of old riverbeds, data on Odonata larval populations can be a useful tool in the management of the alluvial plains such as the Upper-Rhône area (Roux, 1982) and of endangered riverine wetlands. Such faunal tools or "function describers can assist in the management of fluvial system, since it allows us to diagnose not only the state but also the evolution potential of the ecosystem" (Bournaud & Amoros, 1984). Diagnosis of Figure 7 shows how data on Odonata larvae can be taken into account in such a management methodology.

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