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SHORT COMMUNICATIONS

BIODIVERSITY OF RHEOPHILOUS ODONATA IN SOUTHERN SPAIN

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Biodiversity is a complex issue, frequently simplified by equating it with species richness. In this paper an assessment of river systems biodiversity in southern Spain is carried out. Four systems here analysed run through mountains of medium altitude and they are remarkable for their acceptable species richness, high proportion of spp. with a restricted western Mediterranean distribution and low ratio of spp. per genus. Species distinctness was estimated according the schemes of R.I. VANE-WRIGHT et al. (1991, *Biol. Conserv.* 55: 235-254) and R.M. MAY (1990, *Nature, Lond.* 347: 129-130), based on the information content of the topology of a hierarchical classification.

INTRODUCTION

Rheophilous Odonata communities in the Mediterranean Basin are relatively species-rich, compared with fluvial systems in northern and central Europe, where dragonflies and damselflies occupy, by preference, lentic environments (CARCHINI & ROTA, 1982, 1985; JURZITZA, 1993; FERRERAS-ROMERO & GARCÍA--ROJAS, 1995), a fact partly explained by their low exposure to past glaciations, and because the Mediterranean types of ecosystems are particularly heterogeneous (BALLETTO & CASALE, 1991). The conservation of biodiversity is a worldwide need, with several approaches being developed to score its value. Frequently, diversity is expressed by species richness or some cardinal index, which is a simple measure, and takes all species as intrinsically equivalent. However, species are different in many aspects, both in local-ecological and regional-historical contexts (RICKLEFS, 1987). Besides species richness and abundances, a criteria conceptually added in a conservationist context consist mainly of qualifying species accord-

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ing to some intrinsic features such as rarity, geographic and taxonomic (OJEDA et al., 1975). It is worth attempting a first account of biodiversity of Mediterranean dragonfly communities by a multiple approach: species richness, geographic rarity and taxonomic singularity or distinctness (VANE-WRIGHT et al., 1991; MAY, 1990), that express ecological and evolutionary values of the communities.

METHODS

Data from four fluvial systems in southern Spain were analysed: basins of the rivers Yeguas (FERRERAS-ROMERO & GARCÍA-ROJAS, 1995; BELLE, 1985), Guadiato (FERRERAS--ROMERO, 1979; FERRERAS-ROMERO & CORBET, 1995) and Bembezar (FERRERAS-ROMERO, 1988) in the Sierra Morena Mountains, and basin of the Hozgarganta river (FERRERAS-ROMERO et al., 1998; AGÜERO-PELEGRÍN et al., 1998) at the northern side of the Gibraltar Strait. Twenty-eight sampling sites (seven at each catchment) were considered.

For biogeographical analysis, the whole geographic range of each recorded species was taken from information in ASKEW (1988) and PETERS (1991). A chorological type geographically restricted to Western Mediterranean was considered as endemic sensu lato. Species with western Mediterranean distribution here considered were: *Calopteryx xanthostoma* (Charp.), *C. haemorrhoidalis* (Vander L.), *Platycnemis latipes* Ramb., *P. acutipennis* Sél., *Ischnura graellsii* (Ramb.), *Boyeria irene* (Fonsc.), *Gomphus simillimus* Sél., *G. graslinii* Ramb., *Onychogomphus uncatus* (Charp.), *O. costae* Sél., *Oxygastra curtisii* (Dale), *Macromia splendens* (Pictet) and *Orthetrum nitidinerve* (Sél.).

Taxonomic singularity can be scored through to assign indices of taxonomic distinctness to each of the species in question. Estimation for the different catchments and habitat types were calculated taking into account taxonomic distinctness according the schemes of VANE-WRIGHT et al. (1991) and MAY (1990), based on the information content of the topology of a hierarchical classification, for this work European Odonata classification according to ASKEW (1988). On the basis of 117 European species, *Calopteryx xanthostoma*, *Boyeria cretensis* Peters and *Somatochlora meridionalis* Nielsen, were regarded as valid species, European taxonomic singularity as a whole is 159.4 (according to the index of Vane-Wright et al.) or 214,9 (index proposed by May). Iberian species here recorded with highest value to first index was *Cordulegaster boltonii* (Don.) (2.33) and species with lowest value *Anax imperator* Leach (1.00). According to May' index, Iberian species with highest values belong to genera *Sympecma* (and *Lindenia*) (3.33), *Platycnemis*, *Cordulegaster*, *Oxygastra* and *Macromia* (3.00), and species with lowest values of index those belonging to genus *Sympetrum* (1.00).

RESULTS AND DISCUSSION

Three components of biodiversity, richness, taxonomic singularity and geographic rarity (endemism) were considered in this study, to assess the conservation value of the catchments and most characteristic types of rheophilous communities in southern Spain. The richness, taxonomic singularity and endemism for each catchment are shown in Table I. The number of species recorded per site ranged from 3 to 17 (average 9). In six localities on main channels of basins, three on seasonal streams and on those three 'throat' (*Garganta*), wide streams in naturally vegetated area, sampled in mountains system of Aljibe (catchment of river Hozgarganta), more than ten species were found.

Richness, taxonomic singularity and endemism averaged by catchment and habitat

type are shown in Table II. Two catchments, Bembezar and Hozgarganta, with the same richness (24 spp.) and similar taxonomic singularity, around 22% of that one the whole of Europe, showed interesting differences as for taxonomic singularity averaged and endemism in the respective sampling sites (scarcely two versus five species). The taxonomic singularity average was significantly different between these catchments (t-test = 2.74, d.f. = 12, $p = 0.01$; t-test = 3.01, d.f. = 12, $p = 0.01$; according the indexes of Vane-Wright et al. and May, respectively).

Table I
Richness, taxonomic singularity and endemism for each catchment

Catchment	Richness	Biodiversity component Taxonomic singularity VANE-WRIGHT	MAY	Endemism
Yeguas	23	33.13	48.08	9
Guadiato	28	39.76	56.69	9
Bembezar	24	33.35	47.25	6
Hozgarganta	24	34.88	51.28	8

As for habitat types, 'Throat' (*Garganta*) showed highest mean in species richness (range 11-13), taxonomic singularity and endemism. In Sierra Morena Mountains, little streams with permanent flow and closed canopy of deciduous trees over most of its length, in spite of low species richness, support populations of interesting endemic species, i.e. *C. haemorrhoidalis*, *B. irene* and *O. uncatus*. Highest values of richness was found in localities in the main chanel of the rivers Guadiato, 200 m a.s.l. (17 spp), Yeguas, 550 m (14), and Hozgarganta, 155 m (14). Likewise, most of endemic species appears associated with sites on main channel of basins, e.g. *Calopteryx xanthostoma*, *Platycnemis acutipennis*, *P. latipes*, *Gomphus graslinii*, *Oxygastra curtisii* and *Macromia splendens*. Seasonal streams showed a mid level of taxonomic singularity, but with lowest endemism average.

In general, endemism showed a direct relationship with taxonomic singularity:

Table II
Richness, taxonomic singularity and endemism averaged by catchment and habitat types (mean ± SE)

Locality	Richness	Biodiversity component Taxonomic singularity VANE-WRIGHT	MAY	Endemism
CATCHMENT				
Yeguas	8.5	11.95 ± 1.73	17.43 ± 2.68	3.1
Guadiato	10.7	15.15 ± 2.26	21.79 ± 3.24	3.4
Bembezar	6.8	9.28 ± 1.50	13.09 ± 2.13	1.5
Hozgarganta	10.7	15.42 ± 1.66	23.03 ± 2.51	5.0
HABITAT TYPE				
Main channel (n=12)	10.0	14.09	21.04	4.1
Perm. streams (n=5)	6.0	9.14	13.82	3.0
'Throat' (n=3)	12.0	17.05	25.31	5.0
Seas. streams (n=8)	9.0	12.09	16.23	1.5

communities containing most endemic species, e.g. some sites on main channel of catchments, show a high taxonomic singularity. Some endemic species studied here are not apparently endangered since they are locally abundant, but the scarce populations found of *Gomphus graslinii*, *Oxygastra curtisii* and *Macromia splendens* seem very reduced.

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