

An annotated checklist of Odonata of the Maltese Islands, with evidence for a recent influx of species

Martin J. Ebejer¹, Godwin Degabriele² and Arnold Sciberras³

¹ Entomology Section, Department of Biodiversity and Systematic Biology,
Amgueddfa Cymru National Museum Wales, Cathays Park, Cardiff CF10 3NP, UK,
<martin.ebejer@btinternet.com>

² 18, Ċentifolja, Triq it-Tank, Siġġiewi, SGW3412, Malta, <gergo@euroweb.net.mt>

³ 'Arnest' 131, Arcade Street, Paola, Malta, <bioislets@gmail.com>

Abstract

Mainly within the last ten years, the number of species of Odonata known from the Maltese Islands has increased from nine resident and two migrant species to 13 residents and two migrants. The former migrant species now regularly breed in the islands. The literature on the Odonata of Malta is reviewed, and an overview of the flight season data is given. Records of all species are given for the first time and some reasons for the recent increase in the number of species are discussed.

Zusammenfassung

Kommentierte Checkliste der Libellen Maltas, mit Belegen für einen jüngsten Zustrom neuer Arten (Odonata) — Die Zahl der Libellenarten, die von der Maltesischen Inselgruppe bekannt sind, hat sich in jüngster Zeit von neun bodenständigen Arten und zwei Migranten auf 13 bodenständige Arten und zwei Migranten erhöht. Die Arten, die früher nur als Migranten auf den Inseln auftauchten, pflanzen sich dort heute regelmäßig fort. Sämtliche Literaturangaben zum Vorkommen von Libellen auf Malta und zahlreiche bislang unpublizierte Nachweise aller Arten werden zusammenfassend präsentiert. Mit dem gesamten Datenmaterial wird eine Übersicht über die Phänologie der Odonata auf den Inseln erstellt. Zudem werden einige mögliche Gründe für den jüngst erfolgten Artenzuwachs diskutiert.

Introduction

There are remarkably few accounts on the Odonata of the Maltese Islands in the literature. The earliest documented records are those of McLACHLAN (1899), where *Ischnura genei*, *Crocothemis erythraea*, and *Sympetrum striolatum* are mentioned as being common species. These data were quoted by COWLEY (1940). VALLETTA (1949, 1957) gave accounts on the following ten taxa: *Anax ephippiger*, *A. imperator*, *A. parthenope*, *Crocothemis erythraea*, *Orthetrum coerulescens anceps* (= *O. ramburi*), *O. brunneum*, *O. cancellatum*, *Selysiothemis nigra*, *Sympetrum fonscolombii*, and *S. striolatum*. He drew attention to *S. nigra* being a rare migrant and *A. ephippiger* being a common migrant seen in some numbers. CILIA (1972) briefly commented on the same species mentioned by VALLETTA (1949, 1957), but he added no new records or information. In an unpublished dissertation studying the ecology of Maltese Odonata, DEGABRIELE (1992) confirmed the common and widespread presence on the islands of all the species recorded up to that time except those of the genus *Orthetrum* and *S. nigra*, which he considered to be scarce and restricted in habitat. He also added that all, except for *Orthetrum* spp. and *S. nigra* – the latter, for lack of sightings at the time of the study – were capable of breeding in brackish water. *Selysiothemis nigra* was not recorded again until the data given in this paper. Specimens of all the other species were found in several private collections and in the collections at the National Museum of Natural History, Mdina.

The aims of this article are to review what is currently known about Odonata in the Maltese Islands, to provide some of our observations concerning the newly recorded species, to update our knowledge on the status of those species already known to occur, and finally to provide a complete list of species with records, since in previous literature very little data was usually given with the species mentioned.

Methods

The personal collections of the authors and their field notes provided the main source of records and observations. Additional collections were also studied, namely, those in the National Museum of Natural History at Mdina, Malta, where G. Lanfranco's collection of Odonata is now housed, along with several specimens collected by other individuals and the private collections of Dennis Magro (Qrendi), Anthony Seguna (Naxxar), and Louis Cassar (Lija). It had not been possible to search foreign institutions for material collected in Malta. We include only those records based on the retained voucher specimens, although our observations are also based on numerous sightings and on captures that were released after close examination.

Where more than one specimen is attributed to a collector, the collector's name is given as initials at the end of each date entry followed by the depository of

voucher specimens in parentheses, where this differs from the collection belonging to the collector: M. Borg Cardona -MBC, L. Cassar -LC, G. Degabriele -GD, M.J. Ebejer -MJE, G. Lanfranco -GL, D. Magro -DM, P. Portelli -PP, P. Sammut -PS, S. Schembri -SS, A. Sciberras -AS, A. Seguna -TS. The same names are given as initials in the text where relevant. The acronym NMNH refers to the National Museum of Natural History, Mdina, Malta.

The identifications of species were based on CONCI & NIELSEN (1956), ASKEW (2004), d'AGUILAR et al. (1985), DIJKSTRA & LEWINGTON (2006) and DUMONT (1991).

Study area

The Maltese Islands are situated in the middle of the Mediterranean Sea about 100 km south of Sicily. Although there are seven islands in the archipelago, only three are large enough to have freshwater habitats suitable for Odonata. These are Malta, Gozo and Comino (Fig. 1). The whole archipelago is composed of sedimentary rock, mainly coralline limestone, which is very permeable to water. The softer upper coralline layer is easily eroded and over the millenia this has resulted in deep water channels. However, these do not retain water all year round because of the relatively short rainy season, the permeable rock and the long, dry, hot summers from early June to the end of September. Temperatures sometimes peak at 40°C although the average for the whole season is about 30°C.

A few coastal areas had significant marshes, but in recent years these have been markedly degraded and reduced in size through various anthropogenic activities. The need for water to irrigate crops has meant that most farmers built small reservoirs all over the islands and the government built dams in most of the water courses. This has compensated to a degree for the loss and degradation of the natural habitats.

Local entomologists learnt through experience where the best localities are for all insects including the Odonata. Thus, the study area includes all the islands and all the habitats, but inevitably, most of the records cited in this article have come from the most productive sites and these are depicted in Figure 1. Sites 2, 3 and 6 are the remnants of marshes; sites 1, 4, 7, 8, and 10 are important flowing freshwater sites; site 9 is a small disused quarry that has become partly vegetated and retains water into the early summer.

Results

We compiled records of altogether 15 species of Odonata – including the sub-specific taxon *Orthetrum coerulescens anceps* – from the Maltese islands (Tab. 1). An overview on the phenology of all species, based on all available records, is presented in Table 2.

Annotated list of species with records

Ischnura genei

Previous records: McLACHLAN (1899), VALLETTA (1949), DEGABRIELE (1992).

Specimens examined: Malta — 1♂, 1♀, Buskett, 22-vi-1969, collector? (NMNH); 1♂, Salina, 08-x-1970, collector? (NMNH); 1♂, Salina, ix-1971, GL; 1♂, 1♀, Buskett, 08-vii-1974, MJE; 1♂, Bahrija, 23-viii-1974, MJE; 1♀, Salina, 20-ix-1975, MJE; 1♀, Balzan, 23-vi-1976, MJE; 1♂, Msida, Tal-Qroqq, 05-vii-1980, LC; 1♀, gynomorph type C, Salina, Kennedy Grove, 31-viii-1992, LC; 1♀, Wied Liemu, 22-viii-1993, MJE; 2♂, Mistra, 03-iv-1996, MJE; 1♂, 1♀, Mtahleb, 10-iii-2004, AS; 2♂, Rabat, Wied il-Qlejgħa, 30-x-2004, TS.

AS observed males to be highly aggressive towards conspecific individuals. Males often guard females while ovipositing. The species prefers standing or running water with rich vegetation and is common and widespread across the Islands. Larvae were collected by GD from brackish water at il-Magħluq, Marsascula.

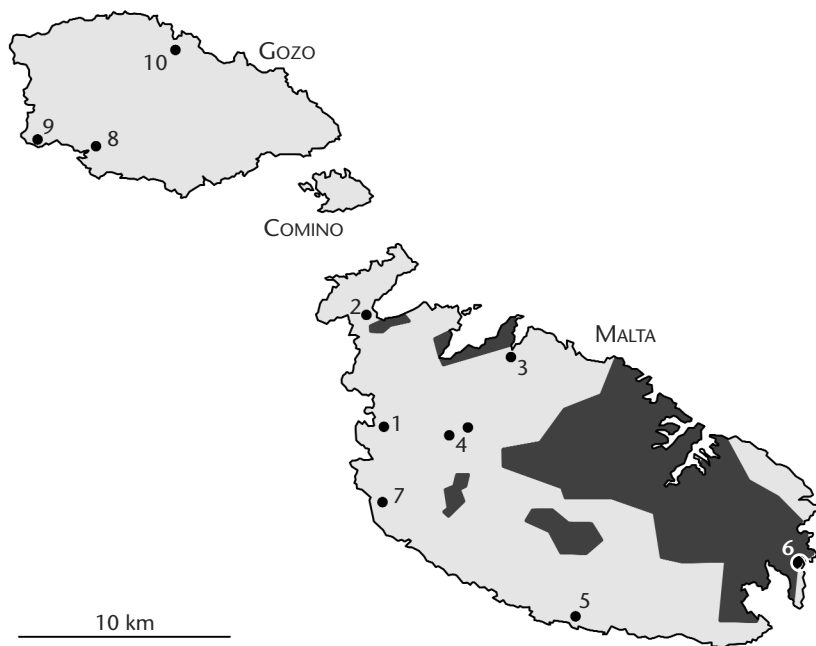


Figure 1: The Maltese Islands and some of the major breeding sites of Odonata: 1 Wied il-Gnejna, 2 Għadira, 3 Salina, 4 Fiddien & Wied il-Qlejgħa, 5 Wied Babu, 6 Marsascula, 7 Bahrija & Mtahleb, 8 Wied il-Lunzjata, 9 Ta'Sarraflu, 10 Wied Marsalforn. The major urban areas are shown shaded. — Abbildung 1: Die Maltesische Inselgruppe mit den wichtigsten Fortpflanzungsgewässern für Libellen (1–10). Urbane Bereiche sind dunkelgrau hervorgehoben.

Aeshna mixta

Specimens examined: Malta — 1 ♀, Balzan, 26-vi-1976, MJE.

New for the Maltese Islands.

Anax ephippiger

Previous records: VALLETTA (1949, 1957), DEGABRIELE (1992)

Specimens examined: Malta — 1 ♀, Attard, Wied Incita, 21-iii-1953, GL; 1 ♀, Sliema, summer 1953, GL (LC); 2 ♀, Rabat, Wied Ghomor, 31-iii-1992, MJE; 1 ♂, Balzan, 05-iv-2000, MJE; 1 ♀, Żurrieq, Wied Babu, 05-iv-2000, DM; 1 ♀, Żurrieq, Wied iż-Żurrieq, 11-viii-2000, TS; 1 ♀, Balzan, 16-iii-2001, AS; 1 ♀, Rabat, Wied il-Qlejgħa, 10-iv-2003, AS; 1 ♀, Għadira, 09-vii-2004, AS; 4 ♂, 15 ♀, Qrendi, il-Maqluba, 18-ii-2007, DM; Comino — 1 ♀, Bejn il-Kmiemen, 25-iv-2004, AS.

Anax ephippiger prefers warm shallow pools, lakes and slow moving streams. MJE observed several individuals mating and ovipositing at Fiddien, Wied Ghomor and Simar. MJE also observed large numbers congregating on trees at dusk before a migration from Abu Dhabi in September 1984. It probably breeds on Malta, but in the absence of exuviae we cannot state that it is established, even though it has been observed to oviposit.

Anax imperator

Previous records: VALLETTA (1949, 1957), DEGABRIELE (1992).

Specimens examined: Malta — 1 ♂, Salina, 02-vii-1952, GL; 1 ♂, Qormi, Wied il-Kbir, 16-vii-1970, MJE; 1 ♂, Buskett, 27-iv-1974, MJE; 1 ♀, Buskett, 15-vii-1974, MJE; 1 ♂, Bahrija, 23-viii-1974, MJE; 1 ♂, Msida, 22-vii-1975, LC; 1 ♀, Mellieħa, Għadira, 14-viii-1975, LC (misidentified as *A. parthenope*); 1 ♀, Għajn Riħana, 02-x-1976, MJE; 1 ♀, Rabat, Fiddien, 03-viii-1996, MJE; 1 ♂, Birzebbuga, Wied Dalam, 20-iv-1998, TS; 1 ♀, Wied Dalam, x-1999, TS; 1 ♀, Ċirkewwa, 20-viii-2001, DM; 1 ♂, Qrendi, il-Maqluba, 05-vii-2002, DM; 7 ♂, 4 ♀, Rabat, Wied il-Qlejgħa, 10-iv-2003, AS; 1 ♂, Rabat, Wied il-Qlejgħa, 30-viii-2004, TS; 1 ♂, Żebbuġ, Wied is-Sewda, 14-x-2004, TS; 1 ♂, Siġġiewi, Għar Lapsi, 08-i-2007, DM; Gozo — 1 ♂, Mgarr ix-Xini, 15-viii-2005, AS.

Anax imperator is common and widespread throughout the Maltese Islands.

Anax parthenope

Previous records: VALLETTA (1949, 1951), DEGABRIELE (1992).

Specimens examined: Malta — 1 ♀, Salina, 29-ix-1971, GL; 1 ♂, 1 ♀, Rabat, Fiddien, 03-vii-1996, MJE; 1 ♂, Żurrieq, Wied Babu, 07-v-2001, AS; 1 ♀, Rabat, Wied il-Qlejgħa, 10-iv-2003, AS; 1 ♀, Armier, 21-ix-2003, TS; 1 ♀, Qrendi, il-Maqluba, 18-ii-2007, DM.

Anax parthenope males were often seen competing for territory with *A. imperator*. Common on the Maltese Islands.

Crocothemis erythraea

Previous records: McLACHLAN (1899), VALLETTA (1949), DEGABRIELE (1992).

Specimens examined: Malta — 1♂, Swieqi, Wied Mejxu, 27-ix-1952, GL; 1♂, Mellieħa, Ġhadira, 23-ix-1965, GL; 1♂, Balzan, 21-iii-1974, MJE; 1♂, Buskett, 08-vii-1974, MJE; 1♂, Attard, Ta' Qali, 24-vii-1974, MJE; 1♂, 1♀, Wied is-Sewda, 21-viii-1974, MJE; 1♀, Rabat, Chadwick Lakes (=Wied il-Qlejgħa), 23-viii-1974, MJE; 1♀, Mellieħa, Ġhadira, 02-viii-1975, LC; 1♂, Mellieħa, Ġhadira, 14-viii-1975, LC; 1♂, Buskett, 08-vii-1979, TS; 2♀, Rabat, vii-1981, P Sammut (NMNH); 1♀, Qormi, Wied il-Kbir, 24-viii-1987, TS; 4♂, 1♀, Mosta, Ġhajj Rihana, 17-x-1989, SS (NMNH); 2♂, Salina, 26-viii-1992, LC; 1♀, Birżebbuġa, Wied Dalam, 05-x-2000, TS; 1♂, Birżebbuġa, Wied Dalam, 10-x-2000, TS; 1♂, Żebbuġ, Wied Qirda, 30-xi-2000, TS; 1♂, Rabat, 02-x-2001, P. Sammut, (NMNH); 3♂, Mellieħa, Sta. Maria Estate, 19-v-2003, AS; 1♂; Hal-Far, Wied Żnuber; 08-vi-2003, DM; 1♀, Rabat, Wied il-Qlejgħa, 10-iv-2003, AS; 2♀, Mellieħa, St. Maria Estate, 19-v-2003, AS; 1♀, Qrendi, il-Maqluba, 19-vii-2003, DM; 2♂, Rabat, Wied il-Qlejgħa, 30-x-2004, TS; 1♂, Qrendi, 20-ix-2005, DM, (NMNH); 1♀, Birżebbuġa, Wied Dalam, 28-x-2006, TS; Gozo — 1♂, Dwejra, 03-viii-1992, LC; 1♂, Dwejra, Qattara, 03-viii-1992, LC; 1♀, Dwejra, 16-x-2004, PS (NMNH); 1♀, Dwejra, Qattara, 03-viii-1992, LC.

On Malta, *C. erythraea* is one of the commonest species. It frequents ponds and stagnant water bodies of all sizes whether in gardens or in the wild.

Orthetrum brunneum

Previous records: VALLETTA (1949), DEGABRIELE (1992).

Specimens examined: Malta — 2♂, 1♀, Baħrija, 23-viii-1974, MJE; 1♀, Ġhajj Rihana, 02-x-1976, MJE; 1♂, Baħrija, 21-vi-1992, MJE; 1♂, Rabat, Baħrija, 15-viii-2001, TS.

On Malta, *O. brunneum* is confined to freshwater streams near Rabat, Buskett, Mtaħleb and Baħrija.

Orthetrum cancellatum

Previous records: VALLETTA (1949), DEGABRIELE (1992).

Specimens examined: Malta — 2♂, Qormi, Wied il-Kbir, 16-vii-1970, MJE; 1♂, Ġhadira, 11-vi-1971, MJE; 1♀, Buskett, 08-vii-1974, MJE; 2♂, Mellieħa, Ġhadira, 14-viii-1975, LC; 1♀, Valletta, 03-vii-1975, F. Cassar (LC); 1♂, 1♀, St. Paul's Bay, is-Simar, 30-vi-1996, MJE; 1♀, Birżebbuġa, Wied Dalam, 25-v-1998, TS; 1♂, Ċirkewwa, 27-vii-2003, DM; Gozo — 1♀, Dwejra, Qattara, 16-vii-2007, AS.

Orthetrum cancellatum is common on Malta and frequents all types of water bodies, including garden ponds.

Orthetrum coerulescens anceps

Previous records: VALLETTA (1957) as *O. ramburi*, DEGABRIELE (1992).

Specimens examined: Malta — 1♂, Buskett, 07-v-1969, collector? (NMNH); 1♂, Buskett, 05-vi-1969, collector? (NMNH); 2♂, Buskett, 22-vi-1969, collector? (NMNH); 1♂, Buskett, 25-ix-1969, collector? (NMNH); 2♂, Buskett, 10-viii-1972, MJE; 1♂, 1♀, Buskett, 08-vii-1974, MJE; 1♂, Mistra, 10-vii-1974, MJE; 1♂, Mistra Village, 23-ix-1974, SS (NMNH); 1♂, Buskett, 22-vii-1976, LC; 1♂, Qormi, Wied il-Kbir, 24-viii-1987, TS; 1♂, 1♀, Mosta, Ghajn Rihana, 17-x-1989, SS (NMNH); 1♂, Ghajn Tuffieħa, 14-iii-1990, GD; 3♂, Rabat, Bahrija, 12-viii-1992, LC; 1♂, Bahrija, 03-vii-1996, MJE; 1♂, Ghajn Rihana, 13-vii-1996, MJE; 1♀, Mgiebah, 29-ix-1996, MJE; 1♂, Rabat, Bahrija, 15-viii-2001, TS; 2♂, 2♀, Mellieħa, Sta. Maria Estate, 19-v-2003, AS; 1♂, 1♀, Hal-Far, Wied Żnuber, 08-vi-2003, DM; 1♂, Rabat, Wied il-Qlejgħa, 30-x-2004, TS; Gozo — 1♂, Qattara, Dwejra, 03-viii-1992, LC; 2♂, Xagħra, 07-vii-2007, AS.

Common in the Maltese Islands near flowing water.

Orthetrum trinacria

Specimens examined: Malta — 1♂, 1♀, Hal-Far, Wied Żnuber, 08-vi-2003, AS; 1♂, Rabat, Bahrija, 12-x-2004, DM (TS); 1♀, Mosta, Wied il-Għasel, 10-viii-2007, DM (TS); Gozo — 1♂, Marsalforn, 06-vi-2003, AS; 3♂, 1♀, Kerċem, Ghadira ta' Sarraflu, 15-viii-2003, AS; 1♂, same data and collector (MJE).

New record for the Maltese Islands. Since it was first discovered on the Maltese Islands by AS in 2003 at Wied Żnuber, more individuals have been sighted or captured in different locations across the islands. Tandem pairs have been observed by AS, and larvae and exuviae were collected by DM.

Selysiotthemis nigra

Previous records: This species was recorded for the first time in Malta in 1952 from San Anton Gardens, Balzan (VALLETTA 1957).

Specimens examined: Malta — 1♀, Fomm ir-Riħ, 06-vi-1996, PP; 1♂, St. Paul's Bay, is-Simar, 06-vi-1996, PP; 1♀, Ghajn Rihana, 13-vi-1996, MJE; 1♂, 3♀, Ċirkewwa, 11-viii-2007, AS; 1♀, Ċirkewwa, 22-viii-2007, AS (NMNH); Gozo — 2♀, Xagħra, Tas-Sellun, 07-vii-2007, AS.

Selysiotthemis nigra prefers standing shallow waters, including brackish water. In Malta, it has been observed mating and ovipositing, but exuviae have not yet been recovered and therefore the same proviso as for *A. ephippiger* applies.

Sympetrum fonscolombii

Previous records: VALLETTA (1949), DEGABRIELE (1992).

Specimens examined: Malta — 1♀, Swieqi, Wied Mejxu, 08-viii-1952, GL; 1♀, Buskett, 09-x-1969, collector? (NMNH); 1♂, 1♀, Salina, 08-x-1970, collector? (NMNH); 1♂, Mosta, Wied Rihana, 11-x-1970, collector? (NMNH); 1♂, Balzan, 22-ix-1974,

MJE; 1♀, Ghadira, 29-ix-1975, MJE; 2♀, Rabat, Fiddien, 07-vii-1976, MJE; 1♂, 1♀, Rabat, Wied il-Qlejgħa, 18-viii-1976, LC; 1♂, Naxxar, 06-iv-1982, PS (NMNH); 1♀, Qormi, Wied is-Sewda, 25-iii-1984, TS; 1♀, Mosta, Għajn Rihana, 17-x-1984, SS (NMNH); 1♀, Buskett, ix-1992, collector? (NMNH); 1♀, Zabbar, 12-iii-1993, GD; 2♂, 1♀, Mġiebaħ, 29-ix-1996, MJE; 1♂, 1♀, Birzebbugħa, Wied Dalam, 18-x-1999, TS; 1♂, Ġnejna, 14-xi-1999, MJE; 1♀, Naxxar, 06-x-2000, TS; 1♂, Mrieħel, 10-iv-2003, AS; 2♀, Attard, 14-iv-2003, AS; 1♂, Mellieħa, St. Maria Estate, 18-v-2003, AS; 1♀, Bingemma, 14-ix-2003, TS; 1♂, 1♀, Armier, 21-ix-2003, TS; 3♂, 2♀, San Ġwann, Wied l-Għomor, 17-x-2003, MBC (AS); 4♂, 15♀, Qrendi, San Niklaw, 29-x-2003, DM; 1♂, Żurrieq, Wied Babu, 24-ix-2004, DM; 1♀, Dingli, Dingli Cliffs, 28-x-2004, TS; 1♀, Siġġiewi, 15-x-2006, DM; 1♀, Rabat, 23-x-2006, P. Sammut, (NMNH); 1♂, Naxxar, 28-x-2006, TS.

One of the most common species everywhere on the Maltese Islands. *Sympetrum fonscolombii* prefers standing water bodies. GD found larvae in brackish water. It was even observed ovipositing in the open sea.

Sympetrum striolatum

Previous records: McLACHLAN (1899), VALLETTA (1949), DEGABRIELE (1992).

Specimens examined: Malta — 1♀, Swieqi, Wied id-Dis, 09-vi-1952, GL (LC); 1♂, 1♀, Buskett, 14-vi-1952, GL; 1♀, Buskett, 17-viii-1952, GL (LC); 1♂, Buskett, 13-vi-1969, collector? (NMNH); 3♀, Buskett, 8-vii-1974, MJE; 1♂, Mellieħa, Ghadira, 14-viii-1975, LC; 1♂, Buskett, 29-vii-1976, LC; 2♀, Rabat, vii-1981, PS (NMNH); 1♂, 1♀, Mosta, Għajn Rihana, 17-x-1989, SS (NMNH) 1♀, Attard, Wied is-Sewda, 10-x-2002, AS; 1♂, Ċirkewwa, 11-viii-2007, AS; Comino — 2♀, Sta. Marija Bay, 13-vii-1976, MJE.

Sympetrum striolatum prefers stagnant water, but it was also recorded near brackish water. Local records suggest that the species was previously more common. Since the 1990s it has been encountered less often.

Trithemis annulata

Specimens examined: Malta — 2♂, Rabat, Wied il-Qlejgħa, 07-vi-2007, AS (NMNH); 2♂, 1♀, Sta. Lucija, 08-viii-2007, AS.

New record for the Maltese Islands. This species, first taken in 2007 at Wied Qlejgħa and Sta. Lucija, has since been observed in increasing numbers in different localities such as at Mistra and Ċirkewwa. Exuviae have also been collected by AS, confirming that the species is also breeding locally.

Trithemis arteriosa

Specimens examined: Malta — 1♀, Balzan, 13-x-2002, AS.

New record for the Maltese Islands.

Table 1. Known distribution of Odonata species on the three main Maltese islands. —
 Tabelle 1. Die bekannte Verbreitung der Libellen auf den drei größeren der Maltesischen
 Inseln. * Newly recorded for the archipelago; neuer Nachweis für den Archipel.

TAXON	Gozo	COMINO	MALTA
<i>Ischnura genei</i>			x
<i>Aeshna mixta</i>			x*
<i>Anax ephippiger</i>		x	x
<i>Anax imperator</i>	x		x
<i>Anax parthenope</i>			x
<i>Crocothemis erythraea</i>	x		x
<i>Orthetrum brunneum</i>			x
<i>Orthetrum cancellatum</i>	x		x
<i>Orthetrum coerulescens anceps</i>	x		x
<i>Orthetrum trinacria</i>	x*		x*
<i>Selysiothemis nigra</i>	x		x
<i>Sympetrum fonscolombii</i>			x
<i>Sympetrum striolatum</i>		x	x
<i>Trithemis annulata</i>			x*
<i>Trithemis arteriosa</i>			x*
Total No. of species	6	2	15

Discussion

We report the discovery in the last few years of four species of dragonflies new to the Maltese Islands (Tab. 1): *Aeshna mixta*, *Orthetrum trinacria*, *Trithemis annulata* and *T. arteriosa*. Two more species, *Anax ephippiger* and *Selysiothemis nigra*, both migrant species and both recorded previously, have been seen more regularly in recent years and are probably breeding locally. However, we do not have direct evidence that the populations are viable without any influx of migrant individuals from one year to the next.

The distribution ranges for many Odonata are changing, at least in northern and central Europe with species from the Mediterranean expanding their ranges northwards. There is some evidence to attribute this to climate change (OTT 2001). For example, in recent years, *Orthetrum brunneum* were found in good numbers as far north as Lithuania (BERNARD 2004). *Crocothemis erythraea* has vastly expanded its range in Switzerland so that by the 1980s it was found across most of the country and frequently breeding, whereas before 1969 records were scanty and it was not known to breed there (GONSETH & MONNERAT 2003). In 1996, *Sympetrum fonscolombii* increased its range in central Europe (LEMPERT 1997). There is little data about similar events occurring within the Mediterranean.

There are a number of reasons that contribute to the dispersal of species. Odonata require water bodies for the development of their larval stages, yet as adults they

Table 2. Known flight season of Odonata on the Maltese islands, based on the data presented here as well as previously published records. — Tabelle 2. Die bekannten Flugzeiten der Libellenarten Malta, zusammenfassend anhand der hier präsentierten Daten, sowie nach Literaturangaben.

Taxon	J	F	M	A	M	J	J	A	S	O	N	D
<i>Ischnura genei</i>			x	x		x	x	x	x	x		
<i>Aeshna mixta</i>						x						
<i>Anax ephippiger</i>		x	x	x			x	x				
<i>Anax imperator</i>	x			x	x	x	x	x	x	x		
<i>Anax parthenope</i>		x		x	x		x		x			x
<i>Crocothemis erythraea</i>			x	x	x	x	x	x	x	x	x	x
<i>Orthetrum brunneum</i>						x	x	x		x		
<i>Orthetrum cancellatum</i>					x	x	x	x	x	x		
<i>Orthetrum coerulescens anceps</i>			x		x	x	x	x	x	x		
<i>Orthetrum trinacria</i>						x		x		x		
<i>Selysiothemis nigra</i>						x	x	x				
<i>Sympetrum fonscolombii</i>			x	x	x		x	x	x	x	x	x
<i>Sympetrum striolatum</i>						x	x	x	x	x		
<i>Trithemis annulata</i>							x		x			
<i>Trithemis arteriosa</i>												x

have a strong preference for hot dry climates, but they are well adapted to make use of both environments. The larvae of several species can tolerate dry seasons and resume their activity and development when rains replenish their habitat with water. Alternatively, some species have evolved faster development of larvae enabling them to complete their life cycle while the water lasts. Adults are fast and strong fliers and hunt a wide range of other insect prey. Since both stages are carnivorous, they have no special requirement for vegetation. Thus, their dispersal is not limited by, for example, the availability of a host plant, as would be the case with the Lepidoptera. In the case of Malta, it may be that the increase in water bodies on the Maltese Islands has favoured the survival of some species once they arrived on a migration. There has been more building of freshwater reservoirs by farmers in recent years, since the Government ban, in the mid 1980s, to tap the water table for irrigation purposes.

The Maltese Islands are composed of sedimentary rock, namely, Upper Coralline Limestone, Greensands, Blue Clay, Globigerina Limestone and Lower Coralline Limestone. Karstland is the predominant surface geology on the islands and thus rainwater rock pools are a common feature, but the long hot summers soon dry them out making the vast majority of them unsuitable habitats for dragonfly larvae. The valleys found in the western and northwestern parts of Malta and throughout the coastal areas of Gozo, contain the most diverse freshwater fauna and flora, since it is here that rainwater accumulates most. However, these seasonal freshwater streams were more common in the past, frequently lasting into the early summer, and a few usually lasted all year. This is now a rare situation (SCHEMBRI 1991).

Table 3. The names of field workers/observers relevant to Odonata in Malta per decade. X indicates the decade in which fieldwork extended for more than 50 % of the years. All individuals were or are known personally to MJE. — Tabelle 3. Namen aller Personen, die pro Dekade durch Freilanderrassungen wesentlich zur Kenntnis der Libellen Malτας beigetragen haben. X bedeutet, dass in dieser Dekade während mehr als der Hälfte der Jahre odonatologische Freilandarbeiten durchgeführt wurden. Alle angegebenen Personen sind oder waren MJE persönlich bekannt.

NAME	1940-49	1950-59	1960-69	1970-79	1980-89	1990-99	2000-07
Bonnet				X	X		
Cassar					X		
Cilia			X	X	X		
Degabriele						X	X
Ebejer				X		X	
Lanfranco		X	X				
Magro						X	X
Portelli						X	
Sammut			X	X	X	X	
Schembri				X	X		
Sciberras						X	X
Seguna					X	X	X
Valetta	X	X	X	X	X		

Coastal marshes are tiny in comparison to those in other Mediterranean countries. Nevertheless, they are vitally important biotopes for a host of organisms, not least the insects, including the Odonata. The sites at Ghadira and Salina in the north and at Marsascala and Marsaxlokk in the south are the most important. Habitats around these frequently host several species in good numbers with the exception of *O. brunneum*, a species with a strong affinity for streams in the Maltese Islands.

In the last 20 years or so the number of people in Malta interested in entomology has grown markedly and at the same time transport and access to all parts of the Islands has increased. It is therefore conceivable that the increase in recent observations merely reflects the greater chance of encounter with the less common species. All the species new to Malta are common around the Mediterranean. Their presence on the Islands would not have been a surprise had their occurrence on the Islands been previously documented. There have been four periods in the last 60 years during which entomological activity on the Islands had a degree of focus on Odonata (Tab. 3). Between the 1940s and the 1970s, A. Valletta collected widely and he recorded and published on several groups of insects including the Odonata (VALLETTA 1949, 1957). In the 1970s, MJE also collected widely and Odonata received particular attention between 1974 and 1976. In the 1990s, GD wrote a dissertation on the Odonata (DEGABRIELE 1992). Between 1998 and 2007, we became aware of other colleagues with a strong interest in Odonata and who conducted frequent field activities. The recently recorded additions to the Maltese fauna occurred from 2000 to 2007, yet by this time the activity and number of field workers had

fallen significantly from the twenty year period between 1980 and 1999. *Selysiothemis nigra* and *A. ephippiger* were observed mating and ovipositing in the latter half of the 1990s. This may be a reflection of the frequent fieldwork at that time. Yet none of the three recent additions – *O. trinacria*, *T. annulata*, *T. arteriosa* – was recorded. We are therefore of the opinion that the new additions to the local fauna do not simply reflect recent interest, but are the result of true extension of the range of the species concerned.

The observation of *A. ephippiger*, *O. trinacria* and *S. nigra* breeding on the Islands is further evidence for a true extension of these species' range. *Trithemis arteriosa* can be expected to extend its distribution northwards (DIJKSTRA & LEWINGTON 2006). The single record from Malta lends some support to this. In time, we may discover it more frequently on Malta, as we have noted for *S. nigra*, or indeed it may become established, as *O. trinacria* appears to have done. *Aeshna mixta*, being dependent on larger water bodies, will likely find serious competition during its developmental stages from those of *A. imperator* and *A. parthenope*. We cannot predict if this species will become established. Therefore, we favour the opinion that the single record was simply a vagrant individual. *Anax ephippiger* is a well-known migrant that often flies from south of the Sahara to central, and more recently even to northern, Europe. It also migrates along latitudes frequently reaching the Mediterranean from the Middle East. A species that has similar long ranging migratory habits – though different biotope requirements – is the gomphid *Lindenia tetraphylla*, which is found in several countries around the Mediterranean. Yet there are still no records of this handsome insect from Malta.

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Autor(en)/Author(s): Ebejer Martin J., Degabriele Godwin, Sciberras Arnold

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