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Odonata records from Alentejo and Algarve, southern Portugal

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Abstract

During two field trips in summer 2008 and spring 2009 to the Alentejo and Algarve in southern Portugal, we altogether recorded 42 species of Odonata at 112 localities. All localities were classified in one of the following five categories: streams, rivers, ponds and pools, reservoir lakes, and brackish waters. Seventeen species are categorised as rheophilous and twelve as having a clear preference for standing waters. Remarkable records of *Lestes dryas*, *Onychogomphus forcipatus*, *O. uncatus*, *Paragomphus genei*, *Orthetrum chrysostigma*, *O. coerulescens*, *O. nitidinerve*, *O. trinacria*, *Diplacodes lefebvrii*, *Brachythemis impartita* and *Zygonyx torridus* are presented in detail and discussed, and a regional distribution map is provided for most of them. With 35 species, the Odonata fauna of southern Portuguese streams and rivers is rich and diverse. This diversity can be explained by the high naturalness of many fluvial systems, resulting in a high degree of variation in velocity and substrate, and by the regionally warm climate. Nearly all endemic and threatened species are restricted in the region to running waters. This demonstrates very well the great importance of streams and rivers for dragonflies and the international responsibility of Portugal to protect and conserve these habitats. Despite their rarity in southern Portugal, ponds and pools harbour relict populations of several northern species like *Lestes dryas* and *Libellula quadrimaculata* at the limits of their distribution. However, today these ponds are endangered by intensification of agriculture and the loss of traditional land use practices and should also be protected.

Zusammenfassung

Libellennachweise aus dem Alentejo und der Algarve, Südportugal (Odonata) — Im Rahmen zweier Exkursionen in die Regionen Alentejo und Algarve im Süden Portugals im Sommer 2008 und im Frühjahr 2009 wiesen wir an insgesamt 112 Fundorten 42 Libellenarten nach. Alle Lokalitäten wurden jeweils einer der folgenden Kategorien zugeordnet: Bach, Fluss, Teich und Becken, Stausee und Brackwasser. Siebzehn Arten wurden demnach als rheophil klassifiziert und zwölf Arten hatten eine eindeutige Vorliebe für Stillgewässer. Es werden bemerkenswerte Nachweise von *Lestes dryas*, *Onychogomphus forcipatus*, *O. uncatus*, *Paragomphus genei*, *Orthetrum chrysostigma*, *O. coerulescens*, *O. nitidinerve*, *O. trinacria*,

Diplacodes lefebvrii, *Brachythemis impartita* und *Zygonyx torridus* im Detail präsentiert und diskutiert. Für die Mehrzahl dieser Arten wurden zudem regionale Verbreitungskarten erstellt. Die Libellenfauna südportugiesischer Bäche und Flüsse ist mit 35 Arten als reich und mannigfaltig zu werten. Diese hohe Vielfalt kann mit der großen Naturnähe vieler Gewässersysteme erklärt werden, die zu einer starken Variabilität bei der Fließgeschwindigkeit und im Substratangebot führt; dazu kommt noch das warme Klima der Region. Fast alle endemischen und gefährdeten Arten sind in Portugal in ihrem Lebensraum auf Fließgewässer beschränkt. Dies belegt sehr gut die hohe Bedeutung von Bächen und Flüssen für Libellen und die internationale Verantwortung des Landes für den Schutz und die Erhaltung dieser Habitate. Teiche und Becken stellen trotz ihrer Seltenheit in Südportugal essentielle Lebensräume für Reliktpopulationen nördlicher Arten wie *Lestes dryas* und *Libellula quadrimaculata* an den Grenzen ihrer Verbreitung dar. Derartige Kleingewässer sind heutzutage jedoch von der Intensivierung der Landwirtschaft und der Aufgabe traditioneller Bewirtschaftungsweisen bedroht und sollten ebenfalls geschützt werden.

Introduction

The Mediterranean basin does not only harbour rare and threatened habitats, many species are also restricted to this region. As a consequence, the Mediterranean has been recognised as a global biodiversity hotspot with a high level of endemism (Blondel & Arronson 1999; Myers et al. 2000).

Portugal is the most southwestern country of the European continent. Although the country does not support the richest dragonfly fauna of the Mediterranean (Boudot et al. 2009; Riservato et al. 2009), it hosts not only a number of western European and all Ibero-Maghrebian endemics (Ferreira et al. 2006), but also a good number of Ethiopian species. Until very recently the odonate fauna of Portugal received little attention, despite its distinct and diverse fauna. It was only in 2005 that a first bibliography of the odonatological literature of Portugal was published (Ferreira & Weihrauch 2005), followed in 2006 by a revised checklist of the Odonata fauna of Portugal (Ferreira et al. 2006). A national survey or mapping of dragonflies in the entire country is just starting up. At the moment regional surveys have been carried out in the Peneda-Gerês National Park (Ferreira et al. 2005), the Natural Park of Serra do Alvão (Moreira et al. 2008) and the Serra da Estrela National Park (Ferreira et al. 2009), all situated in northern Portugal.

The southern part of Portugal has a distinct climate, much warmer and drier than the rest of the country. As a consequence, several species with an African origin – e.g. *Brachythemis impartita*, *Trithemis annulata*, *Paragomphus genei* and *Anax ephippiger* – have been found in the Alentejo and the Algarve (e.g. Aguiar & Aguiar 1983, 1985; Lohr 2005a). However thorough odonatological surveys in both southern regions are scarce. The most substantial regional contributions have been made by Lohr (2005a), who investigated 35 localities for their dragonfly fauna, and by Malkmus & Ruf (2008) with 43 sites. Furthermore, Gardiner (1997) published an Odonata atlas for the western Algarve. Fulan et al. (2008) investigated 105 sites in a very small area in eastern Alentejo. Apart from these,

several contributions have been published on the local fauna or on spring and autumn phenology of Odonata (Hartung 1996; Jahn 1996; Jones 1996; Malkmus 1996, 1998; Röhn 1996; Weihrauch & Weihrauch 2003). Nearly all of these works have been published by foreign authors and are based on observations during their holiday trips.

The Algarve is Portugal's most southern and most touristic region. The Alentejo is different, an expanded region, generally of low rolling hills, with comparatively little tourism. It is divided into four districts: Portalegre in the north, Évora in the centre, the southern part of the Setúbal district bordering the Atlantic Ocean, and Beja in the south at the border to the Algarve. The Algarve has a year round warm climate with summer temperatures up to 35°C and maximum winter temperatures of 15°C. The Alentejo has a much more severe climate: very hot and dry summers up to 40°C, and relatively cold winters, when frost and snow are not unusual. The western and southwestern part of Portugal has a strong Atlantic climatic influence, resulting in mild winters and not too hot summers.

Here we present our results of two field trips to the Alentejo and Algarve in summer 2008 and in spring 2009.

Material & Methods

Odonata were investigated during two field trips from 24-vi-2008 to 24-vii-2008 and from 22-iv-2009 to 04-v-2009 to the two southernmost regions of Portugal, Alentejo and Algarve. With the help of topographic maps (1:25,000) of Portugal, a daily list of localities to be visited was selected. This selection was based on the most obvious suitable localities for the occurrence of dragonflies in the region we were passing by. At each locality we searched for adult dragonflies above the water, at gravel banks, in and above the bank vegetation and in the surroundings. The survey lasted until we presumed it as thoroughly investigated, or as long as no new species were found anymore. Most species were identified through binoculars. Individuals that are difficult to identify like females, tenerals and rarer species were caught with an insect net for determination. We only searched sporadically for exuviae or larvae. For some species we collected voucher specimens that are preserved in GDK's collection.

Localities

We checked approximately 200 places for the presence of Odonata and were able to record dragonflies in 112 different localities (Fig. 1). Five of these were visited twice, once in summer 2008 and once in spring 2009; one site was even visited three times, twice in summer 2008 and once in spring 2009, and one place was visited twice in spring 2009. Forty-nine of the sites were situated in the Algarve, and 63 in the Alentejo (Portalegre 15, Beja 35, Setúbal 13). In the few places we visited in the Évora district, no dragonflies were found. For each of the 112 places with Odonata records (see Appendix 1), the name of the nearest village and topo-

nym on the map, the name of the river or pond if available, the type of habitat, the 1x1 km UTM grid cell based on the topographic maps, the longitude and the latitude – checked by Google Earth – and finally the date of observation is given. The localities are numbered chronologically per district.

Habitat types

To characterise the Odonata communities, we grouped all locations into five different categories of habitat types: major running waters, small running waters, ponds and pools, reservoir lakes and brackish waters. This is to a large extent in accordance with the classification proposed by Lohr (2005a). He made a subdivision of our group of 'pools and ponds' into the group of pools and ponds, located in river valleys and into a group of small dam lakes and clay-, sand- or gravel-pits. Our experience is that nearly all pools and ponds are a result of small-scale damming of streams that are quite often only temporary. Therefore we treat them as one group. We also found that most pools in river beds were dried out in early summer, so that they no longer were appropriate as a habitat for dragonflies. Locality 2 could not be classified under one of these types, because the observation was done in the city centre of Marvão, away from any water. The five different categories are briefly described below.

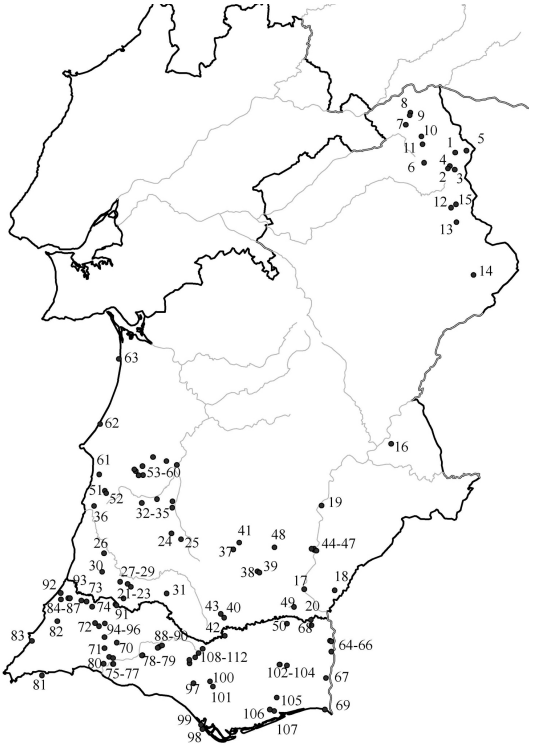

Figure 1: Overview of the localities investigated during this study in Portugals' southern regions Algarve and Alentejo. – Abbildung 1: Überblick aller Lokalitäten, die im südlichen Portugal in der Algarve und im Alentejo im Rahmen dieser Arbeit untersucht wurden.

Type I – Rivers
A total of 28 localities were classified as major running waters that are at least 5 m wide. Some of them had a clear current, while others were nearly stagnant. This was often a consequence of construction of dams or a result of low precipitation during the last months. The classification of Type I (river) and Type II (small running water) was based on the physical characteristics of the waters during our survey. It is likely that several streams and small rivers will hold more water during winter time or in wet years, and will shift from Type II to Type I. On the other hand, some of our river types may be classified as small running waters by the end of the summer. All localities within this group were usually characterised by deep pools in the streambed. Parts of the river bank were overgrown by bushes and trees, resulting locally in lots of shade and cooler ambient temperatures. Most rivers also had bare banks lacking any vegetation and local occurrences of gravel banks.

Type II – Small running waters
Thirty-six localities were considered as small running waters with a maximum width of 5 m. Several of these were very small streams, sometimes only less than 1 m wide. Many of them were partly shaded due to overhanging bushes and trees. Water temperature was mostly low. Riverbank vegetation was only locally present. Running channels and irrigation ditches in rice fields are also classified in this group.

Type III – Pools and ponds
Thirty-five localities were classified as pools and ponds. This group is quite diverse in origin, shape and use. They have in common that the water is stagnant and that they are generally smaller than 1000 m^2. Most are man-made and are the result of damming temporary, all winter running waters. These ponds often serve as water reservoirs for livestock and are mostly sun-exposed. Several of them were characterised by well-developed floating and submerged vegetation, and by the presence of riparian vegetation like reed and rushes.

Type IV – Reservoir lakes
Due to the almost complete absence of rainfall in Alentejo and Algarve during summer, many huge reservoir lakes exist. Especially in the hilly parts of both regions, these reservoirs often had very steep slopes without any vegetation on the banks (e.g. Barragem do Arade, without any dragonfly records) and a high fluctuation of the water level. Other reservoir lakes are situated in a more open, flat landscape, e.g. Barragem de Pavão (loc. 10), Barragem do Monte da Rocha (25) or Barragem de Morgavel (61). Banks were here partly covered by bare sand and alternated with parts rich in vegetation dominated by rushes and therophytes. Eight localities were investigated.

Type V - Brackish
Streams and rivers influenced by the tides of the Atlantic Ocean are mostly brackish. This phenomenon exists along the River Odelouca (75, 76), up to 10 km inland. Further we investigated the Salinas, standing brackish ponds which serve partly for salt extraction near Faro (98) and Castro Marim (69). Four sites are classified as brackish.

Results

Altogether, we collected 467 Odonata records (302 in 2008, and 165 in 2009) of 42 species, 17 Zygoptera and 25 Anisoptera on 112 different localities. Here, we give for each species or subspecies the number of individuals seen at each locality on that particular day. Abbreviations: m = males, f = females, im = imagines, cop = copulation, ovi = oviposition, ten = teneral(s), ex = exuvia(e), lar = larva(e) and x = the species has been observed, but the exact number was not possible to determine or was not noted at all.

***Calopteryx haemorrhoidalis* (Vander Linden, 1825)**
Loc. 3: 3 m, 4 f; loc. 4: 1 m, 3 f; loc. 5: 10 m, 15 f; loc. 6: 2 m, 3 f; loc. 12: 2 m; loc. 15: 2 m, 1 f; loc. 22: 1 m, 5 f; loc.22: 1 m, 5 f; loc. 30: 2 f; loc. 73a: 1 f; loc. 74a: 1 f; loc. 74b: 1 f; loc. 87a: 2 m, 3 f; loc. 94: 2 f; loc. 96: 20 im, 10 ten, x lar; loc. 97b: 1 f; loc. 106: 1 m, 1 f

***Calopteryx virgo meridionalis* (Selys 1873)**
Loc. 3: 10 m, 3 f; loc. 5: 2 m, 3 f; loc. 15: 1 m, 1 f; loc.22: 1 m, 1 f; loc. 74a: 1 m, 2 f; loc. 74b: 1 m; loc. 87a: 1 m, 1 f; loc. 91: 1 m; loc. 96: 1 m, loc. 100: 1 m; loc. 107: 1 m

***Calopteryx xanthostoma* (Charpentier, 1825)**
Loc. 3: 2 m, 1 f; loc. 4: 5 m, 2 f; loc. 5: 100 im, 3 ovi; loc. 6: 1 m; loc. 13: 1 m; loc. 74a: 1 m; loc. 87a: 1 m

***Lestes dryas* Kirby, 1890**
Loc. 93: 8 im

***Lestes virens* (Charpentier, 1825)**
Loc. 1: 1 m; loc. 102: 2 ten

***Lestes viridis* (Vander Linden, 1825)**
Loc. 8: 1 m; loc. 23: 1 m

***Sympecma fusca* (Vander Linden, 1820)**
Loc. 40: 5 im; loc. 41: 10 im; loc. 92: 1 m

***Coenagrion scitulum* (Rambur, 1842)**
Loc. 15: 4 m, 5 cop; loc. 20b: 1 f, 1 im, 1 ten; loc. 49: 1 m, 1 f, x ten

***Ceriagrion tenellum* (Villers, 1789)**
Loc. 27: 1 m; loc. 99: 50 im, x ten

***Enallagma cyathigerum* (Charpentier, 1840)**
Loc. 16: 1 m; loc. 38: 2 m, 1 cop; loc. 40: 20 im; loc. 41: 10 m, 5 f, 1 cop; loc. 51: x im; loc. 53: 2 m; loc. 55: 2 m, 1 cop; loc. 61: 1 m; loc. 85: 1 m; loc. 89: 1 m; loc. 92: 10 im, 1 ten; loc. 93: 1 m; loc. 112: 1 f, 1 ten

***Erythromma lindenii* (Selys, 1840)**
Loc. 4: 2 m; loc. 5: 6 m; loc. 7: 2 m; loc. 10: 10 m, 2 cop, 1 ovi; loc. 11: 5 m, 1 f; loc. 14: 3 m, 1 cop; loc. 15: 2 m; loc. 16: 50 im, 10 cop; loc. 17: 4 m; loc. 18: 10 m; loc. 19: 30 im; loc. 20a: 3 m; loc. 20b: 6 m, 2 f; loc. 27: 1 m; loc. 31: 2 m; loc. 33: 1 m; loc. 38: 50 im, 5 cop; loc. 39: 1 cop; loc. 40: 4 m, 5 f, 5 cop; loc. 41: 4 m ; loc. 42 : 3m, 2 cop ; loc. 43 : 2 m, 3 cop ; loc. 44 : 1 m, 1 f, x ten; loc. 45: 1 m; loc. 46: 1 m; loc. 47: 1 m; loc. 49: 1 m, 1 f ; loc. 50: 5 m, 2 f, 4 cop; loc. 53: 2 m, 1 cop; loc. 55: 1 m; loc. 57: 1 m; loc. 60: 1 m; loc. 65: 5 m; loc. 67: 1 m; loc. 68a: 10 m, 5 f; loc. 68b: 5 m, 1 f, 5 cop; loc. 69: 1 m; loc. 71: 2 m; loc. 79: 1 m, 1 f; loc. 82: 15 m; loc. 86: 1 m; loc. 90: 1 m; loc. 97b: 3 m, 1 cop; loc. 101: 1 m; loc. 102: 2 m; loc. 103: 2 m, 2 cop; loc. 104: 6 m; loc. 106: 8 m, 2 ten; loc. 107: x im ; loc. 108: 5 m; loc. 109: 5 m, 1 cop; loc. 111: 1 m; loc. 112: 1 m

***Erythromma viridulum* (Charpentier, 1840)**
Loc.7: 50 im; loc. 10: 2 m; loc. 16: 50 im, x cop, x ovi; loc. 17: 2 m; loc. 18: 3 m; loc. 19: 10 im; loc. 20a: 50 im; loc. 20b: 1 f; loc. 53: 50 im, x cop, x ovi

***Ischnura graellsii* (Rambur, 1842)**
Loc. 4: 1 m; loc. 5: 2 m, 1 f; loc. 6: 1 m, 1 f; loc. 9: 2 m; loc. 10: 5 m, 3 f, 15 ovi; loc. 11: 1 m; loc. 14: 2 m; loc. 16: 2 m, 1 f; loc. 17: 10 im; loc. 18: 3 m, 1 f; loc. 19: 10 im; loc. 20a: 3 m; loc. 20b: 100 im; loc. 23: 1 m; loc. 24: 3 m, 1 cop; loc. 25: 1 m, 1 ten; loc. 27: 10 m; loc. 29: 1 m; loc. 29: 1 m; loc. 32: 1 m; loc. 33: 3 m; loc. 35: 5 im; loc. 36: 5 m, 1 f (leg. 1m, 1f); loc. 37: 2 m; loc. 38: 30 im, x ten; loc. 39: 2 m; loc. 40: 3 m, 1 f, 1 cop; loc. 41: 20 im; loc. 42: 2m, 1 f; loc. 43: 1 m; loc. 44: 2 m; loc .48: 1m; loc. 49: 15 im; loc. 50: 5 im; loc. 52: 2 m, 3 f ; loc. 53: 2 m, 1 f; loc. 55: 1 m; loc. 57: 2 m; loc. 60: 1 m, loc. 61: 2 m; loc. 64: x im; loc. 66: x im; loc. 67: 1 m; loc. 68a: 10 im; loc. 68b: 20 im; loc. 69: 15 im; loc. 71: 5 im; loc. 73c: 2 m; loc. 79: 2m, 3 f; loc. 83: 1m; loc. 87: 1m; loc. 92: 2 m; loc. 93: 30 im, 3 cop; loc. 95: 1 f; loc. 96: 1m; loc. 97: 1 m; loc. 99: 40 im; loc. 101: 5 m, 2 f ; loc. 102: 10 im; loc. 103: 2 m, 1 f ; loc. 104: 2 m; loc 106: 30 im; loc. 108: 3 m

***Ischnura pumilio* (Charpentier, 1825)**
Loc. 20b: 1 f, 1 ten; loc. 80: 1 f

***Pyrrhosoma nymphula* (Sulzer, 1776)**
Loc. 3: 2 m, 1 cop; loc. 42: 1 m; loc. 94: 2 m; loc. 95: 4 m, 1 cop; loc. 100: 1 m; loc. 110: 1 f

***Platycnemis acutipennis* Selys, 1841**
Loc. 27: 1 m, 3 f; loc. 46: 1 m; loc. 50: x im; loc. 68b: 30 im; loc. 87a: 1 m; loc. 87b: 1 m; loc. 94: 1 m; loc. 101: 2 f; loc. 106: 15 im.

***Platycnemis latipes* Rambur, 1842**
Loc. 17: 30 im; loc. 27: 30 im; loc. 28: 2 m; loc. 30: 1 m; loc. 35: 3 m; loc. 58: 1m; loc. 68a: 100 im, x cop, x ovi; loc. 73a: 3 m; loc. 77: 1 ten; loc. 80: 2 m, 1 f; loc. 82: 1 m; loc. 87: 20 im

***Anax imperator* Leach, 1815**
Loc. 1: 1 m, loc. 7: 1 m; loc. 9: 1 m; loc. 11: 2 m; loc. 20a: 2 m; loc. 20b: 1 m; loc. 28: 1 m; loc. 36: 1 m; loc. 38: 1 m; loc. 46: 1 m; loc. 53: 1 m, 1ovi; loc. 68: 1 m, 1 f; loc. 72: 1 m; loc. 74c: 1 m; loc. 87a: 1 m; loc. 93: 5 exu; loc. 94: 1 m; loc. 95: 1 m; loc. 96: 1 m; loc. 97a: 1 m; loc. 97b: 3 m; loc. 101: 2 m; loc. 105: 2 m; loc. 107: x im; loc. 108: 1 m; loc. 109: 1 m; loc. 110: 1 m, 1 ovi

***Anax parthenope* Selys, 1839**
Loc. 16: 1 m; loc. 32: 1 m

***Boyeria irene* (Fonscolombe, 1838)**
Loc. 2: 1 im; loc. 73b: 10 exu; loc. 74a: 10 im; loc. 74c: 20 lar; loc. 96: 15 lar; loc. 110: 1 lar

***Gomphus graslinii* Rambur, 1842**
Loc. 87: 1 m, 1 cop

***Gomphus pulchellus* Selys, 1840**
Loc. 38: 5 im; loc. 41: 1 ovi; loc. 74: 3 m; loc. 109: 2 im; loc. 112: 2 m

***Onychogomphus forcipatus unguiculatus* (Linnaeus, 1758)**
Loc. 5: 20 im; loc. 8: 2 m; loc. 12: 10 im, 1 cop; loc. 15: 50 im, x cop, x ovi; loc. 31: 1 m; loc. 42: 1 ovi; loc. 50: 1 ten; loc. 68b: 1 ten; loc. 76: 1 m; loc. 96: x lar; loc. 97b: 2 m; loc. 105: 1 m

***Onychogomphus uncatus* (Charpentier, 1840)**
Loc. 3: 2 m, 3 im; loc. 9: 1 m; loc. 70: 2 m; loc. 73a: 3 m, 1 f, 1 ten; loc. 74a: 1 f, 1 ten; loc. 82: 1 m; loc. 87a: 2 m

***Paragomphus genei* (Selys, 1841)**
Loc. 51: 2 m, 1 f; loc. 52: 1 m; loc. 61: 15 im

***Cordulegaster boltonii* (Donovan, 1807)**
Loc. 87: 2 im

***Oxygastra curtisii* (Dale, 1834)**
Loc. 50: 1 m; loc. 68b: 1 m; loc. 103: 1 m; loc. 106: 1 m; loc. 110: 1 m

***Brachythemis impartita* (Karsch, 1890)**
Loc. 10: 2m; loc. 16: 10.000 im, x cop, x ovi, x ten; loc. 17: 1m, 4f; loc. 33: 2m, 3f; loc. 52: 100 im (leg. 1m, 1f); loc. 61: 3m, 1f

***Crocothemis erythraea* (Brullé, 1832)**
Loc. 7: 2 m; loc. 9: 1 m; loc. 10: 15 im; loc. 19: 3 m; loc. 20a: 50 im, x ovi; loc. 21: 4 m, 1 f; loc. 27: 3 m, 1 f; loc. 28: 4 m; loc. 29: 1 m; loc. 32: 2 m; loc 34: 10 ten; loc. 36: 50 im, x ten; loc. 38: 3 m; loc. 39: 1 m, 1 f, 1 ovi; loc. 49: 1 f, x ten; loc. 53: 100 im, x cop, x ovi; loc. 55: 1 m; loc. 56: 1m; loc. 57: 4 m, 1 f; loc. 60: 1 m; loc. 63: 1m; loc. 68a: 30 im, x ovi; loc. 69: 1 m, 1 f, 1 ten; loc. 70: 1 m; loc. 71: 3 m; loc. 74c: 1 m; loc. 75: 1 f; loc. 78: 1 m; loc. 79: 4 m, 1 f, 1 ten; loc. 81: x im; loc. 82: 4 m; loc. 83: 2 m; loc. 85: 50 im, x cop, x ovi, x ten; loc. 86: 10 m, 2f; loc. 88: 3 m; loc. 89: 10 m; loc. 94: 1 m; loc. 96: 1 m; loc. 97a: 1 m; loc. 97b: 1 ovi; loc. 102: 1 m; loc. 103: 2 m

***Diplacodes lefebvrii* (Rambur, 1842)**
Loc. 78: 1 m; loc. 79: 3 m; loc. 85: 150 im, x cop, x ovi, x ten (leg 1f); loc. 86: 10 im, 2 ovi; loc. 88: 2 m

***Libellula depressa* Linnaeus, 1758**
Loc. 1: 2 m; loc. 95: 1 f

***Libellula quadrimaculata* Linnaeus, 1758**
Loc. 40: 1 m

***Orthetrum brunneum* (Fonscolombe, 1837)**
Loc. 68a: 2 m; loc. 70: 2 m; loc. 71: 2 m; loc. 87a: 1 m

***Orthetrum cancellatum* (Linnaeus, 1758)**
Loc. 7: 1 m; loc. 10: 1 m, 1 f; loc. 20: 5 m; loc. 24: 1 m, 1 ten; loc. 38: 2 m, 1 cop, 1 ten; loc. 40: 1 m; loc. 46: 1 ten; loc. 52: 1 m; loc. 53: 1 m; loc. 56: 1 m; loc. 57: 2 m, 1 f, 1 cop ; loc. 62: 3 m, 1 f ; loc. 98: 1 m, 1 ten; loc. 111: 2 m; loc. 112: 1 ten

***Orthetrum chrysostigma* (Burmeister, 1839)**
Loc. 10: 10 im (leg. 1m); loc. 18: 1 m; loc. 19: 3 m; loc. 26: 1 m; loc. 27: 3 m, 1 f, 1 ten; loc. 29: 1 m; loc. 31: 5 m, 1 f; loc. 32: 1 m, 1 f; loc. 34: 1 m, 1 ten; loc. 36: 5 m, 3 f, 1 cop, 1 ovi; loc. 60: 2 m; loc. 63: 3 m, 1 f, 1 ten; loc. 67: 1 m; loc. 68a: 10 im; loc.

70: 1 m; loc. 77: 2 m (leg. 1m); loc. 80: 1 m; loc. 82: 3 m; loc. 83: 2 m, 1 f, 1 ovi; loc 84: 2 m, 1 f, 1 ovi; loc. 90: 1 m; loc. 94: 1 f; loc. 96: 1 cop; loc. 97b: 2 m, 3 f

***Orthetrum coerulescens* (Fabricius, 1798)**
Loc. 5: 1 m; loc. 6: 1 ten; loc. 9: 1 m; loc. 11: 2 m; loc. 12: 2 m; loc. 14: 1 m; loc. 15: 4 m; loc. 31: 1 m; loc. 65: 1 m; loc. 73a: 1 m; loc. 74a: 1 m; loc. 107: x im

***Orthetrum nitidinerve* (Selys, 1841)**
Loc. 52: 1 m

***Orthetrum trinacria* (Selys, 1841)**
Loc. 20a: 3 m, 1 f; loc. 24: 40 m, 5 f; loc. 36: 5 m, 1 f; loc. 53: 50 im; loc. 55: 1 m; loc. 56: 2 m; loc. 60: 1 m; loc. 79: 1 m, 2 f; loc. 89: 2 m

***Sympetrum fonscolombii* (Selys, 1840)**
Loc. 10: 150 im; loc. 14: 10 im; loc. 16: 10 im; loc. 17: 5 m, 5 f, 3 ten; loc. 19: 5 im; loc. 20b: 1 ten; loc. 25: 1 m; loc. 32: 5.000 im, x cop, x ovi, x ten; loc. 33: 50 im, x ten; loc. 34: 500 im (leg. 1f); loc. 36: 50 im, x cop, x ten; loc. 38: 1 m; loc. 40: 2 m, 1 f; loc. 41: 1 ten; loc. 46: 5 ten; loc. 52: 15 im; loc. 53: 100 im, x ten; loc. 54: 1 m, 5 f; loc. 55: 20 im; loc. 56: 1 m, 5 f, 1 ten; loc. 57: 10 im; loc. 59: 5 f; loc. 60: 1m, 2 f; loc. 61: 1 f; loc. 68a: 10 im; loc. 71: 1 m; loc. 92: 5 ten; loc. 108: 1 m, 1 f, 1 cop, 1 ten; loc. 109: 1 m, 1 cop, 1 ovi

***Sympetrum striolatum* (Charpentier, 1840)**
Loc. 11: 1 m, 1 ten; loc. 95: 1 m; loc. 102: 10 ten

***Trithemis annulata* (Palisot de Beauvois, 1807)**
Loc. 16: 150 im, x cop, x ovi; loc. 17: 10 im; loc. 18: 3 m; loc. 19: 10 im; loc. 20a: 10 im; loc. 21: 1 m; loc. 24: 30 m; loc. 33: 1 m; loc. 40: 1 f, 1 ten; loc. 46: 3 ten; loc. 52: 3 ten; loc. 53: 10 m, 2 f; loc. 55: 5 m, 1 f; loc. 56: 3 m; loc. 60: 1 m; loc. 61: 2 m; loc. 64: x im; loc. 65: 4 m, 1 f; loc. 67: 2 m; loc. 68a: 100 im, x cop, x ovi; loc. 68b: 2 m, 4 f; loc. 69: 5 m, 1 f; loc. 70: 10 im; loc. 71: 10 im; loc. 76: 1 m; loc. 78: 3 m; loc. 79: 15 m; loc. 82: 10 im; loc. 89: 20 m (leg. 1m); loc. 97a: 1 m; loc. 102: 1 f

***Zygonyx torridus* (Kirby, 1889)**
Loc. 106: 3m

Dragonfly fauna of the different types of water
The three most investigated habitat types were rivers (n = 28), small running waters or streams (n = 36) and ponds and pools (n = 35), each harbouring 27 species of dragonflies (Tab. 1). Furthermore, we observed 14 species at reservoir lakes (n = 8) and six species at brackish waters (n = 4). For each species, the frequency of occurrence within the different types of waters is given in Table 1, and the preference of each species for one of the five different types of waters is

Table 1. Frequency of occurrence [%] of each odonate species recorded during this study within the different types of water bodies in Alentejo and Algarve, Portugal, and the total number of species for each type. – Tabelle 1. Häufigkeit des Vorkommens [%] jeder in dieser Arbeit nachgewiesenen Libellenart an verschiedenen Gewässertypen im Alentejo und in der Algarve, Portugal, sowie die Artenzahl für jeden Gewässertyp.

Species	records	river	stream	pond	reservoir	brackish
Number of investigated sites		28	36	35	8	4
Calopteryx haemorrhoidalis	16	32.1	19.4	-	-	-
Calopteryx virgo meridionalis	11	25.0	11.1	-	-	-
Calopteryx xanthostoma	7	17.9	5.6	-	-	-
Lestes dryas	1	-	-	2.9	-	-
Lestes virens	2	-	2.8	2.9	-	-
Lestes viridis	2	-	5.6	-	-	-
Sympecma fusca	3	-	-	8.6	-	-
Coenagrion scitulum	3	-	2.8	5.7	-	-
Ceriagrion tenellum	2	3.6	-	2.9	-	-
Enallagma cyathigerum	13	-	-	28.6	37.5	-
Erythromma lindenii	53	60.7	27.8	54.3	75.0	25.0
Erythromma viridulum	9	7.1	-	11.4	37.5	-
Ischnura graellsii	62	75.0	33.3	60.0	87.5	25.0
Ischnura pumilio	2	3.6	-	2.9	-	-
Pyrrhosoma nymphula	6	7.1	8.3	2.9	-	-
Platycnemis acutipennis	9	21.4	5.6	2.9	-	-
Platycnemis latipes	12	28.6	11.1	-	-	-
Anax imperator	27	21.4	30.6	28.6	-	-
Anax parthenope	2	-	2.8	-	12.5	-
Boyeria irene	6	14.3	2.8	-	-	-
Gomphus graslinii	1	3.6	-	-	-	-
Gomphus pulchellus	5	3.6	-	8.6	12.5	-
Onychogomphus forcipatus unguiculatus	12	17.9	16.7	-	-	25.0
Onychogomphus uncatus	7	14.3	8.3	-	-	-
Paragomphus genei	3	-	-	5.7	12.5	-
Cordulegaster boltonii	1	3.6	-	-	-	-
Oxygastra curtisii	5	14.3	2.8	-	-	-
Brachythemis leucosticta	6	3.6	-	5.7	37.5	-
Crocothemis erythraea	42	35.7	33.3	48.6	12.5	50.0
Diplacodes lefebvrii	5	-	-	14.3	-	-
Libellula depressa	2	-	2.8	2.9	-	-
Libellula quadrimaculata	1	-	-	2.9	-	-
Orthetrum brunneum	4	10.7	2.8	-	-	-
Orthetrum cancellatum	15	-	2.8	31.4	25.0	25.0
Orthetrum chrysostigma	24	28.6	33.3	2.9	37.5	-
Orthetrum coerulescens	12	17.9	16.7	-	12.5	-
Orthetrum nitidinerve	1	-	-	2.9	-	-
Orthetrum trinacria	9	-	2.8	22.9	-	-
Sympetrum fonscolombii	29	14.3	16.7	40.0	62.5	-
Sympetrum striolatum	3	-	2.8	5.7	-	-
Trithemis annulata	31	21.4	13.9	40.0	50.0	50.0
Zygonyx torridus	1	3.6	-	-	-	-
Number of species	42	27	27	27	14	6

Table 2. Preference (pref.) of each odonate species recorded during this study in Alentejo and Algarve, Portugal, for the habitat types river, stream, pond/pool, reservoir lake and brackish waters, and for the combination of both types of lotic waters and both types of standing water. The species are ordered in descending preference for lotic waters: Those in the upper third have a clear preference for running waters, in the lower third for standing waters and in between (shaded grey) is an intermediate group. – Tabelle 2. Präferenz der in dieser Arbeit nachgewiesenen Libellenarten im Alentejo und in der Algarve, Portugal, für die Habitattypen Fluss, Bach, Teich/Becken, Stausee und Brackwasser, sowie zusammenfassend für Fließ- und Stillgewässer. Die Arten sind hinsichtlich ihrer Präferenz für Fließgewässer abnehmend sortiert: Das obere Drittel beinhaltet Arten mit einer klaren Präferenz für Fließgewässer, das untere Drittel Stillgewässerarten und dazwischen (grau hinterlegt) existiert eine intermediäre Gruppe.

species	records	river pref. [%]	stream pref. [%]	all lotic pref. [%]	pond & pool pref. [%]	reser-voir pref. [%]	all stag-nant pref. [%]	brack-ish pref. [%]
Calopteryx haemorrhoidalis	16	56	44	100	0	0	0	0
Calopteryx virgo meridionalis	11	64	36	100	0	0	0	0
Platycnemis latipes	12	67	33	100	0	0	0	0
Calopteryx xanthostoma	7	71	29	100	0	0	0	0
Onychogomphus uncatus	7	57	43	100	0	0	0	0
Oxygastra curtisii	5	80	20	100	0	0	0	0
Orthetrum brunneum	4	75	25	100	0	0	0	0
Lestes viridis	2	0	100	100	0	0	0	0
Cordulegaster boltonii	1	100	0	100	0	0	0	0
Gomphus graslinii	1	100	0	100	0	0	0	0
Zygonyx torridus	1	100	0	100	0	0	0	0
Onychogomphus forcipatus unguiculatus	12	42	50	92	0	0	0	8
Orthetrum coerulescens	12	42	50	92	0	8	8	0
Platycnemis acutipennis	9	67	22	89	11	0	11	0
Orthetrum chrysostigma	24	33	50	83	4	13	17	0
Boyeria irene	6	67	17	83	0	0	0	0
Pyrrhosoma nymphula	6	33	50	83	17	0	17	0
Anax imperator	27	22	41	63	37	0	37	0
Ischnura graellsii	62	34	19	53	34	11	45	2
Crocothemis erythraea	42	24	29	52	40	2	43	5
Erythromma lindenii	53	32	19	51	36	11	47	2
Anax parthenope	2	0	50	50	0	50	50	0
Ceriagrion tenellum	2	50	0	50	50	0	50	0

species	records	river pref. [%]	stream pref. [%]	all lotic pref. [%]	pond & pool pref. [%]	reser-voir pref. [%]	all stag-nant pref. [%]	brack-ish pref. [%]
Ischnura pumilio	2	50	0	50	50	0	50	0
Lestes virens	2	0	50	50	50	0	50	0
Libellula depressa	2	0	50	50	50	0	50	0
Trithemis annulata	31	19	16	35	45	13	58	6
Sympetrum fonscolombii	29	14	21	34	48	17	66	0
Coenagrion scitulum	3	0	33	33	67	0	67	0
Sympetrum striolatum	3	0	33	33	67	0	67	0
Erythromma viridulum	9	22	0	22	44	33	78	0
Gomphus pulchellus	5	20	0	20	60	20	80	0
Brachythemis impartita	6	17	0	17	33	50	83	0
Orthetrum trinacria	9	0	11	11	89	0	89	0
Orthetrum cancellatum	15	0	7	7	73	13	87	7
Lestes dryas	1	0	0	0	100	0	100	0
Libellula quadrimaculata	1	0	0	0	100	0	100	0
Orthetrum nitidinerve	1	0	0	0	100	0	100	0
Paragomphus genei	3	0	0	0	67	33	100	0
Sympecma fusca	3	0	0	0	100	0	100	0
Diplacodes lefebvrii	5	0	0	0	100	0	100	0
Enallagma cyathigerum	13	0	0	0	77	23	100	0

given in Table 2. Eleven species occurred only at running waters and six more had a clear preference (>70%) for lotic waters. This resulted in a group of 17 species that can be classified as rheophilous. A closer look at the two groups of running waters reveals that *Oxygastra curtisii*, *Orthetrum brunneum*, *Calopteryx xanthostoma*, *Platycnemis latipes*, *P. acutipennis* and *Boyeria irene* had two thirds of their localities exclusively at rivers with a width of at least 5 m. Except *Lestes viridis*, which was only found at two streams, no other species really seemed to prefer small running waters instead of the larger ones. An intermediate group of 13 species showed no clear preference between running and standing waters, including *Crocothemis erythraea*, *Sympetrum fonscolombii* and *Trithemis annulata*, which are generally not considered as species occurring in lotic waters. All the species of this group were much more common at ponds than at reservoirs. Only *Anax parthenope* showed a higher frequency for reservoirs instead of ponds and pools. Finally, twelve species were more present at stagnant waters, where more than 70 % of their occurrences were observed. From this group, *Lestes dryas*, *Sympecma fusca*, *Enallagma cyathigerum*, *Paragomphus genei*, *Libellula quadrimaculata*, *Orthetrum nitidinerve* and *Diplacodes lefebvrii* were only found at stagnant wa-

ters. The only species within this group that had a higher frequency at reservoirs instead of ponds and pools was *Brachythemis impartita*. All other species of this group were more present at ponds and pools, and even half of them being absent from reservoir lakes. None of the species showed any preference for brackish waters.

Discussion

General species diversity

During two fieldtrips we recorded 42 species of Odonata in the Algarve and the Alentejo, comprising 67 % of the fauna of continental Portugal (n = 63 species; Ferreira et al. 2006). Several of the species we found were only known from one or a handful of localities in the country. Apart from the 42 species we evidenced, eleven more species have been reported from Alentejo and Algarve: *Lestes macrostigma* (Kappes & Kappes 1999), *Coenagrion puella* (Lohr 2005a), *Aeshna cyanea* (Malkmus & Ruf 2008), *Aeshna isoceles* (Jahn 1996; Jones, 1996), *Aeshna mixta* (Lohr 2005a; Malkmus & Ruf 2008), mass migration of *Anax ephippiger* (Boness 2000), *Gomphus simillimus* (Weihrauch & Weihrauch 2003), *Onychogomphus costae* (Jahn 1996), *Macromia splendens* (Malkmus 1996; Weihrauch & Weihrauch 2003; Lohr 2005a), *Libellula fulva* (Dijkstra 1997) and *Selysiothemis nigra* (Lohr 2005b). This results in a list of 52 species for both regions, or more than 80 % of the total dragonfly fauna of Portugal.

The three most common species we found were *Ischnura graellsii*, *Erythromma lindenii* and *Crocothemis erythraea*, each occurring in at least 40 % of all localities (Tab. 1). Twelve species were only found at one or two sites. Among these, *Cordulegaster boltonii*, *Gomphus graslinii* and *Zygonyx torridus* are strictly rheophilous species, restricted to a limited number of streams and rivers in the south of Portugal with special habitat characteristics. Others like *Lestes dryas*, *L. viridis*, *Libellula depressa and L. quadrimaculata* occur in Portugal nearly at the southern edge of their distribution range with only scattered populations. Very surprisingly, *Ceriagrion tenellum*, *Coenagrion scitulum*, *Anax parthenope* and *Orthetrum brunneum* – species with a strong Mediterranean affinity – were rare.

Comment on some 'rare' species

Eight tenerals of *Lestes dryas* were observed on 22-iv-2009 at a small pond just outside the 'Parque Natural do Sudoeste Alentejano e Costa Vicentina'. This site matches the one where Lohr (2005a) had already recorded the species in 2003, and the individuals that we found emerged probably from the same habitat. This confirms the presence of a local population of this species in the southwestern part of Portugal and at low altitude. Other populations of *L. dryas* seem limited to northern mountain ranges of Portugal, such as the Serra do Gerês (Ferreira & Grosso-Silva 2006) and Serra da Estrela (Ferreira et al. 2009).

The rheophilous species *Onychogomphus forcipatus unguiculatus* and *O. uncatus* seem to be limited to the Serra de São Mamede in northern Alentejo and to the Serra de Monchique, Serra do Caldeirão, Serra de Alcaria do Cume and their foothills in the Algarve (Fig. 2). *Onychogomphus forcipatus unguiculatus* has been recorded in both regions (e.g. Jahn 1996; Malkmus 1996, 1998; Weihrauch & Weihrauch 2003; Lohr 2005a). The findings of *O. uncatus* are much more scarce and altogether comprise only six localities, all situated in the western Algarve (Jones 1996; Gardiner 1997; Lohr 2005a), which corresponds to our results. Both species are semivoltine and need permanent water for reproduction. As a consequence, they are mostly limited to the upper and middle courses in southern Portugal. This has also been found by Hampe (1998) for southern Spain.

We only recorded *Paragomphus genei* at three localities at the west coast south of Sines (Fig. 3). One locality was a reservoir lake and the others were large dammed farmland ponds, resembling a reservoir lake. All were large open standing waters with sparse aquatic vegetation and with sandy, gravelly bare soil at the shoreline. In a survey of the Alqueva dam on the Guadiana River and its surroundings, Fulan et al. (2008) found *P. genei* at no less than 26 localities. In neighbouring Spain's Extremadura, the species was locally especially present at cattle ponds

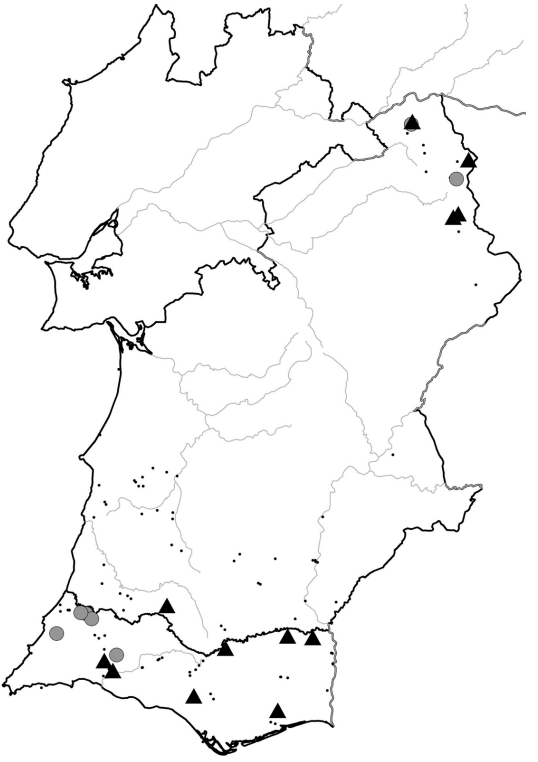

Figure 2: Distribution of *Onychogomphus forcipatus unguiculatus* (black triangles) and *O. uncatus* (grey dots) in Alentejo and Algarve, Portugal, based on this study. The situation of all prospected localities is shown by small dots. – Abbildung 2: Verbreitung von *Onychogomphus forcipatus unguiculatus* (schwarze Dreiecke) und *O. uncatus* (graue Punkte) im Alentejo und in der Algarve, Portugal, nach dieser Arbeit. Kleine Punkte zeigen die Lage aller untersuchten Lokalitäten.

(S. Ferreira pers. comm.). Jahn (1996) however also found larvae of *P. genei* at running waters like the Rio Guadiana and one of its tributaries. Weihrauch & Weihrauch (2003) found the species emerging from quiet littoral parts of the Ribeira do Vascão with sandy substrate. It seems that in southwestern Europe it inhabits both standing and running waters with bare sandy, rocky or gravelly soils that can heat up easily. This is supported by Testard (1975) who observed that the larvae prefer bare humid sands near the water for emergence. Although the species was first mentioned for Portugal by Girard (1891) already in the 19th century, the number of records is still rare for this Afro-tropical dragonfly (see also Weihrauch & Weihrauch 2003). We expect that the species is much more common than hitherto known, and that it can be found at many cattle ponds and warm rivers in the southern part of Portugal and Spain.

Orthetrum chrysostigma was especially present at streams and rivers, making it the most common species of running waters. We noticed it at very small streams, nearly lacking any water, up to major rivers like the Guadiana. All recording sites had in common that the banks were partly stony, rocky or sandy and easily heated up. Its congener *O. coerulescens* was present at twelve sites. Figure 4 shows the distribution of *O. chrysostigma* and *O. coerulescens* in Alentejo and Algarve based

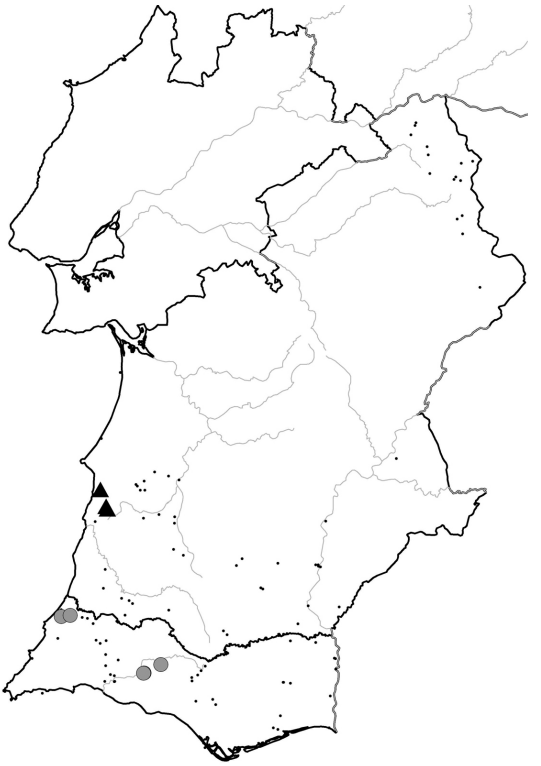

Figure 3: Distribution of *Diplacodes lefebvrii* (grey dots) and *Paragomphus genei* (black triangles) in Alentejo and Algarve, Portugal, based on this study. The situation of all prospected localities is shown by small dots. – Abbildung 3: Verbreitung von *Diplacodes lefebvrii* (graue Punkte) und *Paragomphus genei* (schwarze Dreiecke) im Alentejo und in der Algarve, Portugal, nach dieser Arbeit. Kleine Punkte zeigen die Lage aller untersuchten Lokalitäten.

on our records. *Orthetrum coerulescens* is especially present in northern Alentejo but rare in southern Alentejo and Algarve. All rivers and streams where *O. coerulescens* was present were characterised by gallery forest, resulting in relatively cool water even in mid-summer. On the other hand, *O. chrysostigma* was especially present in southern Alentejo and Algarve, with less trees and bushes at the water side. The two species were only syntopic at one locality, the Ribeira de Santana near Santana da Serra (31). Lohr (2005a) found *O. chrysostigma* at 13 and *O. coerulescens* at five localities, without any overlap between them. Jahn (1996) recorded only one syntopic occurrence among five sites with *O. chrysostigma* and two sites with *O. coerulescens*. This suggests that both species have different specific habitat requirements and are not in competition with each other. *Orthetrum chrysostigma* is also quite common at all kinds of running waters in the south of Spain (Ferreras Romero & Cano Villegas 2004).

Despite a specific search for *Orthetrum nitidinerve*, we only saw one male of this species at a cattle pond in Cercal do Alentejo (52). In 1994, we recorded the species at Barragem Monte da Rocha near Garvão (25). Revisiting this locality in 2008 proved to be unsuccessful. *Orthetrum nitidinerve* is a western Mediterranean endemic associated with larger river systems and has its strongest populations

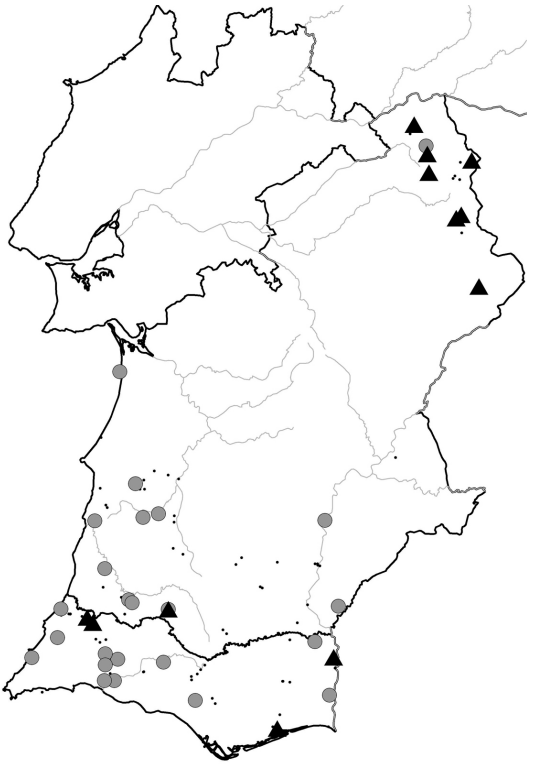

Figure 4: Distribution of *Orthetrum chrysostigma* (grey dots) and *O. coerulescens* (black triangles) in Alentejo and Algarve, Portugal, based on this study. The situation of all prospected localities is shown by small dots. – Abbildung 4: Verbreitung von *Orthetrum chrysostigma* (graue Punkte) und *O. coerulescens* (schwarze Dreiecke) im Alentejo und in der Algarve, Portugal, nach dieser Arbeit. Kleine Punkte zeigen die Lage aller untersuchten Lokalitäten.

in the Maghreb in brooks, springs and seepage waters (Jödicke et al. 2000). However, in Morocco it also inhabits rivers with standing water in summer and even marshland with some flowing current through it (Jacquemin & Boudot 1999). Knowledge about details of its habitat preferences in Portugal and Spain is largely lacking.

Orthetrum trinacria was firstly reported from Spain by Belle (1984) and from Portugal by Jahn (1996), at a reservoir lake close to the Guadiana River. We found *O. trinacria* at eight ponds and one stream, nearly all situated in the western part of Alentejo and Algarve (Fig. 5). This is a considerable increase in range compared to the maps published by Dijkstra & Lewington (2006) where only the eastern part of both regions are highlighted. Locally the species seems to be very common at small cattle ponds with well developed vegetation at the water edge and sometimes with aquatic plants. However, Belle (1984) and Conesa Garcia (1985) mention the species for small reservoir lakes without practically any aquatic plants. During a trip to Sicily in 2009 we recorded the species at four localities, all ponds with well developed aquatic and riparian vegetation (GDK & HD unpubl.). We assume that optimal habitats of *O. trinacria* are rather ponds with presence of aquatic and shoreline vegetation than large reservoir lakes. We only

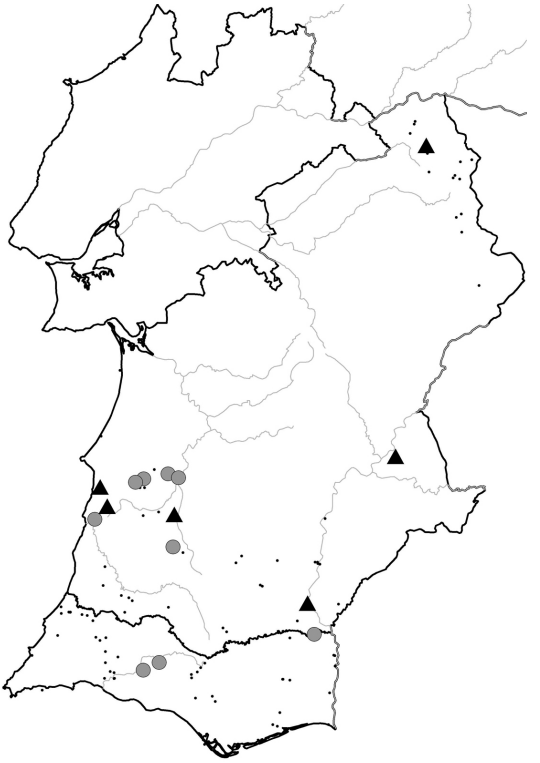

Figure 5: Distribution of *Orthetrum trinacria* (grey dots) and *Brachythemis impartita* (black triangles) in Alentejo and Algarve, Portugal, based on this study. The situation of all prospected localities is shown by small dots. – Abbildung 5: Verbreitung von *Orthetrum trinacria* (graue Punkte) und *Brachythemis impartita* (schwarze Dreiecke) im Alentejo und in der Algarve, Portugal, nach dieser Arbeit. Kleine Punkte zeigen die Lage aller untersuchten Lokalitäten.

observed the species during our 2008 trip and not during spring 2009, suggesting that *O. trinacria* in spring is not yet on the wing. This explains probably the complete absence of the species in the intensive spring surveys by Jahn (1996), Weihrauch & Weihrauch (2003) and Lohr (2005a).

Diplacodes lefebvrii was observed at five ponds in the western part of the Algarve (Fig. 3), one cluster near São Bartolomeu de Messines (78, 79 and 88) and more than 200 individuals at a cluster near Maria Vinagre (85 and 86) in the 'Parque Natural do Sudoeste Alentejano e Costa Vicentina'. Although we failed to observe this species at other similar ponds in the region, we expect it to be found at many more sites. Jones (1996) mentioned the species also for the Alvor marshes, at the south coast of the Algarve.

Recent research by Dijkstra & Matushkina (2009) on *Brachythemis leucosticta* revealed that this taxon includes two morphotypes, which represent separate species. The true *B. leucosticta* occupies most of tropical Africa and Madagascar, while *B. impartita* ranges north and south of the Sahara and extends into Eurasia. Hence, all *Brachythemis* individuals observed in Portugal must be regarded as pertaining to *B. impartita*. This species was found predominantly at bigger reservoir lakes with gentle slopes and fine sediments at the shores, alternating with open sparse vegetation. Aquatic water plants were only present in very low densities, so that most of the water surface remained open. The number of individuals was extremely high at Barragem do Alqueva (16) where we counted more than 10,000 adults at several hundred meters of shoreline. This reservoir has a surface of over 250 km^2 and has many inlets. Most of its shore seems to provide suitable habitats for *B. impartita*, probably resulting in millions of individuals. At this locality we found females with fully developed wing bands while others had clear wings, proving that both 'forms' can co-occur. The species was also found at reservoir lakes in Morocco (Juillerat & Monnerat 2009), Tunisia (Jödicke et al. 2000) and Spain (Ocharan 1985). All of the *B. impartita* localities we found were situated in the low rolling hills of the Alentejo region (Fig. 5). It was first mentioned for Europe by Moura (1960) who collected one male at Vale de Santarem, north of Lisbon in July 1957. Since then, the number of published records from south western Iberia has steadily grown (Ocharan 1983). A more recent overview is given by Weihrauch & Weihrauch (2003). However, the published records for Portugal are still very scarce (Aguiar & Aguiar 1983; Jahn 1996; Ferreira & Grosso-Silva 2006) and only concern some individuals. Weihrauch & Weihrauch (2003) mention the collection of two exuviae from the Ribeira do Vascão, which was later revised by Ferreira & Weihrauch (2005) as a misidentification of *Trithemis annulata*. Our most northern records are from Barragem de Pavão, west of Marvão in the Portalegre district. This suggests an actual expansion of the species during the last decades. Based on the huge numbers seen at Barragem do Alqueva, we expect the species to be currently more present, even locally quite abundant, at many suitable reservoir lakes in Spain and Portugal.

The most remarkable species we discovered in southern Portugal was *Zygonyx torridus*. The range of this Oriental-African species in Europe reaches northern

Africa and Sicily, Spain, and Portugal (Kunz et al. 2006), where it is only known from a very limited number of localities. It is a good migrant and able to colonise new sites for a short period. Prior to our visits, *Z. torridus* was only known in Portugal by one record from the Serra de Monchique near Caldas de Monchique (Aguiar 1989). Because precise information on the exact locality was missing, we explored several streams in the surroundings of Caldas de Monchique in 2008 and 2009. Most of the streams and rivers in the Serra de Monchique had dried up in 2008. However, on one of our last days during the 2009 trip we found at least three males displaying territorial behaviour up- and downstream of the waterfalls on the Ribeira de Alportel at Moinhos da Rocha (Tavira). Our record is thus the second published for Portugal. Due to the quantity of rivers in the Monchique area and the lack of precise information on the locality, it is possible that the species is still present there.

Dragonfly fauna of the different types of waterbodies

Although the mean number of species per investigated locality is low, the total diversity of Odonata in southern Portuguese fluvial systems is high (Tab. 2) because of a high species turnover from locality to locality. High species richness of running waters in southern Iberia has also been shown by Ferreras Romero (1999) who found 28 species in four southern Spanish streams and rivers, by Jahn (1996) who observed 34 species for the Guadiana catchment area, and by Lohr (2005a) who recorded 26 species in southern Portugal. With 35 species, we found the highest number for southern Iberia. This can partly be explained by the huge number of investigated sites of running waters. Nevertheless, we were not able to detect *Onychogomphus costae* or *Macromia splendens*, two rheophilous species already known for the region. *Onychogomphus costae*, an endemic of the Maghreb and the Iberian Peninsula, has been first recorded in southern Portugal by Jahn (1996) at three localities along the Guadiana River, west of Serpa. The species was found again in the same area by Malkmus (2002), and Figueiredo & Gouveia (2001) found *O. costae* east of Evora. None of these localities have been investigated by us. The species seems to be associated with the lower part of rivers with fine substrate in the riverbed (Cano-Villegas 2009), but precise information about its habitat choice is still largely lacking from Spain and Portugal. *Macromia splendens* was observed in southern Portugal at two sites by Lohr (2005a) and at two additional sites by Malkmus (1996, 1998) and Weihrauch & Weihrauch (2003). The reasons for a high diversity of rheophilous species in southern Portuguese fluvial systems are diverse. Probably most important is the variation in streams and rivers itself. Most of them are still preserved in a more or less natural condition, or are only dammed by small barriers. The alternation of fast, shallow parts with calm, deep parts is the result of the riffle-pool-morphology that is very typical of Mediterranean fluvial systems with high discharge diversity: very low discharges in hot, dry summers and extremely high but short floods in autumn. These differences in velocity together with the variation in substrate lead to a high diversity of micro-habitats. Another important reason for the high diversity

is the warm climate. Particularly in those parts of the river where water is nearly stagnant, water temperatures are approaching those of lentic waters. Therefore it is not surprising that we found several thermophile species like *Crocothemis erythraea*, *Sympetrum fonscolombii* and *Trithemis annulata* to be common at lotic systems. Finally, the Iberian Peninsula was a refugium for many species during glacial periods (Sternberg 1998), resulting in the presence of many western European and Ibero-Maghrebian endemics (Ferreras Romero 1999; Jacquemin & Boudot 1999; Sahlén et al. 2004; Kalkman et al. 2010). Among the twelve endemics we found, only *Ischnura graellsii* and *Ceriagrion tenellum* are characteristic for standing waters. Most of the lotic endemics – *Calopteryx haemorrhoidalis*, *C. xanthostoma*, *Platycnemis acutipennis*, *P. latipes*, *Boyeria irene, Onychogomphus uncatus* and *Oxygastra curtisii* – are quite common in southwestern Europe and were found in several streams and rivers in southern Portugal. *Gomphus graslinii* and *Orthetrum nitidinerve* obviously have a more restricted range and were found only at one locality.

The absence of true lakes in this region explains the dominance of lotic species. The most common lentic habitats are usually man-made ponds. Nevertheless, several species are confined to those standing waters. *Lestes dryas*, *Sympecma fusca* and *Libellula quadrimaculata* are here, near the southern boundary of their distribution, and are rare in southern Iberia. Relict populations of these species are very vulnerable and prone to local extinctions, because recolonisation from more northern latitudes is very unlikely. *Paragomphus genei*, *O. trinacria*, *D. lefebvrii* and *B. impartita* are all confined to standing waters in southern Portugal. Recent colonisation of Europe could even have been impossible without the existence of these standing waters, resulting in a lower diversity of dragonflies.

Threats and conservation

Among the species of Odonata known from Alentejo and Algarve, three are of Community interest in Europe. *Gomphus graslinii*, *Macromia splendens* and *Oxygastra curtisii* are listed on Annexes II and IV of the European Habitats Directive. It is stipulated that for their conservation the designation of Special Areas of Conservation (SAC) is needed. This means that Portugal has a particular responsibility and should designate such areas, and moreover has to work out a favourable conservation status. Very recently a European Red List of Odonata has been published (Kalkman et al. 2010), in which *G. graslinii* and *O. curtisii* were assessed as «Near Threatened» and *M. splendens* as «Vulnerable». Two more species of our list, *O. nitidinerve* and *Z. torridus*, were also assessed as «Vulnerable». Besides those threatened species or the ones of European importance (category 'Near Threatened'), several others are also confined to river systems such as *Onychogomphus uncatus*, *Cordulegaster boltonii* and the relatively common endemics of the Western Mediterranean, e.g. *P. latipes*. This demonstrates the great importance of streams and rivers in southern Portugal for several dragonfly species in Europe and the need to protect their habitats.

Currently the main threat to dragonflies in southern Portugal is desiccation of their habitats due to the increasingly hot and dry summers combined with intensified water extraction for drinking, irrigation and tourism along the coast (Kalkman et al. 2010). This is especially the case along the south coast of the Algarve. Other important threats to rheophilous species are water pollution and deterioration of water quality caused by lowering oxygen level, and the construction of dams and reservoirs. The construction of dams results in changes in hydraulic regime from running to nearly standing water and in changes of sediment discharges. This also has consequences for the dragonfly communities. Species with a semi- or partivoltine larval life cycle, like most of the rarer rheophilous species, need to have permanent water for successful reproduction. These species are limited to the upper and middle courses where water is nearly always present. Some middle and especially the lower courses are more prone to desiccation and harbour more species with uni- or bivoltine larval development (see also Hampe 1998), like many species typical of standing waters. Rheophilous species are declining or even becoming locally extinct and several multivoltine species typical of standing waters – *Crocothemis erythraea*, *Trithemis annulata* and *Sympetrum fonscolombii* – are becoming omnipresent along streams and rivers.

The present trend in Mediterranean ponds is clearly regressive. The transition from traditional to intensive agriculture, with abandonment of traditional land use practices and conversion of ponds into farmland, represents the major threat for ponds and pools (Pinto-Cruz et al. 2009). We want to stress the importance for the maintenance and the conservation of cattle ponds, pools and very small scale reservoir lakes. These standing waters are in southern Portugal home to relict populations of several species with a more northern European distribution like *Lestes dryas*. They are also habitat for Afro-tropical species like *Paragomphus genei*, *Orthetrum trinacria*, *Brachythemis impartita* and *Diplacodes lefebvrii*, which in continental Europe are as yet only present in southwestern Iberia.

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Appendix 1. Recording sites of Odonata in Algarve and Alentejo, southern Portugal, during two field trips from 24-vi-2008 to 24-vii-2008 and from 22-iv-2009 to 04-v-2009. I-V habitat types (see text). – **Anhang 1.** Fundorte von Libellen in der Algarve und im Alentejo, südliches Portugal, während zweier Exkursionen, die vom 24.06.2008 bis zum 24.07.2008 und vom 22.04.2009 bis zum 04.05.2009 durchgeführt wurden. I-V Gewässertypen (vgl. Text).

Alentejo

Alto Alentejo – Portalegre district

Loc. 1: Beira, II small ditch near village, (UTM – 29S PD4068; 39°26’59”N, 07°21’52.2”W), 24-vi-2008

Loc. 2: Marvão, village center, road- urban, (UTM - 29S PD3961; 39°23’35”N, 07°22’37.4”W), 24-vi-2008

Loc. 3: Ponte Velha, Rio Sever, I river, (UTM - 29S PD4260; 39°23’03.1”N, 07°21’00.2”W), 24-vi-2008

Loc. 4: Portagem , Rio Sever, I river, (UTM - 29S PD3960; 39°22’55.5”N, 07°22’59.5”W), 24-vi-2008

Loc. 5: Santo António das Areias, Rio Sever, I river, (UTM - 29S PD4570; 39°28’03”N, 07°18’42.2”W), 24-vi-2008

Loc. 6: Vale Serrão, Ribeira de Nisa, II stream, (UTM - 29S PD2860; 39°23’01”N, 07°30’25.2”W), 24--vi-2008

Loc. 7: Nisa, III pond, (UTM - 29S PD1774; 39°30’42”N, 07°38’16.3”W), 25-vi-2008

Loc. 8: Nisa, Ribeira de Matadeira, II stream, (UTM - 29S PD1880; 39°33’43”N, 07°37’36”W), 25-vi-2008

Loc. 9: Nisa, Ribeira de Nisa, II stream, (UTM - 29S PD1879; 39°33’04.2”N, 07°37’40.4”W), 25-vi-2008

Loc. 10: Póvoa e Meados, Barragem de Pavão, IV reservoir, (UTM - 29S PD2571; 39°28’53.5”N, 07°32’50”W), 25-vi-2008

Loc. 11: Póvoa e Meados, Barragem de Pavão x Rio Nisa, II stream, (UTM - 29S PD2668; 39°27’07”N, 07°32’02”W), 25-vi-2008. Inflow from Nisa river into the reservoir lake.

Loc. 12: Alegrete, Ribeira de SãoPedro, II stream, (UTM - 29S PD4444; 39°14’10”N, 07°19’39.2”W), 26-vi-2008

Loc. 13: Barulho, Ribeira de Arronches, II stream, (UTM - 29S PD4838; 39°11’05”N, 07°17’12.6”W), 26-vi-2008

Loc. 14: Campo Maior, Barragem do Caia, IV reservoir, (UTM - 29S PD6019; 38°59’54”N, 07°08’59”W), 26-vi-2008

Loc. 15: Montarecos, Ribeira de Arronches, II stream, (UTM - 29S PD4646; 39°15’11.5”N, 07°18’26”W), 26-vi-2008

Baixo Alentejo – Beja district

Loc. 16: Estrela, Barragem do Alqueva, IV reservoir, (UTM - 29S PC4037; 38°16’49.5”N, 07°22’48”W), 27-vi-2008

Loc. 17: Mertola, Rio Guadiana, I river, (UTM - 29S PB1967; 37°38’48”N, 07°39’08W), 28-vi-2008

Loc. 18: Mina de São Domingos, Barragem de Tapada Grande, IV reservoir, (UTM - 29S PB3170; 37°40’12”N, 07°30’18.5”W), 28-vi-2008

Loc. 19: Serpa, Rio Guadiana, I river, (UTM - 29S PC1804; 37°58’54”N, 07°39’14”W), 28-vi-2008

Loc. 20: Sedas, III pond, (UTM - 29S PB2455; 37°32’08.3”N, 07°35’21”W) - 20a: 30-vi-2008; 20b: 30--iv-2009

Loc. 21: Moitinhos, III pond (UTM - 29S NB3041; 37°24’50.5”N, 08°32’17.5”W), 11-vii-2008

Loc. 22: Moitinhos, Barroncos, II stream, (UTM - 29S NB3140; 37°24’42”N, 08°31’56”W), 11-vii-2008

Loc. 23: Torquines de Cima, Ribeira de Torquines, II stream, (UTM - 29S NB4344; 37°26’42.5”N, 08°30’24.6”W), 11-vii-2008

Loc. 24: Funcheira, Funcheira de Baixo, III cattle pond, (UTM - 29S NB5777; 37°44’16”N, 08°20’44”W), 12-vii-2008

Loc. 25: Garvão, Barragem Monte da Rocha, IV reservoir, (UTM - 29S NB6175; 37°43’27”N, 08°17’34.5”W), 12-vii-2008

Loc. 26: Odemira, Rio Mira, I river, (UTM - VNB3161; 37°35’53.5”N, 08°38’49”W), 12-vii-2008

Loc. 27: Saboia, Rio Mira, I river, (UTM - 29S NB4451; 37°30’12.5”N, 08°30’07”W), 12-vii-2008

Loc. 28: Sabóia, Rio Mira bis, I river, (UTM - 29S NB4151; 37°30’18.5”N, 08°32’23.5”W), 12-vii-2008

Loc. 29: Santa Clara - Sabóia, Rio Mira, I river, (UTM - 29S NB4550; 37°29’44.7”N, 08°28’58”W), 12--vii-2008

Loc. 30: Sobreiro, Ribeira dos Camachos, II stream, (UTM - 29S NB3253 ; 37°31’33”N, 08°38’10”W), 12-vii-2008

Loc. 31: Santana da Serra, Ribeira de Santana, II stream, (UTM - 29S NB6151; 37°30’17”N, 08°18’20”W), 15-vii-2008

Loc. 32: Bicos, Ribeira de Campilhas, II small ditches in rice fields, (UTM - 29S NB4286; 37°49’35”N, 08°31’10”W), 16-vii-2008

Loc. 33: Fornalhas Velhas, Amêndoa de Cima, III pond, (UTM - 29S NB5590 ; 37°51’38”N, 08°22’25.5”W), 16-vii-2008

Loc. 34: Fornalhas Velhas , Castelo Velha Ribeira de Campilhas, II small ditches in rice fields, (UTM - 29S NB4890; 37°51’16.5”N, 08°27’02.5”W), 16-vii-2008

Loc. 35: Torre Vã , Rio Sado, I river, (UTM - 29S NB5588; 37°50’13”N, 08°22’06”W), 16-vii-2008

Loc. 36: Vila Nova de Milfontes, Brejo de Excomungado, III pond, (UTM - 29S NB2280; 37°46’07”N, 08°44’39”W), 17-vii-2008

Loc. 37: Entradas, Centro de Educação de Ambiental, III pond, (UTM - 29S NB8577; 37°44’04”N, 08°01’57”W), 27-iv-2009

Loc. 38: Guerreiro, Monte de Guerreiro, III pond, (UTM - 29S NB9770; 37°40’20.53”N, 07°53’40”W), 27-iv-2009

Loc. 39: Guerreiro, Ribeira de Alvacar, III pond, (UTM - 29S NB9869; 37°40’11”N, 07°53’01”W), 27-iv-2009

Loc. 40: Dogueno, Monte Branco, III pond, (UTM - 29S NB8747; 37°27’55”N, 08°00’24”W), 28-iv-2009

Loc. 41: Entradas, Ribeira de Terges, III pools in riverbed, (UTM - 29S NB8680; 37°45’55”N, 08°00’41”W), 28-iv-2009

Loc. 42: Fornalha, Ribeira do Vascão (N2), I river, (UTM - 29S NB8939; 37°23’47.5”N, 07°59’05”W), 28-iv-2009

Loc. 43: Morgadinho, Ribeira de Oeiras, I river, (UTM - 29S NB8648; 37°28’36”N, 08°01’36”W), 28-iv-2009

Loc. 44: Amendoeira, Monte de Pias, III pond, (UTM - 29S PB1985; 37°48’21”N, 07°38’36”W), 29-iv-2009

Loc. 45: Amendoeira, Monte de Pias, south of house, III pond, (UTM - 29S PB1985; 37°48’36”N, 07°38’46”W), 29-iv-2009

Loc. 46: Amendoeira, III pond, (UTM - 29S PB1885; 37°48’30”N, 07°39’27”W), 29-iv-2009

Loc. 47: Amendoeira, Pulo de Lobo, I river, (UTM - 29S PB2085; 37°48’16”N, 07°38’00”W), 29-iv-2009

Loc. 48: Outeiro, Ribeira Val de Açor, II stream, (UTM - 29S PB0282; 37°46’48”N, 07°50’15”W), 29-iv-2009

Loc. 49: Álamo, III pond, (UTM - 29S PB1659; 37°34’11.2”N, 07°40’59”W), 30-iv-2009

Loc. 50: São Bartolomeu de Via Glória, Ribeira do Vascão, I river, (UTM - 29S PB1452; 37°29’57”N, 07°42’04”W), 30-iv-2009

Alentejo Litoral – Setúbal district

Loc. 51: Cercal do Alentejo, Casa Velha, III cattle pond, (UTM - 29S NB2587; 37°50’12”N, 08°42’32”W), 16-vii-2008

Loc. 52: Cercal do Alentejo, Herdade de Casa Velha, III cattle pond, (UTM - 29S NB2687; 37°49’43”N, 08°42’00.5”W), 16-vii-2008

Loc. 53: Abela, III cattle pond, (UTM - 29S NC3902; 37°58’01”N, 08°33’22”W), 18-vii-2008

Loc. 54: Cova de Gato, III cattle pond, (UTM - 29S NC4207; 38°00’40”N, 08°30’54”W), 18-vii-2008

Loc. 55: Ermidas-Sado, Monte da Vinha, III cattle pond, (UTM - 29S NC4807; 38°00’30.5”N, 08°26’43”W), 18-vii-2008

Loc. 56: Ermidas-Sado, Pomarinho, III cattle pond, (UTM - 29S NC5306; 38°00’12”N, 08°23’28.5”W), 18-vii-2008

Loc. 57: São Domingos, Ribeira de São Domingos, II stream, (UTM - 29S NB4098; 37°55’58.5”N, 08°32’34”W), 18-vii-2008

Loc. 58: São Domingos, Monte de Pego, Ribeira de São Domingos, II stream, (UTM - 29S NB3898; 37°55’42.5”N, 08°33’52.5”W), 18-vii-2008

Loc. 59: São Domingos, Torna Vacas, II stream, (UTM - 29S NB3699; 37°56’28.6”N, 08°34’56.7”W), 18-vii-2008

Loc. 60: São Domingos, Paridierinho, Ribeira de São Domingos, II stream, (UTM - 29S NC3600; 37°56’48”N, 08°35’26”W), 18-vii-2008

Loc. 61: Sonega, Barragem de Morgavel, IV reservoir, (UTM - 29S NB2194; 37°53’40”N, 08°45’13”W), 18-vii-2008

Loc. 62: Santo André, III dune pond, (UTM - 29S NC1715; 38°05’11”N, 08°48’15”W), 20-vii-2008

Loc. 63: Torre, Vala Real, II irrigation channel in rice fields, (UTM - 29S NC1945; 38°21’07”N, 08°47’04”W), 20-vii-2008

Algarve – Faro district

Loc. 64: Alcoutim, Barranco do Vinagre, II stream, (UTM - 29S PB3644; 37°25’58.2”N, 07°27’36.7”W), 30-vi-2008

Loc. 65: Alcoutim, Ribeira de Cadavais, I river, (UTM - 29S PB3448; 37°28’22”N, 07°28’37.8”W), 30--vi-2008

Loc. 66: Alcoutim, Rio Guadiana, I river, (UTM - 29S PB3548; 37°28’18”N, 07°28’15.2”W), 30-vi-2008

Loc. 67: Choça Queimada, Barragem de Odeleite, IV reservoir, (UTM - 29S PB3131; 37°19’34”N, 07°27’36.7”W), 30-vi-2008

Loc. 68: Santa Marta, Ribeira do Vascão near N122, I river, (UTM - 29S PB2553; 37°30’57”N, 07°34’51.6”W) - 68a: 30-vi-2008, 68b: 30-iv-2009

Loc. 69: Castro Marim, salinas, V brackish, (UTM - 29S PB3919; 37°12’19”N, 07°26’04”W), 01-vii-2008

Loc. 70: Odelouca - Foz do Nuno, Ribeira de Odelouca, II stream, (UTM - 29S NB4525; 37°16’11.5”N, 08°29’31.5”W), 03-vii-2008

Loc. 71: Odelouca - Ponte de Odelouca, Ribeira de Odelouca, I river, (UTM - 29S NB4318; 37°12’29”N, 08°30’48”W), 03-vii-2008

Loc. 72: Chilrão, II small forest stream, (UTM - 29S NB3430; 37°19’26”N, 08°37’01”W), 04-vii-2008

Loc. 73: Foz de Besteiro, Ribeira de Seixe, I river, (UTM - 29S NB2839; 37°23’52.6”N, 008°40’48.2”W) – 73a: 04-vii-2008, 73b: 22-iv-2009

Loc. 74: Selão, Ribeira de Seixe, I river, (UTM - 29S NB3137; 37°23’01.1”N, 008°38’50.8”W) – 74a: 04-vii-2008, 74b: 11-vii-2008, 74c: 22-iv-2009

Loc. 75: Odelouca, Ribeira de Odelouca, V brackish, (UTM - 29S NB4515; 37°11’07”N, 08°29’17”W), 06-vii-2008

Loc. 76: Odelouca, Ribeira de Odelouca, V brackish, (UTM - 29S NB4518; 37°12’26”N, 08°29’38”W), 06-vii-2008

Loc. 77: Odelouca, Ribeira de Odelouca, II channel, (UTM - 29S NB4515; 37°11’09”N, 08°29’12”W), 06-vii-2008

Loc. 78: Vale Fuzeiros, Casas de Baixo, III pond, (UTM - 29S NB5723; 37°14’47”N, 08°21’27”W), 06--vii-2008

Loc. 79: Vale Fuzeiros, Sesmarias, III pond, (UTM - 29S NB5622; 37°14’40.8”N, 08°21’32”W), 06-vii-2008

Loc. 80: Vau - Porto de Lagos, Ribeira de Boina, I river, (UTM - 29S NB4114; 37°10’38.4”N, 008°31’58.5”W) – 80a: 06-vii-2008, 80b: 22-iv-2009

Loc. 81: Salema, Ribeira de Budens, II stream, (UTM - 29S NA1603; 37°04’26.7”N, 08°48’49”W), 07--vii-2008

Loc. 82: Aljezur, Ribeira das Alfambras, II stream, (UTM - 29S NB1827; 37°17’39.5”N, 08°47’50.7”W), 09-vii-2008

Loc. 83: Carrapateira, Ribeira do Carrapateira, I river, (UTM - 29S NB0916; 37°11’43”N, 08°53’51”W), 09-vii-2008

Loc. 84: Aljezur, Esteveira, II stream, (UTM - 29S NB1640; 37°24’20.5”N, 08°48’41.8”W), 10-vii-2008

Loc. 85: Rogil, Bemparece, III pond, (UTM - 29S NB1737; 37°22’51.6”N, 08°48’12.4”W), 10-vii-2008

Loc. 86: Aljezur, Maria Vinagre Piegoes, III pond, (UTM - 29S NB2038; 37°23’37.4”N, 08°45’48.1”W), 11-vii-2008

Loc. 87: Zambujeiro de Baixo, Ribeira de Seixe, I river, (UTM - 29S NB2639; 37°23’47.5”N, 008°42’19.3”W) - 87a: 11-vii-2008, 87b: 22-iv-2009

Loc. 88: São Bartolomeu de Messines, III pond 1,100 m near N268, (UTM - 29S NB6327; 37°17’37.6”N, 08°17’12”W), 15-vii-2008

Loc. 89: São Bartolomeu de Messines, III pond 200 m near N265, (UTM - 29S NB6227; 37°17’19.6”N, 08°17’34.5”W), 15-vii-2008

Loc. 90: São Bartolomeu de Messines, Ribeira de Arade, II stream, (UTM - 29S NB6327; 08°17’34.5”N, 08°16’26”W), 15-vii-2008

Loc. 91: Curral do Touril, II stream (UTM - 29S NB2831; 37°19’53.3”N, 008°34’07.2”W), 22-iv-2009

Loc. 92: Aljezur, Maria Vinagre Piegões, III new pond, (UTM - 29S NB2038; 37°23’35.9”N, 008°46’11”W), 22-iv-2009

Loc. 93: Aljezur, Maria Vinagre Piegões, III pond, (UTM - 29S NB2139; 37°23’41.3”N, 008°45’43.3”W), 22-iv-2009

Loc. 94: Caldas de Monchique, Baranco do Lajeada, II stream, (UTM - 29S NB3926; 37°16’44”N, 008°33’23.2”W), 22-iv-2009

Loc. 95: Monchique, Fóia, III pond, (UTM - 29S NB3630; 37°18’57.7”N, 008°35’37.2”W), 22-iv-2009

Loc. 96: Rasmalho, Ribeira de Boina x Ribeira das Canas, I river, (UTM - 29S NB4021; 37° 14’ 12.6”N, 008° 32’ 42.7”W), 22-iv-2009

Loc. 97: Loulé, Ribeira de Algibre, II stream, (UTM - 29S NB8016; 37°11’11.5”N, 08°05’12”W) – 97a: 24-iv-2009, 97b: 04-v-2009

Loc. 98: Faro, Ludo, V brackish, salinas, (UTM - 29S NA8997; 37°01’10”N, 07°59’50”W), 25-iv-2009

Loc. 99: Faro, Quinta do Lago, III pond, (UTM - 29S NA8699; 37°02’07”N, 08°00’27”W), 25-iv-2009

Loc. 100: Querença, Fonte da Benémola, II stream, (UTM - 29S NB8818; 37°12’30”N, 08°00’32.5”W), 26-iv-2009

Loc. 101: Querença, Ribeira das Mercês, II stream, (UTM - 29S NB8916; 37°11’30”N, 07°59’23”W), 26-iv-2009

Loc. 102: Bentos, Ribeira de Odeleite, III oxbow river, (UTM - 29S PB1633; 37°20’11”N, 07°41’35”W), 03-v-2009

Loc. 103: Bentos, Ribeira de Odeleite, I river, (UTM - 29S PB1633; 37°20’10”N, 07°41’42”W), 03-v-2009

Loc. 104: Galaxes, Ribeira de Odeleite, I river, (UTM - 29S PB1833; 37°20’23”N, 07°39’34”W), 03-v-2009

Loc. 105: Ribeirinha, Ribeira de Carriços, II stream, (UTM - PB1718; 37°12’26.5”N, 07°40’29.5”W), 03-v-2009

Loc. 106: Tavira, Cascata Moinhos da Rocha, Ribeira de Alportel, I river, (UTM - 29S PB1613; 37°09’20.5”N, 07°41’45.8”W), 03-v-2009

Loc. 107: Tavira, São Domingos, Rio Sequa, I river, (UTM - 29S PB1712; 37°09’13.5”N, 07°40’24”W), 03-v-2009

Loc. 108: Equas, Ribeira do Vascanito, II stream, (UTM - 29S NB8131; 37°19’35.5”N, 08°04’39”W), 04-v-2009

Loc. 109: Malhão, Cravais de Cima, III pond, (UTM - NB8029; 37°18’21.5”N, 08°05’30.5”W), 04-v-2009

Loc. 110: Pé de Coelho, Ribeira de Arade, II stream, (UTM - 29S NB7927; 37°17’11”N, 08°06’13”W), 04-v-2009

Loc. 111: Penina, Quinta do Freixo, III pond, (UTM - 29S NB7724; 37°15’32.5”N, 08°07’27”W), 04-v-2009

Loc. 112: Penina, Sobradinho, IV reservoir (UTM - 29S NB7725; 37°16’18”N, 08°07’45”W), 04-v-2009.