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Reference to use in further citations:

LAMBRET P., COHEZ D. & JANCZAK A., 2009. *Lestes macrostigma* (Eversmann, 1836) en Camargue et en Crau (Département des Bouches-du-Rhône) (Odonata, Zygoptera, Lestidae). *Martinia* 25(2): 51-65. + Erratum, *Martinia* 25(3): 115.

Corresponding author: P. Lambret, Marais du Vigueirat, F-13104 Mas-Thibert, France.
<philambret@hotmail.com>

Translation: P. Lambret & J. Williamson.

Final translation realised on the September 26th, 2009.

Lestes macrostigma (Eversmann, 1836) in Camargue and in Crau (Bouches-du-Rhône department, France) (Odonata, Zygoptera, Lestidae)

By Philippe LAMBRET, Damien COHEZ & Alexandra JANCZAK

Key-words : *LESTES MACROSTIGMA*, CAMARGUE, CRAU, DISTRIBUTION, HABITAT, PROTECTION.

Abstract: *Lestes macrostigma* is a very local species, with a fragmented distribution. It is not legally protected, in Europe or in France, despite its conservation status. This paper reviews the previous and recent investigations (i.e. before and from 1998) in Camargue and in Crau. Its abundance can suffer great variations from one year to another and the species can even disappear from a site during some time. However, those eclipses are not irreversible. Our data show that its biology and ecology are still poorly known. Numerous human activities threaten the preferred habitats of the species and therefore increase its weakness. Hence, it seems necessary (i) to lead further investigations in the area and (ii) to monitor and to study already known populations and (iii) to protect this endangered species at European scale.

Lestes macrostigma (Eversmann 1836) is a Lestid that differs from *L. sponsa* (Hansemann 1823) and *L. dryas* (Kirby 1890) by its general darker aspect and its greater blue pruinosity. The pterostigmas are black and big (SELYS-LONGCHAMPS & HAGEN 1850, MARTIN 1931) and cover two to four cells on the fore- or hind-wings (SELYS-LONGCHAMPS 1862). A male whose pterostigma covered a single cell on the forewing has been observed but his hind-wing stigma covered three and a half cells (n=55) (A. Dorgère unpublished). Adults can measure 48 mm in length (DIJKSTRA 2007), which makes this species the biggest of the family in France, together with *Chalcolestes viridis* (Vander Linden, 1825). Thus, as underlined by FERRERAS-ROMERO *et al.* (2005), odonatologists are unlike to misidentify and/or to 'miss' this Lestid when encountered.

In France, *L. macrostigma* flies from May to August (GRAND & BOUDOT 2006, DIJKSTRA 2007). However, in Camargue, one cannot encounter any individual after the third decade of July. The single reference to *L. macrostigma* in the revised edition of CORBET's book (2004) clearly shows that its biology has been poorly studied yet: most of studies concern its distribution area and very few deal with its life history through specific data (e.g. NIELSEN 1954, AGUESSE 1955 1960, PLATTNER 1967, MONTES et al. 1982). *L. macrostigma* is stenoecic (NIELSEN 1954): larvae mainly grow in brackish water (e.g. ROBERT 1958, PLATTNER 1967, D'AGUILAR & DOMMANGET 1987, JÖDICKE 1997). Despite females can lay eggs in *Schoenoplectus (=Scirpus) lacustris* (STARK 1980), they mainly do in *Bolboschoenus (=Scirpus) maritimus* (PLATTNER 1967) which seems to be of primary importance for oviposition (JÖDICKE 1997). Brackish waters are typical of temporary ponds; their salinity increases according to summer evaporation which represents twice the rainfalls in Camargue (PICON 1980). Although AGUESSE (1960) worked in Camargue on diapause, hatching (in March) and larval development duration (8 to 10 weeks), further information concerning eggs and larval phenology is required (JÖDICKE 1997).

The distribution area is wide and one can encounter *L. macrostigma* from the Atlantic coast (France, Portugal) to Central Asia (Mongolia's steppes) and across Middle East (D'AGUILAR & DOMMANGET 1985, ASKEW 2004). In Europe, it is mainly present in the Mediterranean area –Portugal, Spain, France, Corsica, Sardinia, Italia, Greece, Cyprus, Armenia (ASKEW 2004)– but also under different climates (e.g. LANDEMAINE 1991) and inland as in Hungarian plains (DIJKSTRA 2007). However its distribution is fragmented (DIJKSTRA, 2007) and populations are extremely local (DOMMANGET 1987). Whereas it can be common in the eastern part if its distribution area (ASKEW 2004, GRAND & BOUDOT 2006), it is rare or very rare in Western Europe (GRAND & BOUDOT 2006). It is only present in France in two areas and both are littoral: the first is along the Atlantic coast and the second is in the Mediterranean (GRAND & BOUDOT 2006, DIJKSTRA 2007). Along the Atlantic coast, *L. macrostigma* is present in Charente-Maritime department (LEBIODA 1987, ORIEUX 1994, BRAUD 1996, JOURDE et al. 1999) and, some years, in Vendée department (LANDEMAINE, 1991) and in Loire-Atlantique department (PICARD & MEURGEY 2005a, b). On the Mediterranean coast, long-lasting populations are only present in Corsica (MAC LACHLAN 1866, C. Vanappelghem pers. com.) and Camargue. Indeed populations do not seem to survive in Hérault department (DOMMANGET 1987, GRAND & BOUDOT 2006, X. Rufray pers. com.), in Bouches-du-Rhône department except Camargue (BENCE & BENCE 1989, PAPAZIAN 1995) and Vaucluse department (COFFIN 1989). WENDLER & NÜß (1997) considered that *L. macrostigma* is often present in small numbers. However a high abundance has already been reported (e.g. MAC LACHLAN 1866, BENCE & BENCE 1989, DIJKSTRA & KALKMAN 2001) but without consistency (FATON et al. 2000). Indeed abundance can vary greatly depending in particular on rainfalls and winter conditions (see AGUESSE 1960 and PLATTNER 1967).

Finally, according to its rarity, a noteworthy conservation value has been stated at different scales (see Tab. 1).

Hence, with its conservation in view, it seems essential to better assess the ecological requirements of *L. macrostigma* not only through population monitoring but also specific and comprehensive studies. A European legal protection status would be also of primary importance. Therefore, through the Camargue and Crau situation, we aimed to highlight (i) the ongoing species fragility using a chronological and geographical review of literature and unpublished data, (ii) the lack of knowledge regarding its biology by underlining new data and (iii) the threats to this species.

Area	Status	Reference
World	Not evaluated	IUCN 2008
Europe	Not protected Possibly declining To be evaluated	VAN TOL & VERDONK 1988, Bern Convention 1979 (updated the 1st of March, 2002) SAHLEN et al. 2004 European RL 2009-10 (J.-P. Boudot pers. com.)
Mediterranean	NT	BOUDOT et al. 2009
Russia, Ukraine	None	National RL (N. Matushkina pers. com.)
Bulgaria	CR	MARINOV 2005
Hungary	Protected	Ministerial law 13/2001 (V.9.)
Slovenia	CR	ANONYMOUS 2001, BEDJANIC 1995
Spain	VU	ROSAS et al. 1992, OCHARAN et al. 2006
France	2 (extremely confined), EN	DOMMANGET 1987, DOMMANGET et al. 2008
Poitou-Charentes dep.	CR	COTREL et al. 2007
Languedoc-Roussillon dep.	Noteworthy sp.	MILCENT & DOMMANGET 2005, BIOTOPE et al. 2007

Table 1 – Conservation legal status and values of *Lestes macrostigma* across its distribution area
(RL: red list, NT: near threatened, VU: vulnerable, EN: endangered, CR: critically endangered, dep.: department).

Study area and method

The study area is composed first by the Camargue *sensu lato*, that is Rhône's delta from Arles city to the north to Mediterranean Sea to the South and from Nîmes city mounts and the Languedoc region pools to the west to the Vigueirat canal to the east. Three subareas can be established within Camargue according to their situation relatively to the Petit (small) and the Grand (great) Rhône: the Petite Camargue, the île de Camargue (Camargue island) and the Plan du Bourg (see Fig. 1). The second part of the study area is the Crau, that is the ancient delta of Durance river, bordered to the north by Alpilles montains and to the east by Berre's lake. The Crau is a xeric plain with few wetlands in its western part because of the resurgence of phreatic water. The Tour du Valat (TdV, Fig. 1: 8) covers 2560ha and is located between the Petit Rhône and the Grand Rhône. TdV noteworthy biotopes cover 1844ha and are protected through a Regional Natural Reserve status. Various biotopes are part of the Habitat Directive and represent 65% of the global surface. Those biotopes are representative of the past natural dynamic commanded by rivers and lakes: salted openlands (with *Juncus* spp and halophile vegetation here after called *sansouïre*), old dunes, grasslands and various marshes that cover 600 ha. According to hydrological system and management, these marshes can be semi-permanent pools (i.e. that sometime dry up in summer for shorter time) or temporary pools (i.e. that dry out every year for longer time), with emerging vegetation or not, with fresh or brackish water, etc. Thirty-three species of Odonata have been inventoried in TdV. The Marais du Vigueirat (MdV, Fig. 1: 4) cover 958ha belonging to the Conservatoire du littoral (French coast conservatory) and are located in the Plan du Bourg, just before Crau marshes to

the east. This means that MdV are located on an ecotone which could explain the high species richness and diversity of this protected area. Within ten sites of Camargue and Crau, MdV has the highest Odonata richness: 42 species. Odonata biodiversity is noteworthy as well (Shannon Weaver index, JAKOB 2008). This richness is one of the reason why MdV have been integrated in Natura 2000 PR100 area and why MdV will soon benefit of the National Natural Reserve status. Main biotopes are from the fresher to the more halophile: riparian forests, reeds, temporary marshes (with *Juncus* spp and *Scirpus* spp) and sansouïres.

Because of the short flying period of *Lestes macrostigma* in Camargue, we only selected the distribution data from the first decade of May to the second decade of July. Those data were collected not only from available literature but also from unpublished data and occasional investigations. We therefore retained the data that display (i) *L. macrostigma* presence, (ii) its absence from a site when it has been previously and further cited from this site and (iii) its absence although investigations were leaded during its flying period and among favourable biotope. We have to underline that those data exhibit sites where *L. macrostigma* reproduced but also those where individuals have only dispersed. We found no paper that only indicates larvae presence. Moreover, the *L. macrostigma* distribution is monitored in TdV and MdV: the whole pools are investigated every year for adults within the flying period.

Information about biology and biotopes result from observations made during those investigations but only for pools where reproduction is obvious, because of the dispersal ability of *L. macrostigma* (AGUESSE 1960, PAPAZIAN 1995).

Population abundance in TdV was assessed along 30m transects randomly executed on the main pools where *L. macrostigma* breeds.

Finally, salinity (grams of salt per litter of water) of pool water is assessed by their conductivity (milliSiemens per centimeter). This conductivity is measured by a sensor driven few cm under water surface and plugged to a conductimeter WTW Cond 315i.

Results

Lestes macrostigma is historically known from six different sites in Camargue and two in Crau (Tab. 2). The La Palissade protected area has been investigated several times, always unsuccessfully (PAPAZIAN 1995, D. Cohez pers. obs.). The only two sites where *L. macrostigma* was known to breed in 2008 are the TdV and the MdV.

L. macrostigma presence has been known in the TdV since 1955 (AGUESSE 1955). One could not find any individual in the 90's, but it has been observed again since 2000 (DORGÈRE 2001). It has been yearly monitored since 2003 according to TdV management plan (SINASSAMY & PINEAU 2001, COHEZ et al. 2007). It has been observed in the MdV since 2005.

It is mainly encountered in both sites among brackish pools and marshes that measure from 310m² to 69ha. However during May (when larvae are surely present) and in water where *L. macrostigma* surely breed (exuviae are found) the conductivity can vary greatly from one year to another, from one season to another and from one pool to another: 0.9 to 33.3mS.cm^{-1} i.e. a salinity that spreads from 0.42-0.5 to 20.8-22.9g.L^{-1} (this range of values results from two different formula we used to convert conductivity into salinity). We measured maximal value just before adults emerged, exactly where we collected their exuviae.

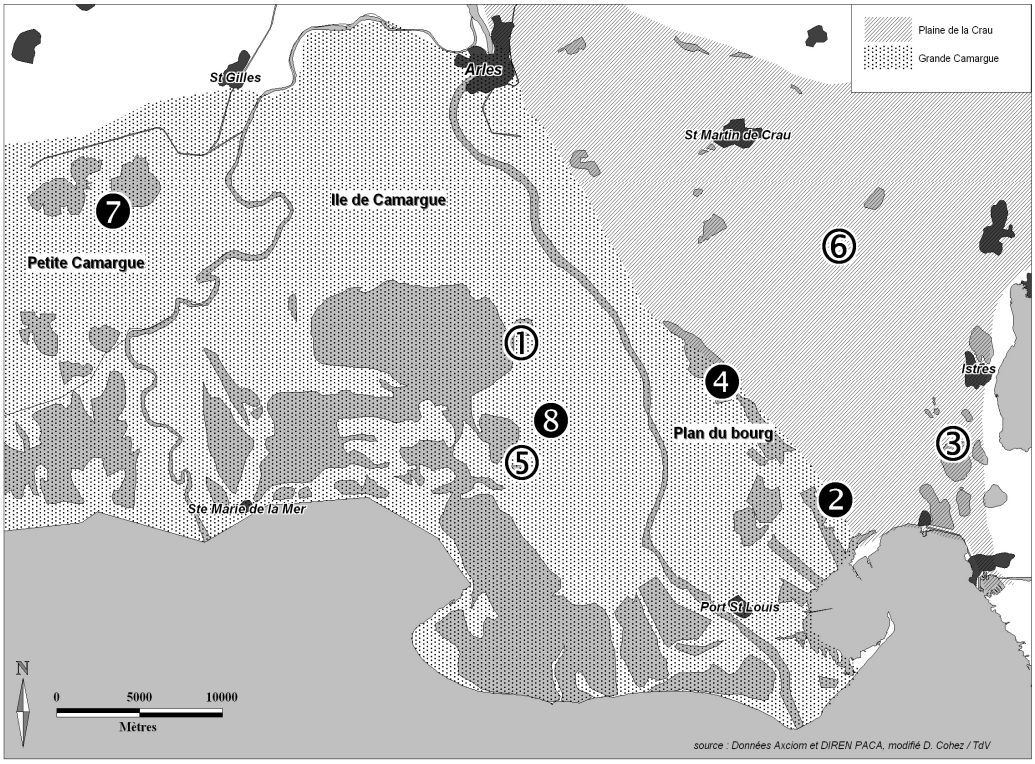

Figure 1 – Old (before 1998, white rings) and recent (from 1998, black rings) data of *Lestes macrostigma*.
Numbers refer to Table 2.

Site	Year	Presence x	Reference
① La Capelière	1977		MARTENS & SMEYERS 1978
	1981	x	H. Heidemann, SFO
	1992		PAPAZIAN 1992
❷ Fos-sur-Mer	2005	x	Y. Braud pers. com.
	2007		Y. Braud pers. com.
③ Istres	1987	x	C. & P. Juliand, SFO
❹ Marais du Vigueirat	1985 to 94		SCHRIDDE et al. In LUCCHESI & GERBEAUX 1994
	1990		PAPAZIAN & BENCE 1991
	2003		FATON, 2003
	2004		J.-B. Nogues unpublished
	2005 & 06	x	J.-B. Nogues unpublished
	2007 & 08	x	P. Lambret pers. obs.
⑤ Salin-de-Badon	1977	x	MARTENS & SMEYERS 1978
	1983	x	J.-P. Boudot, SFO
	1986 & 88	x	C. Deliry, SFO
	1992		PAPAZIAN 1992
	1995	x	FATON et al. 2000
	1999 & 2000		FATON et al. 2000
⑥ St-Martin-de-Crau	1987	x	C. & P. Juliand, SFO
	1988	x	C. Deliry, SFO
	1990	x	C. & P. Juliand, SFO
❼ Scamandre	2000	x	PAGANO-ZENASNI 2006
❽ Tour du Valat	1955 to 61	x	AGUESSE 1955, unpublished
	1977	x	MARTENS & SMEYERS 1978
	1992		PAPAZIAN 1995
	1995		JAKOB 1995
	2000 & 01	x	A. Dorgère unpublished
	2002 to 08	x	D. Cohez et al. pers. obs.

Table 2 – Compilation of data from Odonatological inventories and *Lestes macrostigma* investigations in Camargue and in Crau.

In the TdV, most regular and abundant populations seem to be linked to the big temporary pools where water remains for long period (i.e. temporary pools that usually dry out from July). Small temporary pools are less often used because of their uncertain hydrological conditions. Thus during favourable years (i.e. when rainfalls are enough to allow a sufficiently long water period), *L. macrostigma* disperse to adjacent pools and one can encounter the species in various pools (such as in 2004, see Tab. 3). On the one hand, when several years with good rainfall conditions follow each other and induce great water levels, the species breed as well in numerous pools. On the other hand, when rain conditions are not convenient, the development of the species is limited. In the MdV *L. macrostigma* is restricted to the temporary pools that are managed so that we try as well as possible to reproduce the ancient hydrological rhythm of the Rhône (i.e. before its banks were fixed by human activities): water is voluntarily released from the Vigueirat canal and the Arles à Bouc canal, using a ditch net. Water-gates are open from early October to late April; the evaporation –which is increased by high temperatures and the strong wind and the scarce rainfalls– leads to a drying period after that.

	N	Pools where *L. macrostigma* has already bred (name en surface in ha)											
		P_4	P_{11}	P_{14}	P_{15}	P_{16}	P_{17}	P_{18}	P_{19}	P_{20}	P_{21}	P_{22}	P_{23}
		7,15	6,1	7,6	6,5	69,2	1,2	3,9	2,8	28,5	21,9	3,8	16,3
2000	10		/	/	/	/				x	x		x
2001	8		x		x	/		/		x	x		
2003	8	x	x		x					x	x		
2004	25	/	x	x	x	x	x	x	x	x	x	x	x
2005	11	/				/				x	x	/	
2006	2					/					x		
2007	6		x				/	x		x	x		
2008	5		x					x	/	x	x		

Table 3 – Presence of *Lestes macrostigma* on few pools (P_i) of the Regional Natural reserve of TdV:
N: total number of pools where the species has been observed, x: breeding, /: dispersal. Data are not sufficient to have an accurate vision of 2002 situation. We only encountered two individuals in 2006.

We have to underline that in the TdV, *L. macrostigma* breeding in St Seren pool (69ha) has only been proven since 2004, whereas this pool is characterized first by rather stable water conditions from one year to another and second by large areas covered by *Bolboschoenus maritimus*. Moreover its vegetation is grazed from April to September by Camargue cows when the other pools are grazed from September to March or even not grazed at all. To the opposite all MdV marshes are grazed from April to November. Between 2003 and 2006 only Camargue horses grazed in MdV and in 2007 Camargue horses and Angus cows did, the later being less inclined to graze on wetland. In 2008 MdV returned to the grazing scheme given by our management plan (i.e. cows and horses both from Camargue). The TdV and the MdV marshes are never overgrazed.

The phytocenosis of those pools is largely dominated by *B. maritimus* in the TdV whereas in MdV *Juncus maritimus* can be as abundant (see Fig. 2). Pool borders are colonised by *Juncus acutus*, *Arthrocnemum* spp. and *Tamarix gallica*. Few other helophytes can be encountered: *Scirpus littoralis, Schoenoplectus lacustris, Juncus sububulatus, Phragmites australis*, etc. Futhermore, in the MdV, *L. macrostigma* seems absent from the pools that are dominated by *B. maritimus*. We have even collected few exuviae in 2007 and in 2008 in a pool where *B. maritimus* is almost absent, which is noteworthy. Plant density varies greatly: open water can be dominant or almost absent.

Figure 2 – Example of *Lestes macrostigma* breeding biotope in MdV: *Juncus maritimus* is a dominant species within the phytocenosis.

Discussion

First, the low number of sites where *Lestes macrostigma* occurs in Camargue and in Crau could infer a low investigation effort. Indeed available data are issued from a few sites that only represent a small part of the study area. This is partly due to the fact that lots of lands are private in Camargue and therefore difficult to access ~~to~~. However FATON et al. (2000) showed that the number of favourable sites decreased in relation with the marshes hydrological management (see below).

Second, the few data available for the same sites for one or several decades highlight that *L. macrostigma* is temporally unstable which add to its regional discontinuous distribution (*op. cit.*). As shown by the TdV monitoring results, this species can rapidly vary from high abundance (2004) to extreme rarity (2006), where it can easily go unnoticed. Such disappearance may not be true *per se* as suggested FERRERAS-ROMERO et al. (2005). Thus *L. macrostigma* could have been present in the MdV before 2005 but in very low numbers, which is why it has not been detected. Another hypothesis is that it has been first observed in 2005 because of a very recent colonisation. Adults, if highly abundant, seem to disperse and to be able to fly over dozens of kilometers (BENCE & BENCE 1989, PAPAZIAN 1995); erratism could even be frequent (DIJKSTRA 2007). Some individuals could have dispersed from the TdV because of a high abundance in 2004 and colonised the MdV, which are ten kilometers from the TdV although on the other bank of the Grand Rhône. This scenario could also apply to the individuals that have been observed in 2005 in Fos-sur-Mer which is less than 20km from the TdV. According to such scenario, a new colonisation could be possible after a real population disappearing. In any case, we have to focus on this species especially during dry years, in order to manage the water levels in a suitable way to insure its breeding.

Our results also show that the effects of some settings, such as salinity, on larval development need to be further explored. AGUESSE (1955, 1960) first assessed a lethal salinity to $8.4 g.L^{-1}$ but described then *L. macrostigma* as a oligobrackish-oligopoïkilohaline and oligobrackish-mesopoïkilohaline water species (i.e. a species whom larvae grow in water that salinity is lower than $16 g.L^{-1}$). The method he used to measure the salinity is more accurate

than our transformation from conductivity but our maximal value 20.8-22.9g.L^{-1} obviously shows a higher larval tolerance level. NIELSEN (1967) mentioned some populations growing in pools that were directly connected to the sea –which has a salinity of 30g.L^{-1} at least– and underlined that the species *L. macrostigma* is feeding on also have to withstand such salinity. On the contrary we can compare our lower salinity values to some situations in Russia where *L. macrostigma* can grow in fresh water, dozens of kilometres away from the closest brackish waters (BELYSHEV 1973, KOSTERIN 1996, pers. com.). The knowledge about the effects of some biotic settings, such as the crustaceans *L. macrostigma* larvae feed on, also has to be improved (FATON et al. 2000).

One can encounter *L. macrostigma* in the TdV where the *Bolboschoenus maritimus* cover is relatively homogeneous, which seems close to Atlantic coast settings (PICARD & MEURGEY, 2005b; PICARD, 2005). In the MdV, its absence from the pools where *B. maritimus* is dominant may be related to the high vegetation density. Indeed adults rather live where openwater is more present (LEBIODA 1997, M. Marinov pers. com.) and ovipositing pair fly is difficult when the vegetation is too dense (P. Lambret, pers. obs.). More simply, adults could have not spread to those pools yet. Although most of eggs are laid in *B. maritimus* (e.g. LEBIODA 1987, MACHET 1990, PICARD & MEURGEY 2005b), the numerous ovipositions observed in *Juncus maritimus* together with exuviae sampling demonstrate that *L. macrostigma* is able to breed successfully when *J. maritimus* is a major species of the phytocenosis and even when *B. maritimus* is very rare (P. Lambret & V. Cannevelle unpublished). Therefore, *B. maritimus* is not the only plant that hosts *L. macrostigma* oviposition, as AGUESSE (1955) thought and as CASSAGNE-MÉJEAN (1965) and STARK (1980) highlighted, respectively for *Juncus* sp. and for *Schoenoplectus lacustris*. Moreover, as shown by PICARD (2005) investigations, the presence of *B. maritimus* in a pool does not mean that *L. macrostigma* is there as well. As the latter is related to brackish temporary pools in Camargue (see AGUESSE 1960) the oviposition in the former could be an evolutive convergence because those particular hydrological settings induce *B. maritimus* development. However fresh waters in which *L. macrostigma* breed in the eastern part of its distribution area are also colonised by *B. maritimus* (O. Kosterin pers. com.); AGUESSE (1955) also emphasize that *B. maritimus* can grow in fresh water. Therefore one must further investigate a large panel of biotope from temporary pools to permanent pools where *B. maritimus* is present and even the smallest pools, as HEIDEMANN and SEIDENBUSCH (2002) observed populations in Camargue that breed over several years in tiny pools (one square meter each).

Different activities threaten both *L. macrostigma* and its biotope. JOURDE (2003) cited as main threats the conchyculture, the fight against mosquitoes and the revival of salt exploitation. GRAND & BOUDOT (2006) underlined that the species is threatened on the continent because of industrialisation and the increase on the littoral of viticulture, tourism and urbanisation. We can recall that, in 2008, *L. macrostigma* was observed only in two protected areas, which gives the conservation teams a real responsibility.

Nowadays, the saline industry is decreasing in Camargue. Corresponding pools could be new spots where *L. macrostigma* will breed but this depends on future management. Many land projects concern not only those biotope but also the natural areas of the Port Autonome de Marseille (i.e. the public structure in charge of Marseille's harbour development). Numerous marshes of these areas could be favourable to the species; the discovery of a new population in Fos-sur-mer in 2005 is an example. However most of those areas are planed to host new harbour projects and potential sites may turn into industrial warehouses... Moreover the species is also threatened on natural areas. The settings that *L. macrostigma* seems to require rarely correspond to general water management scheme in Camargue. Marshes managers often turn temporary to permanent pools or empty the pools, which make them

unsuitable to Lestids development. Pastoral and cynegetic objectives and even ornithological objectives seldom befit *L. macrostigma* basic requirements. Added to the threats to its biotope are those upon the species itself. Since September 2006, the EID-Méditerranée (interdepartmental public structure for the fight against mosquitoes) experimentally spreads some Bti on several sites of Port-St-Louis-du-Rhône and Salin-de-Giraud, some of which are natural protected areas (e.g. la Palissade, Conservatoire du littoral). Bti is a toxin naturally synthesised by *Bacillus thuringiensis* var. *israelensis* which directly affects only a few Diptera Nematocera, such as Culicidae and Chironomidae: populations structure is modified. However it does not affect directly Odonata (see FRANQUET & FAYOLLE 2004). Because those Diptera are one of the very first steps in the food chain, the fight against mosquitoes could affect their predators. The PNRC (Natural regional parc of Camargue) leads ongoing studies to assess the consequences of this spreading on Odonata; EID should also do so in the near future.

Finally, as suggested by FERRERAS-ROMERO et al. (2005), overgrazing could influence the abundance or even the presence of *L. macrostigma*. Some authors observed females ovipositing in the lower part of *B. maritimus* plants (MACHET 1990) and even in the lower part of stems (LEBIODA 1987), when others did in the upper part of stems (PICARD & MEURGEY 2005b). Although we also observed females ovipositing in *B. maritimus* and *J. maritimus* very close to water surface, a too strong grazing pressure could destroy a great part of laid eggs. Our results also suggest that seasonal grazing scheme could also have some influence. This brings us back to the lack of knowledge regarding *L. macrotigma* biology: with a better understanding of its requirements, we could understand grazing effect more easily.

Perspectives

The spatial discontinuity and the temporal instability of *Lestes macrostigma* populations, the different threats to its biotope and the lack of knowledge regarding its biology leaded us to engage various actions towards its conservation.

Volunteer odonatologists could investigate further on the study area, in order to establish whether the TdV and the MdV are truly the very last spots of the French Mediterranean coast (except Corsica) where the species occurs. Other favourable sites certainly exist in Camargue and in Languedoc-Roussillon region (lagoons). One should not only check the presence or absence *L. macrostigma* every year –because of the ability of the species to disappear temporally – but also search for exuviae or neonata in order to establish the breeding status of the population.

Natural protected areas are responsible for *L. macrostigma* conservation along the French Mediterranean coast. The species is thereby taken into consideration by the TdV management plan and has just been in the MdV's; it is therefore monitored in both sites (size and distribution of the populations and physico-chemical settings). *L. macrostigma* is one of the noteworthy species that are a priority to monitor according to the French society of odonatology (Sfonat, SONEP program). On the short term we could apply the SONEP method, adding a monitoring of physico-chemical settings (see SUH & SAMWAYS 2001, 2005) and biotics (see FATON et al. 2000). Such a method –with a high level of standardisation– could be applied on other sites, allowing a data collection that should give us a better understanding of the drastic variations in abundance that the species suffers. Studies about its biology and its ecology, especially about limiting settings, are required as well; those would allow conservation biologists to manage properly the biotopes they are in charge of, and

where *L. macrostigma* occurs. The study of its oviposition behaviour and its relation with *B. maritimus* is already ongoing in the MdV. We have to say that such monitoring and studies are the kind of action that the French Odonata restoration plan requires, especially for *L. macrostigma* (P. Dupont pers. com.).

Finally, we have to recall two important points of the Habitat directive: first "[the conservation of wild fauna is] an essential objective of general interest pursued by the Community, as stated in Article 130r of the Treaty". Second, "in the European territory of the Member States, natural habitats are continuing to deteriorate and an increasing number of wild species are seriously threatened; […] given that the threatened habitats and species form part of the Community's natural heritage and the threats to them are often of a transboundary nature, it is necessary to take measures at Community level in order to conserve them". The status of protected species is key in the initiative of conserving a biotope in which such a species can breed, this conservation itself constituting a decisive step for the conservation of threatened species (see MOORE 1997). It is also a way to incite public structures to facilitate improvement of knowledge about its biology *sensu lato*. Regarding (i) the low number of its populations and the few surface they cover, (ii) its high conservation value and status, (iii) the specificity of its ecological niche and (iv) the different threats to this species and its biotopes, it clearly appears that *L. macrostigma* needs to become a protected species at the European scale.

Aknowledgments

We are grateful to Jean-Pierre Boudot and to Michel Papazian, not only for their help in reviewing literature and unpublished data but also for their significant commentaries on the manuscript. This work could not have been possible without the relevant contribution of Matjaz Bedjanik, Sielke Befeld, Yoan Braud, Isabelle Coppée, Geert De Knijf, Cyrille Deliry, Jean-Louis Dommanget, Arnaud Dorgère, Elena Dyatlova, Jean-Michel Faton, Christiane Jakob, Reinhard Jödicke, Marianne Kiauta, Oleg Kosterin, Andrea Kourgli, Armin Landsmann, Martin Loedl, Milen Marinov, Nataly Matushkina, Jürgen Ott, Lionel Picard, Hubert Piguet, Susanne Randolf, Elisa Riservato, Xavier Rufray, Rosa Ana Sánchez, Cédric Vanappelghem and Jean-François Voisin. INVOD data were made available by the SFO.

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