Odonatologica 36(1): 1-12 *March 1, 2007*

This pdf has colour graphs instead of the b&w published in the printed version

A PRELIMINARY STUDY OF BIODIVERSITY HOTSPOTS FOR ODONATES IN GALICIA, NW SPAIN

M. AZPILICUETA AMORÍN[1], C. REY RAÑÓ[2], F. DOCAMPO BARRUECO[2], X.L. REY MUÑIZ[2] and A. CORDERO RIVERA[1]*

[1] Grupo de Ecoloxía Evolutiva e da Conservación, Departamento de Ecoloxía e Bioloxía Animal, Universidade de Vigo, E.U.E.T. Forestal, Campus Universitario, ES-36005 Pontevedra, Galicia, Spain

[2] Sociedade Galega de Historia Natural, Sección de Entomoloxía, Apdo. de Correos n° 303, ES-36600 Vilagarcía de Arousa, Galicia, Spain

Received April 4, 2006 / Revised and Accepted May 12, 2006

The analysis of distribution data of odon. in NW Spain indicates the presence of 49 spp. *Macromia splendens, Oxygastra curtisii, Gomphus graslini* and *Coenagrion mercuriale* are protected under the European Habitats Directive and Spanish Law. Localities of specimens collected between 1978 and 2004 were situated in UTM squares of 10x10 km to produce a map of species richness for the region. Additionally, all localities (UTM 1 x 1 km) where protected and rare spp. were found are introduced in a GIS system, on a map of the Natura 2000 network of the region. The results indicate that *O. curtisii* and *C. mercuriale* are common in NW Spain. As local rare taxa are identified *Brachytron pratense, Aeshna affinis* and *Erythromma viridulum,* because they were found in less than 10 squares, and are also relatively rare in the Iberian peninsula. As areas of special interest are selected those that include all known populations of *M. splendens, G graslini,* and *B. pratense,* all localities with at least 2 of the 4 protected spp., and areas with more than 20 spp. This gives a list of 24 hotspots, most of them (15) at least partially included in the Natura 2000 network. Unfortunately the analysis also reveals that the knowledge of this group is clearly fragmentary, with most records concentrated on the coastal region, and very few squares sampled more than 20 times, the minimum to obtain reliable data. Therefore a systematic sampling of the region is needed to properly identify areas with high species richness.

INTRODUCTION

The current rate of biodiversity loss is mainly due to overexploitation, habitat destruction and introduction of exotic species (HUNTER, 1996). All these causes

* **Corresponding author:** adolfo.cordero@uvigo.es

are in fact different sides of the same problem, the fact that human population is growing at an exponential rate, and demanding a huge quantity of resources (EHRLICH & EHRLICH, 1993; HALL et al., 2000). Given the social, demographic and economic pressures on land, setting aside large areas for biodiversity preservation is an unrealistic scenario. Therefore conservationists have tried to identify areas of special concern, where a large fraction of biodiversity is concentrated, known as "biodiversity hotspots" (BIBBY et al., 1992; BIBBY, 1998; REID, 1998; MYERS et al., 2000). These hotspots are concentrated in tropical and subtropical areas, where paradoxically human population is growing faster than in temperate areas (CINCOTTA et al., 2000), a fact that does not allow optimism on the conservation of these areas.

Using the former concept of global hotspots for regional conservation is unrealistic, as it leaves a great part of Earth's biodiversity outside of protection goals. We give a practical sense to this concept to include areas of special relevance due to the presence of a number of species higher than regional average, or to the presence of endangered and rare species. Under this approach the identification of local hotspots might be of special relevance for regional conservation planning (REY BEN AYAS & DE LA MONTANA, 2003). There is evidence that biodiversity hotspots are not geographically concordant among taxonomic groups (PRENDERGAST et al., 1993). This fact indicates that no single group can be used as an indicator of overall diversity. Therefore we should detect and propose areas of special relevance for important taxonomic groups.

In this paper our aim is to use all available information to detect hotspots for Odonata in NW Spain. We have selected this group because odonates are large and conspicuous animals with complex life-histories (CORBET, 1999), that are good indicators of the situation of riverine and wetland ecosystems (CORBET, 1995; EDA, 1995; SAMWAYS & STEYTLER, 1996; CHOVANEC & RAAB, 1997; CHOVANEC & WARINGER, 2001). Furthermore, these animals are taxonomically rather well-known in Europe (ASKEW, 1988), and previous accounts of faunistic studies have been published in the studied region (OCHARAN, 1988; CORDERO, 1996). Finally, odonates are "umbrella" species for freshwater invertebrate conservation and are emblematic, probably as charismatic as butterflies (NEW et al., 1995), and several taxa are included in European lists of endangered species (VAN TOL & VERDONK, 1988).

METHODS

This study is a summary of the available data on Odonate distribution in NW Spain. We identified all the specimens (N = 3,085) preserved in the Laboratory of Ecology of the Forestry School of Pontevedra (University of Vigo, Spain), Natural History Museum of Ferrol and private collections of authors, that have been collected between 1978 and 2004, although most of them were collected between 1995 and 2004. Furthermore, we also included in the analysis 723 personal sightings of common species, without voucher specimens, and 272 bibliographic records (mainly based on

OCHARAN, 1987; JODICKE, 1996). Species identification follows ASKEW (1988). Localities of collection were found in 245 UTM squares of 1 Ox 10 km (of a total of 365), and distribution maps were produced with ArcMap 9.1 (www.esri.com). These maps reflect the presence of species but cannot easily give an impression of sampling bias, which is a problem in most biological databases. The number of records per square clearly depends on sampling intensity (DENNIS, 2001; WILLOTT, 2001; MORENO & HALFFTER, 2001a, 2001b), which in turn might depend simply on distance to universities and other research centres (DENNIS & THOMAS, 2000). Therefore we estimated the minimum number of samples needed to obtain reliable estimates of odonate richness by a species rarefaction curve based on the number of samplings made in each square. Given the limited geographical extent of this study, and specially the scarcity of records, we have assumed that all squares may have a similar number of species, which is incorrect at larger scales, but a good approximation when data are limited (HORTAL et al., 2001; LOBO & MARTIN-PIERA, 2002).

Localities (UTM 1 x 1 km when possible) where protected species were found were included in a GIS system based on ArcMap 9.1, and then overlaid on a map of the Natura 2000 network of the region. Boundaries of Natura 2000 areas were obtained from the regional government web site *(www.xunta.es/conselle/cma/CMA05e/CMA05ehlp05eh01 .htm)*. This methodology is equivalent to preliminary GAP analysis (SCOTT et al., 1993; JENNINGS, 1995; PRENDERGAST et al., 1999). The proportion of habitats that is protected was estimated by overlaying the boundaries of the Galician Inventory of Wetlands (RAMIL REGO et al., 2003) with the boundaries of Natura 2000 habitats using Arc View.

RESULTS

We collected a total of 46 species (see Tab. I), and found published records of three additional species not recorded in our survey. Species richness in squares of 10 x 10 km oscillates between 1 and 31 (Fig. 1). Most records lie on coastal areas, but we have some information on only 67% of squares. The relationship between the number of samplings and species richness in the visited squares (Fig. 2) suggests that most squares are poorly studied, and about 20 samplings are needed to obtain a good representation of the local fauna.

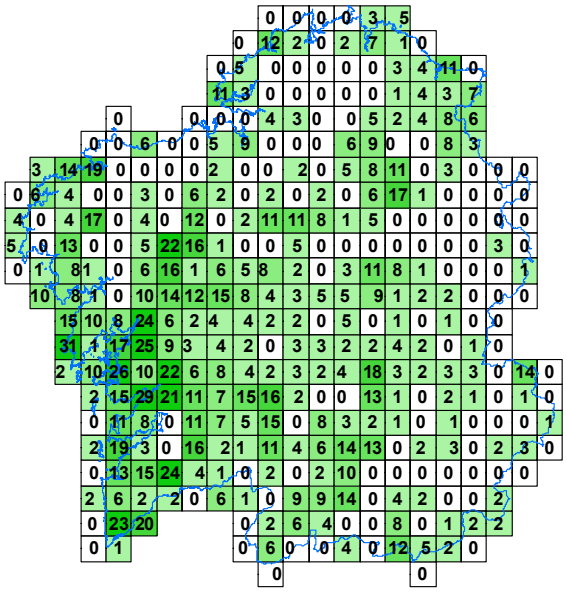

Fig. 1. The number of species found in the squares (UTM 10 x 10 km) sampled during this study and bibliographic records.

Table II shows the relative importance of dif-

Table I

List of species found in Galicia, with their abundance. Species protected under Spanish law are shown in bold. Number of habitats is based only on personal records

Species	Number habitats	UTM squares	Number of records
Calopteryx haemorrhoidalis	10	29	82
Calopteryx virgo	14	150	336
Calopteryx xanthostoma	6	58	118
Lestes barbarus	6	13	29
Lestes dryas	11	17	39
Lestes virens	10	32	76
Chalcolestes viridis	11	41	86
Sympecma fusca	5	9	23
Platycnemis acutipennis	9	45	105
Platycnemis latipes	7	46	90
Pyrrhosoma nymphula	15	124	248
Erythromma lindenii	6	27	62
Erythromma viridulum	3	8	17
Coenagrion mercuriale	9	41	105
Coenagrion puella	10	36	90
Coenagrion scitulum	7	24	118
Enallagma cyathigerum	10	38	108
Ischnura elegans	6	18	155
Ischnura graellsii	13	64	432
Ischnura pumilio	6	11	24
Ceriagrion tenellum	16	54	281
Aeshna affinis	3	2	5
Aeshna cyanea	14	22	33
Aeshna mixta	6	10	23
Anax imp erat or	14	65	120
Hemianax ephippiger	3	4	4
Brachytron pratense	4	3	9
Boyeria irene	9	79	140
Gomphus graslini	2	2	18
Gomphus pulchellus	8	30	66
Gomphus simillimus	4	12	22
Gomphus vulgatissimus		1	1
Onychogomphus forcipatus	2	5	5
Onychogomphus uncatus	7	68	126
Cordulegaster boltonii	17	114	186
Oxygastra curtisii	9	44	129
Macromia splendens	4	13	35
Libellula depressa	9	27	37
Libellula quadrimaculata	15	39	64
Orthetrum brunneum		2	2
Orthetrum cancellatum	9	27	43
Orthetrum coerulescens	16	63	115
Crocothemis erythraea	6	22	43
Sympetrum fonscolombei	8	26	45
Sympetrum meridionale	2	8	14
Sympetrum pedemontanum		2	2
Sympetrum sanguineum	13	49	94
Sympetrum striolatum	11	35	70
Trithemis annulata	1	1	1

ferent habitats for odonates, calculated from the number of species that were collected at each habitat. The absence of true lakes in this region, clearly dominated by a dense river system (MARTINEZ ANSEMIL & MEMBIELA, 1992) explains the dominance of lotic species.

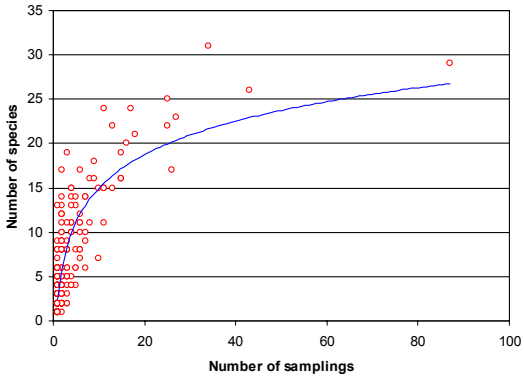

Fig. 2. The relationship between sampling intensity (number of visits) and species richness in the UTM squares sampled during this study. The rarefaction curve suggests that most areas are poorly studied.

The most common lentic habitat is constituted by small to medium ponds, many of them in coastal dunes (coastal lagoons; 21 out of 58 ponds sampled during this study). The majority of these coastal lagoons are formally protected under the Natura 2000 network (53% of 72 lagoons and temporary ponds on coastal sand dunes; Tab. II and Fig. 3). We found 33 odonates in these ponds, but only one is considered as endangered under the Spanish law (C *mercuriale,* that is actually not breeding in the lagoons but in small irrigation channels; see below).

RARE AND PROTECTED SPECIES

Twelve species were found in less than 10 squares (Tab. I). Some are migrant species (*H. ephippiger)* and others have been captured a long time ago (G. *vulgatissimus, O. brunneum, S. pedemontanum),* suggesting they do not have stable populations in the area. Most of the remaining species are common elsewhere in Spain *(Onychogomphus forcipatus, Sympecma fusca, Gomphus simillimus, Sympetrum meridionale)* but *Brachytron pratense, Aeshna affinis* and *Erythromma viridulum* are rather rare in the Iberian peninsula (OCHARAN, 1987). These three species are considered here as important target species. Also, we found four species, namely *Coenagion mercuriale, Macromia splendens, Oxygastra curtisii* and *Gomphus graslini,* that are included in the Spanish list of Endangered Species, and also in the Habitats Directive of the European Community, and therefore are also part of the target group of species. The status of all these species is as follows:

— *E. viridulum* — There are 17 records of this species, all of them in large ponds with floating vegetation (Fig. 3). It usually flights far from the shore, and this makes it not easily detectable.

- *C. mercuriale* - Widespread in coastal areas (found in 41 squares; Fig. 3). This species appears in small irrigation channels and rivulets with dense veg-

Table II

The rank-order of habitats for odonates in NW Spain. The percentage indicates the proportion of species recorded at each type of habitat (out of a total of 46 species). There are no true lakes in this region. The proportion of each habitat that is protected indicates habitats that are at least partially included in the Natura 2000 network (see Fig. 3)

Habitat	Number of species (%)		Number of records	Habitat Protection
Rivers	39	84.8	1297	<50%
Permanent and temporary ponds	38	82.6	1101	29%
(natural and man-made) Coastal	33	71.7	443	53%
lagoons Streams and rivulets	29	63.0	345	<25%
Man-made reservoirs	28	60.9	171	28%
Acid bogs	20	43.5	110	37%
Salt marshes	13	28.3	68	49%
Others (springs, irrigation channels and ponds, forest roads, etc)	32	69.6	206	

etation, where usually is the dominant damselfly.

- *A. affinnis* - Very rare. Only found as isolated specimens in two coastal lagoons, and apparently does not have permanent populations in the region (Fig. 3).
- *B. pratense* — Very rare. It has been found breeding in three localities, two of them included in legally protected areas (Fig. 3).
- *G. graslini* — Rare, only known from two rivers and at low densities (Fig. 3), in both cases together with *M. splendens* and in one case also with *O. curtisii.*
- *M. splendens* - Known from 13 squares (Fig. 3), it lives in medium to large rivers, where the species might be locally common, especially in lentic areas (CORDERO RIVERA et al., 1999; CORDERO RIVERA, 2000).
- *O. curtisii* - Widespread and with dense populations in the region (44 squares, Fig. 3). Larvae are common in most rivers. Males are territorial in the same rivers, but occasionally can be found in ponds patrolling the shore.

Most of the localities where these target species have been found are included in protected areas. The proportion of localities at least partially included in the Natura 2000 network is 54% (7/13) in *M. splendens,* 59% (26/44) in *O. curtisii* 66% (27/41) in C *mercuriale,* 50% (1/2) in G *graslini,* 67% (2/3), in *B. pratense,* 100% (3/3), in *A. affinnis* and 63% (5/8) in *E. viridulum.* Of the four protected species, *C. mercuriale* has a different distribution (due to its habitat requirements) and usually does not coincide with the other species (Fig. 3). *M. splendens* and *O. curtisii* are found together in eight localities, and a single locality has *M. splendens, O. curtisii* and *G graslini.*

HOTSPOTS

We tentatively selected as areas of special interest those that include all known populations of *M. splendens, G graslini,* and *B. pratense,* all localities with at least two of the four protected species, and areas with more than 20 species. We do not use the presence of *O. curtisii* and *C. mercuriale* as a selection criterion, because both are very common in the region. *A affinis* is probably not a breeding species, and *E. viridulum* is likely more common than appears, due to its flying behaviour far from the shore. Using these criteria gives a list of 24 hotspots, most of them (15) included in the Natura 2000 network (Tab III).

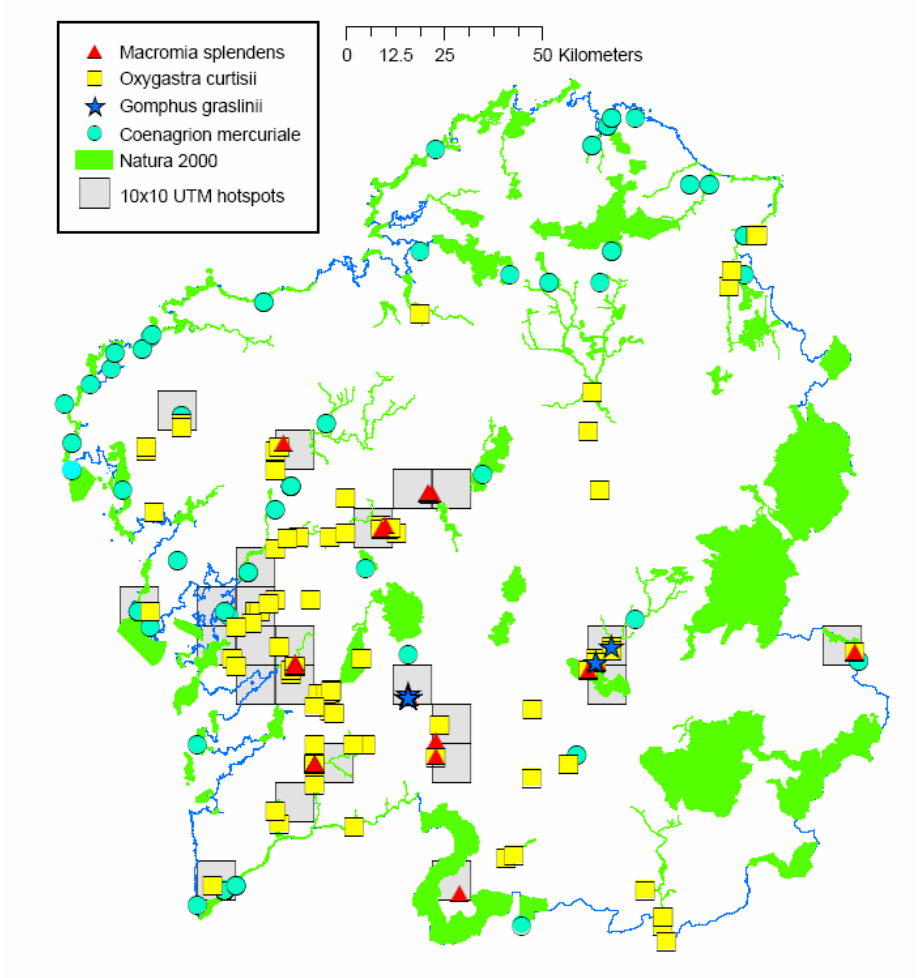

Fig. 3. The geographical distribution of the four species included in Spanish List of Endangered Species that were found in Galicia. Shaded areas are those protected under the Natura 2000 network. Grey squares indicate our proposed hotspots for odonates in this region.

Table III

Areas of special interest (hotspots) for the protection of odonates in Galicia. These areas include all known populations of *M. splendens, G graslinii,* and *B. prat-ense,* all localities with at least two protected species, and areas with more than 20 species. Squares in bold are at least partially included in the Natura 2000 network

Main Locality	Province	UTM square	n°sp	Type habitat	Focal species
Corrubedo	A Corufia	**MH91**	31	Coastal lagoons, streams, ponds	*O. curtisii* *C. mercuriale* *S. fusca* *B pratense*
Pontevedra	Pontevedra	NG29	29	Ponds, streams, rivers, acid bogs, salt marshes	
O Porriño	Pontevedra	**NG36**	29	Ponds	*T. annulata* *O. curtisii* *E. vridulum*
Illa de Arousa-O Grove	Pontevedra	**NH10**	26	Streams, rivers, ponds, coastal lagoons	*A. affinis* *O. curtisii* *B. pratense* *E. viridilum* *S. fusca* *S. meridionale*
river Umia	Pontevedra	NH21	25	Streams, rivers, man-made reservoirs	*O. curtisii* *G. simillimus*
Goián (Tomiño)	Pontevedra	**NG14**	25	Ponds, streams, rivers	*C. mercuriale* *O. curtisii* *S. fusca* *E. viridilum*
river Ulla	Pontevedra	**NH22**	24	Ponds, acid bogs, rivers	*C. mercuriale*
river Lerez	Pontevedra	**NH30**	22	Ponds, man-made reservoirs, streams, river	*M. splendens* *O. curtisii* *G simillimus*
river Tambre	A Coruña	**NH35**	22	Streams, rivers, ponds	*O. curtisii* *G simillimus*
river Lérez	Pontevedra	NG39	21	Ponds, rivers	*O. curtisii* *G simillimus*
river Cabe	Lugo	**PH10**	18	Streams, rivers, ponds	*M. splendens* *G graslinii* *O. curtisii*
Vilagarcia de Arousa	Pontevedra	NH11	17	Acis bogs, rivers, coastal lagoons, ponds	*B. pratense* *C. mercuriale*
river Xallas	A Coruña	NH06	17	Acid bogs, streams, rivers. man-made reservoirs	*O. curtisii* *C. mercuriale* *G simillimus*
River Tea	Pontevedra	**NG47**	16	Ponds, rivers	*M. splendens* *O. curtisii* *G simillimus*
river Deza	Pontevedra	**NH53**	15	Streams, rivers	*M. splendens* *O. curtisii* *C. mercuriale* *G simillimus*
Albarellos reservoir	Ourense	NG69	15	Ponds, rivers. Man-made reservoirs	*M. splendens* *G. graslinii* *O. forcipatus*
Ribadavia	Ourense	NG78	15	Rivers	*M. splendens* *O. curtisii*
Rubiá	Ourense	**PH70**	14	Man-made reservoirs, rivers, streams	*M. splendens* *O. curtisii* *C. mercuriale* *G simillimus*
river Cabe	Lugo	PG19	13	Ponds, rivers	*M. splendens* *O. curtisii*
river Arnoia	Ourense	**NG77**	11	Rivers	*M. splendens* *O. curtisii*
river Umia	Pontevedra	NH20	10	Ponds, streams, rivers	*O. curtisii* *C. mercuriale*
Portodemouros	Pont.-A Coruña	**NH74**	8	Man-made reservoirs, rivers	*M. splendens*
Portodemouros	Pont.-A Coruña	NH64	5	Man-made reservoirs	*M. splendens*
Lobios	Ourense	**NG74**	2	Man-made reservoirs	*M. splendens*

DISCUSSION

"RARE" SPECIES

Rarity is a relative concept in conservation: one species might be rare in a global scale but very common in a particular area. Therefore we need to approach this question from different scales (GARDENFORS, 2001). We refer here to rarity in extension and abundance of populations. We have gathered records of 49 species from Galicia (including species not found in this survey), that constitute 71% of the species found in Spain (OCHARAN, 1988). Among them, four species are included in the National Red List, in three categories: "Endangered" (M *splendens),* "Sensible to Habitat Alteration" *(O. curtisii)* and "Of Special Interest" (C *mercuriale* and *G graslini).*

Our analysis clearly suggests that *O. curtisii* and *C. mercuriale* are not rare at the regional scale, and we are optimistic about their conservation. The situation of *M. splendens* is especially interesting because this species is a taxonomic rarity in Europe (DOMMANGET & GRAND, 1996). Previous studies (CORDERO RIVERA et al., 1999; CORDERO RIVERA, 2000) indicate that NW Spain might have the best populations of the species. Recent studies in France (LEIPELT et al., 1999; DOMMANGET, 2001) and Portugal (MALKMUS, 2002b) indicate that this species is not endangered at the global scale.

Very different is the situation for *G graslini.* We were able to find only two populations of this species in NW Spain, and the low number of records in other areas of the Iberian Peninsula (a total of 18 records) (OCHARAN, 1987; Florian Weihrauch, pers. comm.; JODICKE, 1996; MALKMUS, 2002a) and France (DOMMANGET et al., 2002), do not allow optimism about its conservation. We think that this species should be included in the "Endangered" category in the Spanish Red List.

Our review of the literature and collections has identified three rare taxa at the regional scale *(B. pratense, A. affinis* and *E. viridulum)* that are also rare in the Iberian peninsula. We propose that these species should be included in the future Galician Red list as species of "special interest".

HABITATS OF SPECIAL INTEREST

Given the results of Table I, the most important habitats for odonate conservation are large rivers with populations of *M. splendens, O. curtisii* and *G graslini.* These rivers are common in the region and are in good conditions for odonate survival, but many will be heavily transformed by hydro-electric dams in the near future. From this point of view, only the river Tea (Tab. II) will probably be free of dams because it has been included in the Natura 2000 network (but this is not guarantee!).

The second most relevant habitat type is represented by ponds and coastal lagoons, that are common in the region and include the breeding area of at least 38 species. Coastal lagoons are reasonably well represented in the Natura 2000 network of the region (Tab. II). The most interesting species in this habitat is *C. scitulum*. Furthermore, all localities where *B. pratense* and *A. affinis* were found in this region are coastal lagoons and ponds.

LOCALITIES OF SPECIAL INTEREST (HOTSPOTS)

We have identified 24 UTM squares (10 x10 km) of special relevance for odonate conservation in NW Spain. Fortunately, many of the habitats included in these hotspots are formally protected. We have also found that our knowledge of the biodiversity of odonates is rather poor in most areas: only 19 squares have been sampled more than 10 times, and Figure 2 suggests that at least 20 samplings are needed to have a good estimation of odonate richness. From this point of view the UTM square 29TNG29 that has 29 species is probably simply the result of the vicinity of this area to our laboratory (87 samplings), and suggests that many areas should be of similar importance when our knowledge of odonate distribution improves. For instance the square 29TMH91 has 31 species with 34 samplings. A program to map odonate diversity, similar to the INVOD project in France (DOMMANGET et al., 2002), is clearly necessary and it is being developed by a local Natural History Association (SGHN).

The final part of river Cabe (29TPH10) is the most important hotspot for odonates in NW Spain. This place has a Mediterranean climate (CARBALLEIRA et al., 1983) that explains the presence of large populations of *M. splendens* and *O. curtisii*. Furthermore, in 2002 we found also two specimens of *G graslini*. This is therefore the only river that has all three protected anisopterans. This area is included in the Natura 2000 network and is also interesting from a botanical point of view, due to the confluence of Atlantic and Mediterranean species (ROMERO BUJÁN, 1993).

Future work should concentrate in a planned sampling of habitats, and the recently published Inventary of the Wetlands of Galicia (RAMIL REGO et al., 2003) is a very useful tool for the selection of habitats by type and geographical distribution. The aim is to produce a Geographical Information System that will help in conservation planning.

ACKNOWLEDGEMENTS

This research was founded by grants from Xunta de Galicia (PGIDT01MAM37101PR) and Ministry of Science and Technology (BOS2001-3642) to ACR. MA was supported by a grant from the Dirección Xeral de Medio Ambiente Natural of Xunta de Galicia (Axudas para a conservación da biodiversidade 2001). Animals were captured with permits from the Direccion Xeral de Conservación da Natureza, Xunta de Galicia.

REFERENCES

ASKEW, R.R., 1988. *The dragonflies of Europe.* Harley Books, Martins (Essex).
BTBBY, C.J., 1998. Selecting areas for conservation. *In:* W.J.Sutherland, [Ed.], *Conservation science and action,* pp. 176-201. Blackwell, Oxford. BTBBY, C.J., N.J. COLLAR, M.J. CROSBY, M.F. HEATH, CH. IMBODEN, T.H. JOHNSON, A.J. LONG, A.J. STATTERSFIELD, & S.J. THIRGOOD, 1992. *Putting biodiversity on the map: priority areas for global conservation.* Int. Council Bird Preserv., Cambridge. CARBALLEIRA, A., C. DEVESA, R. RETUERTO, E. SANTILLÁN, & F. UCIEDA, 1983. *Bio-climatologia de Galicia.* Fundacion Barrie de la Maza, A Coruña. CHOVANEC, A. & R. RAAB, 1997. Dragonflies (Insecta, Odonata) and the ecological status of newly created wetlands - Examples for long-term bioindication programmes. *Limnologica* 27: 381-392. CHOVANEC, A. & J. WARINGER, 2001. Ecological integrity of river-floodplain systems-assessment by dragonfly surveys (Insecta: Odonata). *Regulated Rivers Res. Mngmt* 17: 493-507. CINCOTTA, R.P., J. WISNEWSKI & R. ENGELMAN, 2000. Human population in the biodiversity hotspots. *Nature, Lond.* 404: 990-992. CORBET, PS., 1995. Habitats and habits of world dragonflies and the need to conserve species and habitats. *Proc. Int. Symp. Conserv. Dragonflies and their Habitats,* pp. 1-7, Kushiro. CORBET, PS., 1999. *Dragonflies. Behaviour and ecology of Odonata.* Harley Books, Essex, UK. CORDERO RIVERA, A., 2000. Distribution, habitat requirements and conservation of Macromia splendens Pictet (Odonata: Corduliidae) in Galicia (NW Spain). *Int. J. Odonatol.* 3: 73-83. CORDERO RIVERA, A., C. UTZERI & S. SANTOLAMAZZA CARBONE, 1999. Emergence and adult behaviour of Macromia splendens (Pictet) in Galicia, northwestern Spain (Anisoptera: Corduliidae). *Odonatologica* 28: 333-342. CORDERO, A., 1996. A preliminary checklist of the Odonata of Galicia. *Adv. Odonatol.* (Suppl.) 1:13-25. DENNIS, R.L.H., 2001. Progressive bias in species status is symptomatic of fine-grained mapping units subject to repeated sampling. *Biodiv. Conserv.* 10: 483-494. DENNIS, R.L.H. & CD. THOMAS, 2000. Bias in butterfly distribution maps: the influence of hot spots and recorder's home range. *J. Insect Conserv.* 4: 73-77. DOMMANGET, C, T. DOMMANGET & J.L. DOMMANGET, 2002. Inventaire cartographique des odonates de France. Bilan 1982-2000. *Martinia* 18: 1-68. DOMMANGET, J.L., 2001. *Etude de Macromia splendens (Pictet, 1843) dans la vallee du Tarn (Tarn, Aveyron) et statut national de l'espece (Odonata, Anisoptera, Macromiidae).* Unpublished Report to Ministere de l'Amenagement du Territoire et de PEnvironment. DOMMANGET, J.L. & D GRAND, 1996. Macromia splendens (Pictet, 1843). *In:* P.J.van Helsdingen, L.Willemse & M.C.D.Speight, [Eds], *Background information on invertebrates of the Habitats Directive and the Bern Convention,* 2: *Mantodea, Odonata, Orthoptera and Arachnida,* pp. 315-323. Council of Europe. EDA, S., 1995. The conservation of dragonflies, including endangered or vulnerable species, in Japan. *Proc. Int. Symp. Conserv. Dragonflies and their Habitats,* pp. 19-22, Kushiro. EHRLICH, PR. & A.H. EHRLICH, 1993. *La explosion demogrdfica. El principal problema ecologico.* Salvat, Barcelona. GARDENFORS, U., 2001. Classifying threatened species at national versus global levels. *Trends Ecol.Evol.* 16:511-516. HALL, C.A.S., P. W. JONES, T.M. DONOVAN & J.P GIBBS, 2000. The implications of mainstream economics for wildlife conservation. *Wildlife Soc. Bull.* 28: 16-25. HORTAL, J., J.M. LOBO & F. PIERA, 2001. Forecasting insect species richness scores in poorly surveyed territories: the case of the Portuguese dung beetles (Col. Scarabaeinae). *Biodiv. Conserv.* 10: 1343-1367. HUNTER, M.L., 1996. *Eundamentals of conservation biology.* Blackwell Science, Oxford.

JENNINGS, M.D, 1995. Gap analysis today: a confluence of biology, ecology, and geography for management of biological resources. *Wildlife Soc. Bull.* 23: 658-662.

JODICKE, R., [Ed.], 1996. *Studies on Iberian dragonflies.* Ursus Scient. Publishers, Bilthoven.

LEIPELT, KG, C. SCHUTTE, T. SCHRIMPF, C. SCHUTTE & F. SUHLING, 1999. Untersuchungen zur Habitatwahl der Larven von Macromia splendens (Pictet) (Anisoptera: Macromiidae). *Libellula* 18: 15-30.

LOBO, J.M. & F. MARTÍN-PIER A, 2002. Searching for a predictive model for species richness of Iberian Dung Beetle based on spatial and environmental variables. *Conserv. Biol.* 16: 158-173.

MALKMUS, R., 2002a. Die Verbreitung der Libellen Portugals, Madeiras und der Azoren. *Nachr. naturw. Mus. Aschaffenburg* 106: 117-143.

MALKMUS, R., 2002b. Weitere Funde von Macromia splendens (Pictect) in Portugal (Anisoptera: Corduliidae). *Nachr. naturw. Mus. Aschaffenburg* 106: 144-147.

MARTINEZ ANSEMIL, E. & P. MEMBIELA, 1992. The low mineralized and fast turnover watercourses of Galicia. *Limnetica* 8: 125-130.

MORENO, C.E. & G. HALFFTER, 2001a. Assessing the completeness of bat biodiversity inventories using species accumulation curves. *J. appl. Ecol* 37: 149-158.

MORENO, C.E. & G. HALFFTER, 2001b. On the measure of sampling effort used in species accumulation curves. *J. appl. Ecol.* 38: 487-490.

MYERS, N., R.A. MITTERMEIER, C.G. MITTERMEIER, G.A.B. DA FONSECA & J. KENT, 2000. Biodiversity hotspots for conservation priorities. *Nature, Lond.* 403: 853-858.

NEW, T.R., R.M. PYLE, J.A. THOMAS & PC. HAMMOND, 1995. Butterfly conservation management. *Annu. Rev. Ent.* 40: 57-83.

OCHARÁN, F.J., 1987. *Los Odonatos de Asturiasy de Espana: aspectos sistemdticos y faunisticos.* Univ. Oviedo.

OCHARAN, F.J., 1988. Composition de la odonatofauna Iberica. *Revta Biol. Univ. Oviedo* 6: 83-93.

PRENDERGAST, J.R., R.M. QUINN & J.H. LAWTON, 1999. The gaps between Theory and Practice in selecting Nature Reserves. *Conserv. Biol.* 13: 484-492.

PRENDERGAST, J.R., R.M. QUINN, J.H. LAWTON, B.C. EVERSHAM & D.W GIBBONS, 1993. Rare species, the coincidence of diversity hotspots and conservation strategies. *Nature, Lond.* 365: 335-337.

RAMIL REGO, P., J. IZCO SEVILLANO, J. DOMINGUEZ CONDE, L. GOMEZ-ORELLA-NA RODRIGUEZ, M. RODRIGUEZ GUITIAN, C. MUNOZ SOBRINO, I. ROMERO BUJAN, M. RUBINOS ROMAN, R. ALVITE DIAZ, R. DIAZ VARELA, C. CILLERO CASTRO, J. FERREIRO DA COSTA, M. RODRIGUEZ FREIRE & R. CRECENTE MASEDA, 2003. Inventario dos Humidais de Galicia. *http://www.xunta.es/conselle/cma/CMA05e/CMA05enHumidais/index.htm.*

REID, WV, 1998. Biodiversity hotspots. *Trends Ecol. Evol.* 13: 275-280.

REY BENAYAS, J.M. & E. DE LA MONTANA, 2003. Identifying areas of high-value vertebrate diversity for strengthening conservation. *Biol. Conserv.* 114: 357-370.

ROMERO BUJÁN, M.I., 1993. *La vegetacion del valle del río Cabe (Terra de Lemos, Lugo).* PhD Thesis, Univ. Santiago de Compostela.

SAMWAYS, M.J. & N.S. STEYTLER, 1996. Dragonfly (Odonata) distribution patterns in urban and forest landscapes, and recommendations for riparian management. *Biol. Conserv* 78:279-288.

SCOTT, J.M., F DAVIS, B. CSUTI, R. NOSS, B. BUTTERFIELD, C. GROVES, H. ANDERSON, S. CAICCO, F D'ERCHIA, T.C.JR. EDWARDS, J. ULLIMAN & G.R. WRIGHT, 1993. Gap Analysis: a geographic approach to protection of biological diversity. *Wildlife Monogr.* 123: 1 -41.

VAN TOL, J. & M.J. VERDONK, 1988. *The protection of dragonflies (Odonata) and their biotopes.* Council of Europe, Strasbourg.

WILLOTT, S.J., 2001. Species accumulation curves and the measure of sampling effort. *J. appl. Ecol.* 38; 484-486.