

**NEW DATA ON THE ECOLOGICAL TOLERANCE OF SOME
RHEOPHILOUS ODONATA IN MEDITERRANEAN EUROPE
(SIERRA MORENA, SOUTHERN SPAIN)**

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With reference to the work of G. CARCHINI & E. ROTA (1985, *Odonatologica* 14: 239-245), data are presented on 29 spp., relative to the chemical and physical features of their larval habitats. The ecological tolerance of 13 spp. is discussed. While *Lestes viridis*, *Ischnura graellsii*, *Anax imperator*, *Crocothemis erythraea* and *Sympetrum striolatum* are ecologically adaptable, *Boyeria irene*, *Onychogomphus forcipatus unguiculatus*, *O. uncatus* and *Cordulegaster boltoni* are considered useful indicators for the water quality assessment.

INTRODUCTION

Generally, dragonflies are considered to be relatively tolerant as to the quality of their specific larval habitats, but CARCHINI & ROTA (1985), among others, have clearly shown that the larval occurrence of some species could serve as a reliable indicator in the water quality assessment.

In most European species, the extent of their ecological tolerance is but poorly investigated, therefore it seems useful to bring our Sierra Morena observation herewith on record.

STUDY AREA AND METHODS

Sierra Morena is a vast mountain range, which forms the northern slope of the Guadalquivir River Valley. The larvae were collected at 17 stations on the river, and at 15 permanent or temporary streams, mainly belonging to the hydrographic systems of the Guadalquivir tributaries, viz. the

Table I

Variation ranges of chemico-physical parameters of water — [N: number of individuals collected; — CV: current velocity (cm/s); — DO: dissolved oxygen (mg/l); — Alkalinity, in mg/l of HCO_3^- ; — All ion concentrations are in mg/l except pH; the number of records (i.e. cases in which one or more individuals were found) is given in parentheses]

Species	N	Altitude (m)	°C	CV	DO	pH
<i>Calopteryx haemorrhoidalis</i>	5	60/280	8.0/15.5(4)	—	5.8/8.7(4)	7.7/8.1(4)
<i>C. virgo</i>	7	600/700	8.0/14.5(6)	30/80(6)	8.1/9.7(6)	6.7/7.5(6)
<i>C. xanthostoma</i>	12	270/500	7.0/19.0(7)	—	5.2/9.0(7)	7.8/8.3(7)
<i>Lestes viridis</i>	286	60/570	14.0/24.0(21)	0/37(6)	4.0/15.2(21)	6.5/9.3(19)
<i>Platycnemis</i> spp.	171	20/550	7.0/28.0(56)	0/110(17)	2.4/16.2(56)	6.7/9.0(56)
<i>Pyrrosoma nymphula</i>	7	130/700	10.0/15.0(7)	30/60(5)	6.7/9.9(7)	6.8/8.2(7)
<i>Ischnura graellsii</i>	1148	20/570	7.0/28.0(99)	0/46(18)	2.4/17.5(98)	5.6/8.6(98)
<i>Cercion lindeni</i>	1165	20/550	4.0/30.0(127)	0/125(42)	2.4/16.5(126)	6.5/9.2(125)
<i>Coenagrion caerulescens</i>	25	60/570	5.0/21.0(15)	55/83(5)	4.8/12.3(15)	7.2/8.3(15)
<i>Gomphus pulchellus</i>	106	20/550	7.0/30.0(56)	0/140(30)	3.0/17.5(56)	6.5/9.2(56)
<i>G. graslini</i>	1	300	7.0(1)	—	9.0(1)	8.2(1)
<i>Paragomphus genei</i>	1	290	21.0(1)	37(1)	4.6(1)	7.0(1)
<i>Onychogomphus forcipatus</i>	61	60/660	7.0/24.0(30)	0/140(24)	1.9/16.2(30)	6.5/9.3(30)
<i>O. uncinatus</i>	194	130/700	4.0/22.0(47)	6/125(32)	5.4/11.4(48)	6.4/9.2(47)
<i>Boyeria irene</i>	231	130/700	5.0/22.0(42)	1/100(28)	1.9/10.4(42)	6.4/9.2(42)
<i>Aeshna cyanea</i>	1	160	20.0(1)	—	6.7(1)	8.0(1)
<i>A. mixta</i>	11	60	14.5/18.0(2)	14/19(2)	3.2/7.7(2)	7.5(2)
<i>Anax imperator</i>	97	60/550	6.0/28.0(21)	0/50(7)	2.4/13.7(21)	6.8/9.0(21)
<i>Cordulegaster boltonii</i>	99	130/700	5.0/19.0(34)	6/100(25)	5.7/10.4(34)	6.4/8.4(34)
<i>Oxygastra curtisi</i>	1	290	21.0(1)	37(1)	4.6(1)	7.0(1)
<i>Macromia splendens</i>	2	300	24.0/25.0(2)	0(2)	8.0/9.9(2)	8.3/8.4(2)
<i>Libellula depressa</i>	4	600	4.0/12.0(3)	40/80(3)	8.1/9.7(3)	7.3/7.5(3)
<i>Orthetrum coerulescens</i>	13	120/600	12.0/21.0(7)	25/75(4)	4.6/9.9(7)	6.8/8.0(7)
<i>O. chrysostigma</i>	7	120/570	12.0/23.0(4)	30(1)	5.5/7.6(4)	7.3/9.3(4)
<i>Crocothemis erythraea</i>	95	60/550	6.0/28.0(33)	0/46(10)	2.4/16.2(33)	6.5/9.0(33)
<i>Sympetrum fonscolombei</i>	6	60/550	6.0/21.0(6)	0/46(3)	5.7/16.2(6)	7.0/8.1(6)
<i>S. striolatum</i>	90	60/600	12.0/27.0(19)	0/60(9)	1.9/8.9(19)	7.0/9.3(19)
<i>Trithemis annulata</i>	8	80/200	7.0/24.0(5)	0(2)	2.5/8.5(5)	7.7/9.0(5)

Yeguas, Guadalmellato, Guadiato, Bembezal, Retortillo, and the Guadiamar. The altitude of the sampling site lies between 20 and 700 m above sea level, and the width of the streams varies between 3 and 30 m approximately.

Larvae were sampled with conventional hand nets and without any time limitations, as advocated for odonate surveys in this type of water bodies by CARCHINI & ROTA (1985) and CASTELLA (1987), and discussed in detail by MIELEWCZYK (1986, p.2).

The water analysis methods adopted were those described by A.P.H.A. et al. (1963), GOLTERMAN (1963) and STRICKLAND & PARSON (1968). Measured were the temperature, velocity, pH, alkalinity, dissolved oxygen, and the NO_3^- , NO_2^- , PO_4^{3-} , and Cl^- concentrations. For further details reference is made to FERRERAS ROMERO & TOJA SANTILLANA (1986).

Table I (continued)

Species	Alkalinity	NO_3^-	NO_2^-	PO_4^{3-}	Cl^-
<i>C. haemorrhoidalis</i>	171/312(4)	1.2/7.7(4)	0.0(4)	0.0(4)	11/44(4)
<i>C. virgo</i>	12/24(6)	—	—	—	7/10(6)
<i>C. xanthostoma</i>	88/305(7)	0.2/4.6(7)	0.0(7)	0.0(7)	10/31(7)
<i>L. viridis</i>	82/634(21)	0.0/7.0(12)	0.0(12)	0.0(12)	12/268(20)
<i>Platycnemis</i> spp.	49/335(56)	0.0/11.5(39)	0.0/0.2(39)	0.0/0.2(39)	8/98(56)
<i>P. nymphula</i>	12/312(7)	0.0/2.6(3)	0.0(3)	0.0(2)	7/16(7)
<i>I. graellsii</i>	33/866(99)	0.0/11.5(76)	0.0/0.6(76)	0.0/0.9(76)	8/294(99)
<i>C. lindeni</i>	33/512(127)	0.0/11.5(81)	0.0/0.3(81)	0.0/0.4(81)	8/103(127)
<i>C. caerulescens</i>	30/488(15)	0.2/11.5(10)	0.0/0.3(10)	0.0/0.2(9)	10/91(15)
<i>G. pulchellus</i>	33/475(56)	0.0/7.2(27)	0.0(27)	0.0/0.1(24)	8/189(56)
<i>G. graslini</i>	109(1)	0.2(1)	0.0(1)	0.0(1)	11(1)
<i>P. genei</i>	250(1)	—	—	—	43(1)
<i>O. forcipatus</i>	24/250(30)	0.0/6.8(8)	0.0/0.1(8)	0.0(6)	9/88(30)
<i>O. uncatus</i>	12/355(47)	0.0/4.9(20)	0.0(20)	0.0(15)	7/18(47)
<i>B. irene</i>	12/355(42)	0.0/5.1(20)	0.0(20)	0.0(14)	7/30(42)
<i>A. cyanea</i>	374(1)	7.0(1)	0.0(1)	0.0(1)	29(1)
<i>A. mixta</i>	634/823(2)	—	—	—	268/349(2)
<i>A. imperator</i>	36/634(21)	0.0/11.5(15)	0.0/0.6(15)	0.0/0.4(13)	13/268(21)
<i>C. boltoni</i>	12/355(34)	0.0/5.1(13)	0.0(13)	0.0(9)	7/18(34)
<i>O. curtisi</i>	250(1)	—	—	—	43(1)
<i>M. splendens</i>	158/168(2)	—	—	—	22/26(2)
<i>L. depressa</i>	18/24(3)	—	—	—	9/11(3)
<i>O. coeruleescens</i>	30/250(7)	0.0/4.0(3)	0.0(3)	0.0(3)	10/43(7)
<i>O. chrysostigma</i>	82/375(4)	0.4/7.0(3)	0.0(3)	0.0/0.3(3)	11/35(4)
<i>C. erythraea</i>	73/634(34)	0.0/7.7(22)	0.0/0.3(22)	0.0/0.4(22)	11/268(34)
<i>S. fonscolombei</i>	164/634(6)	0.4/7.7(2)	0.0(2)	0.0/0.3(2)	35/268(6)
<i>S. striolatum</i>	67/866(19)	0.0/7.3(10)	0.0/0.3(10)	0.0/0.2(9)	12/349(19)
<i>T. annulata</i>	149/180(5)	0.0/0.8(3)	0.0(3)	0.0/0.1(3)	13/34(5)

RESULTS AND DISCUSSION

The 29 species collected and the data on the environmental conditions prevailing at the moment of sampling are stated in Table I. The variation in validity of the ranges is due to the difference in the numbers of samples. Ranges based on at least 15-20 measurements may be considered sufficiently realistic, therefore only the data on 13 species are acceptable, viz. *Lestes viridis* (Vander L.), *Platycnemis* spp. (*acutipennis* Sél./*latipes* Ramb.), *Ischnura graellsii* (Ramb.), *Cercion lindeni* (Sél.), *Coenagrion caerulescens* (Fonsc.), *Gomphus pulchellus* Sél., *Onychogomphus forcipatus unguiculatus* (Vander L.), *O. uncatus* (Charp.), *Boyeria irene* (Fonsc.), *Anax imperator* Leach, *Cordulegaster boltoni* (Donovan), *Crocothemis erythraea* (Brullé) and *Sympetrum striolatum* (Charp.).

As pointed out by CARCHINI & ROTA (1985), *L. viridis* exhibits ranges which are conditioned by the brevity of its larval life. Larvae of *Platycnemis* could

be identified to the genus level only, but *P. acutipennis* and *P. latipes* occupy similar biotopes in the zone (FERRERAS ROMERO, 1982).

Ecologically adaptable species in Sierra Morena are *I. graellsii*, *A. imperator*, *C. erythraea* and *S. striolatum*. These are rather euryoekous (Figs 1, 2), tolerating low levels of dissolved oxygen (<3 mg/l) and relatively high chloride and nitrite concentrations (Tab. I).

Platycnemis spp., *C. lindeni*, *C. caerulescens*, *G. pulchellus*, *O. forcipatus unguiculatus* and *B. irene* are moderately tolerant; they occur in streams that are (almost) free of human impact. Particularly the latter two species are good water-quality indicators.

As very exacting appear *O. uncinatus* and *C. boltoni*. They are associated with oligotrophic waters, characterised by high O_2 values (>5 mg/l) and by low chloride and nitrite concentrations, combined with their physiographic habitat features: streams of certain velocity, with abundant greenery along the banks, and whose temperature generally does not exceed 20°C (JARRY & VIDAL, 1960; VOSHELL & SIMMONS, 1978; FERRERAS ROMERO, 1984). In a recent work, carried out to elaborate an index for estimating the biological quality of waters from the Duero Basin, central Spain (GONZALEZ DEL TANAGO & GARCIA JALON, 1984), *B. irene* and *C. boltoni* are recognized as "intolerant species", therefore excellent indicators of good water quality.

In conclusion: in Mediterranean Europe *Calopteryx splendens* (SLADECEK, 1973; CARCHINI & ROTA, 1985), *Ischnura graellsii* and *Crocothemis erythraea*, among others, are ecologically very tolerant, therefore without any indicator value. This is also true of the pioneer species, such as *Anax imperator* and *Sympetrum striolatum* (WILDERMUTH & SCHIESS, 1983), and of those dominating in astatic environments (*Leistes viridis*: Castella, 1987). On the other hand, *Boyeria irene*, *Onychogomphus forcipatus unguiculatus*, *O.*

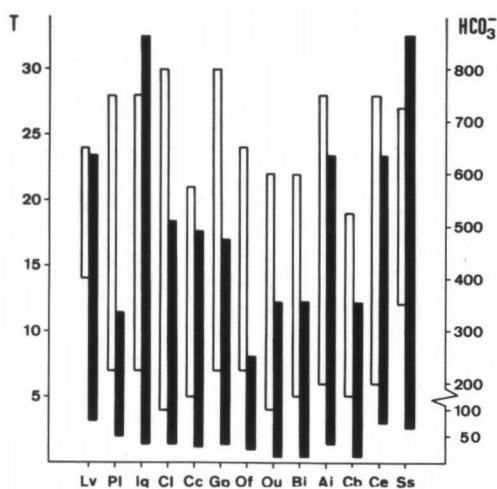


Fig. 1. Tolerances for temperature (T, clear bars), in °C, and alkalinity (HCO_3^- , dark bars), in mg/l, of the more frequently collected species. — Lv: *Leistes viridis*; — Pl: *Platycnemis* spp.; — Ig: *Ischnura graellsii*; — Cl: *Cercion lindeni*; — Cc: *Coenagrion caerulescens*; — Gp: *Gomphus pulchellus*; — Of: *Onychogomphus forcipatus*; — Ou: *O. uncinatus*; — Bi: *Boyeria irene*; — Ai: *Anax imperator*; — Ch: *Cordulegaster boltoni*; — Ce: *Crocothemis erythraea*; — Ss: *Sympetrum striolatum*.

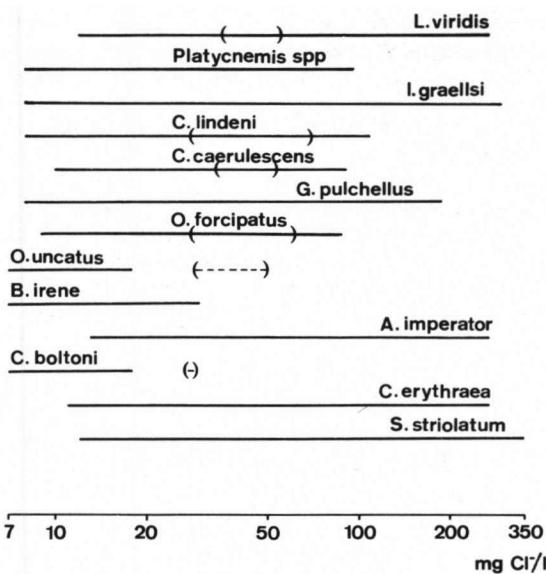


Fig. 2. Tolerance for chloride of the more frequently collected species. The ranges reported by CARCHINI & ROTA (1985) from Mignone River, central Italy, are given in parentheses.

uncatus and *Cordulegaster boltoni* have a high indicative value for the unpolluted environment.

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