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Cover illustration: Mites (*Arrenurus* sp.) on the wings of *Sympetrum meridionale*. Photograph by Hans-Ulrich Kohler

The Journal of the British Dragonfly Society is printed by Artisan Litho, Abingdon, Oxford, www.artisanlitho.co.uk Migrant and dispersive dragonflies in Britain during 2010

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Summary

The year 2010 was a relatively low-key one for many of our commoner migrant species but some highly noteworthy events took place with rarer species. Literally dozens of Southern Migrant Hawker *Aeshna affinis* were seen in southeast England during late July–August, principally around the Thames Estuary. With oviposition being noted, it is even possible that local breeding populations may become established. Southeast England also saw several records of Southern Emerald Damselfly *Lestes barbarus* during the year, as well as the discovery of new sites for Willow Emerald Damselfly *Lestes viridis* away from the recently-established Suffolk population. Perhaps the highlight of the year was the re-discovery of Dainty Damselfly *Coenagrion scitulum*, after an absence from the UK of nearly 60 years. Arrivals of this species must however have taken place prior to 2010, since, in addition to adults, small numbers of exuviae were also discovered, indicating that successful breeding had already taken place. Clearly Britain's dragonfly fauna is currently going through a period of considerable flux.

Account of species

Notable sightings reported to the BDS Migrant Dragonfly Project during 2010 are detailed below; background meteorological information is from the Met Office (2011) and WeatherOnline (2011).

Lestes barbarus (Fab.) – Southern Emerald Damselfly

The following records have been accepted by the Odonata Records Committee:

12 July–1 Aug	Small numbers of males and one female at Cliffe Marshes, Kent (T. Hanson <i>et al.</i>); oviposition observed on 29 July (JL).
20 July–3 Aug	At least three males and one female near Sandwich Bay, Kent (B. Lewis).
22 July	Male at Wat Tyler Country Park, Essex (N. Phillips).
7–8 Aug	Male at Winterton Dunes, Norfolk (D. Filby et al.).
22 Aug	Female at Winterton Dunes, Norfolk (T. Hemmings).
11 Sept	Male at Grain Village, Kent (J. Nelson).

Southern Emerald Damselfly was first noted in Britain during 2002 (Nobes, 2003) and 2010 has the greatest number of records in one year (Fig. 1). With oviposition definitely taking place at one site, and males and females also being present together at another, it may be that the species will shortly succeed in colonising Britain. An apparent breeding colony in Kent during 2003/2004 was short-lived, due to salt-water flooding of the site one winter (Parr, 2006a). Interestingly, although the species has been recorded from Winterton Dunes in Norfolk during no less than five seasons in the last nine years, there has never been any confirmation of breeding there.

Almost all records of Southern Emerald Damselfly in Britain are currently from Kent or coastal East Anglia. The one exception, a female from Keynsham on the River Avon near Bristol in August 2006 (Parr, 2007), however serves to highlight the potential for further unexpected discoveries.

Lestes viridis (Vander Linden) – Willow Emerald Damselfly

In autumn 2009, large numbers of Willow Emerald Damselfly were noted in an area of East Anglia centred on southeast Suffolk, these sightings apparently relating to a recently established breeding population (Parr, 2009). Although some sites in both Suffolk and Essex near the edge of where the species had been seen the previous year produced no further sightings in 2010, the core population remained strong. Numerous tenerals and at least one exuvia (near Campsea Ashe, 24 July 2010, J. & G. Brook) were discovered, so confirming the species' breeding status. A degree of range expansion was indicated by new



Figure 1. Number of sites in the UK at which Southern Emerald Damselfly *Lestes barbarus* was observed each year in the recent era. There are no earlier records.

records at several sites along the River Stour in West Suffolk during September 2010, but, overall, such changes were not especially dramatic. In Norfolk, the species remained recorded from just a single site.

Away from the Suffolk sub-population, some significant new discoveries were made in the Thames Estuary area. Small numbers of individuals were noted at Hadleigh Country Park, south-east Essex, on 6 August (RC) and 31 August (DC), with oviposition scars being found in scrubby willow *Salix* sp. at the end of the season (DC). In north Kent at least two sites were also discovered in the Reculver area (DB, TH). Although it is possible that these sites were occupied in 2009 and simply overlooked, their location in an area where significant arrivals of Southern Emerald Damselfly (see above) and Southern Migrant Hawker *Aeshna affinis* (see below) were noted during 2010 rather suggests that fresh immigration was involved. Clearly Willow Emerald Damselfly is doing well in Britain at the moment and observers are encouraged to be on the lookout for further colonies in south-east England.

Coenagrion scitulum (Rambur) – Dainty Damselfly

The following records have been accepted by the Odonata Records Committee:

21 June One female near Kingsferry Bridge, Isle of Sheppey, Kent (J. & G. Brook).
21 June Two exuviae at "Site B", Isle of Sheppey, Kent (J. & G. Brook).
7 July One female at "Site B", Isle of Sheppey, Kent (J. & G. Brook).
7 July Ovipositing pair at "Site C", Isle of Sheppey, Kent (J. & G. Brook).

These are the first records of the species in the UK since 1952 (Merritt *et al.*, 1996), colonies known from the Hadleigh/Benfleet area of Essex since 1946 having been destroyed by the great coastal floods of the 1952/53 winter. The records of exuviae, however, clearly indicate that the species has been present in Kent for a while, with its initial appearance having gone unnoticed. Since the lifecycle is one year in length (Brooks & Lewington, 1999), it must have been present since at least 2009. The interval since the species was last seen in Britain is however so long, and includes the major Atlas work of the late 1980s (Merritt *et al.*, 1996), that it seems highly unlikely that the Isle of Sheppey population is a relict from when the species was last present in Britain. The species is known to currently be expanding its range in NW Europe (Dijkstra & Lewington, 2006) and in 2009 was reported from Jersey in the Channel Isles for the first time since 1941 (Perchard & Long, 2009). The new British records would appear to be part of this bigger picture.

It will be interesting to follow the fate of the Isle of Sheppey population. Will it survive, or even expand? Because much of the land in the wider area is private it is possible that the present population is much larger than first apparent.

Ischnura elegans (Vander Linden) – Blue-tailed Damselfly

The hot weather in south-east England towards the end of July (WeatherOnline, 2010) was apparently associated with movements of Blue-tailed Damselfly. Small numbers were thus seen in the coastal dunes in the Brancaster/Scolt Head area of Norfolk over 20/21 July (MT, NL) and one was caught in an MV moth-trap at Landguard on the Suffolk coast during the night of 24 July (NO).

Erythromma viridulum (Charp.) – Small Red-eyed Damselfly

Although little in the way of further range expansion within the UK was reported

during 2010, there were a number of records suggestive of continuing immigration onto our east coast. On 19 July an influx of 50+ individuals was noted at Eccleson-Sea, Norfolk (NB), and 20–30 were also reported from the coastal dunes at Brancaster/Scolt Head, Norfolk, over 20/21 July (MT, NL). Interestingly, two individuals were caught in MV moth-traps on Scolt Head during this period (NL).

Aeshna affinis (Vander Linden) – Southern Migrant Hawker

Unprecedented numbers of this previously very rare migrant were reported from south-east England during mid-summer, with the total number of individuals seen being some five times greater than during the previous record influx year of 2006 (Parr, 2007). In addition, the first-ever females to be recorded in the UK were also discovered. The following records have been accepted by the Odonata Records Committee:

20 July–22 Aug	Several at Hadleigh Country Park, Essex (D. Chelmick et al.), with a maximum count of ca. eight, including one female, on 24 July (RW). Ovipositing noted on 28 July (DC, JGB), 29 July (per JO), 8 August (NP) and 11 August (SC).					
24 July	Male at Hockley Woods, Essex (S. Jellet).					
25 July	Male and female at Cliffe Marshes, Kent (J. & G. Brook, R. Woodward); oviposition observed.					
27 July	Up to five males at Vange Wick, Essex (L. Steward).					
28 July	Male on Canvey Island, Essex (D. Chelmick).					
30 July	Male at Old Hall, Essex (J. Rapley).					
1 Aug	Male at Marsh Farm Country Park, Essex (A. Shearring).					
22 Aug	Male at Winterton North Dunes, Norfolk (I. Robinson).					

Southern Migrant Hawker is, as its name suggests, quite closely related to Migrant Hawker *A. mixta*, sharing several aspects of biology but being on average more southerly in distribution. Like Migrant Hawker, it too is presently

expanding its range to the north (Ott, 2010). Substantial numbers of immigrants were clearly present in the far southeast of England during late July and several individuals were also reported from Belgium during this period (G. de Knijf, pers. comm.). Events in The Netherlands were however a little less unusual and there were apparently no Danish records (Wild About Denmark, 2011).

Given the observations of oviposition at two sites with favourable habitat (shallow densely-vegetated ponds or dykes) and with the possibility that it may have gone un-noticed at yet others, there is the chance that breeding colonies might become established in the UK as a result of the summer's events. Such colonies do indeed now exist in The Netherlands (Termaat *et al.*, 2010, Wasscher, pers. comm.). The life-cycle is known to be one year in length (Corbet *et al.*, 2006), so the outcome of events should soon become known.

Aeshna grandis (L.) - Brown Hawker

This species is not resident on Alderney in the Channel Islands, but there were two records there during July (AWT), presumably relating to migrants from France. No obvious immigration was reported from Britain but could easily have been overlooked, especially since the species had a good year and numbers of residents were already high in many areas.

Aeshna mixta Latreille – Migrant Hawker

It was a good year for the species in many areas and, although much of this may have related to good local breeding success, a certain amount of migration also seemed to be involved, particularly during the early part of the species' flight period. Small numbers of individuals were seen along with several other migratory/dispersive Odonata and literally tens of thousands of the migratory moth Silver Y *Autographa gamma* in the coastal dunes around Brancaster/Scolt Head, Norfolk, during the hot weather of 20/21 July (MT/NL), large numbers were present at Dungeness, Kent, on 29 July (DW) and on 6 August numbers were seen patrolling between the houses in Great Yarmouth, Norfolk (AB). Singles were recorded at MV light at Reydon, Suffolk, on the night of 24 July (AC) and at Spurn National Nature Reserve, East Yorkshire, on 5 August (BS); such dragonflies at light are often migrants (Parr, 2006b). Slightly later in the season, arrivals were reported on Bardsey Island, off the Welsh coast, during the second half of August (BBO).

Anax ephippiger (Burmeister) – Vagrant Emperor

There was one sighting during the year, of an individual that as typical lingered only briefly.

14 Oct Male near Gorran, Cornwall (P. Maker).

Vagrant Emperor is a well-known migrant, breeding principally in sub-Saharan Africa but capable of travelling very long distances given the right wind conditions. It has thus been recorded as far afield as Iceland (Olafsson, 1977) and the Caribbean (Meurgey, 2006). There have been roughly 20 confirmed records in the UK prior to the 2010 sighting, plus a number of unidentified dragonflies seen during the winter months (most notably during January–March 1998) that likely also refer to this species (Parr, 1998; 1999).

Large numbers of Vagrant Emperor were apparently present in Northern Africa at the end of 2010 and, when weather conditions were right, many moved north into Europe. The October record documented above was thus the forerunner of a very much larger invasion seen in early 2011. This will be documented elsewhere (Parr, 2011).

Anax parthenope Sélys – Lesser Emperor

First recorded in Britain back in 1996, this species has been seen annually in (usually) small numbers ever since; 2010 was a fairly average year, with records from 11 sites in England as far north as Cheshire and Lancashire. Reports covered the period 9 June–30 August and typically referred to single males, though one or two males and a female were present at Smallhanger, Devon, on 30 August (CRC). There was also a good series of records, including both males and females, from Dungeness, Kent, between 28 June and 5 August (PA, OL, DW). This makes it thirteen years in a row that the species has now been recorded at Dungeness and, although successful breeding has never been rigorously proven, it must surely be taking place. Indeed, an ovipositing female was noted in the Long Pits area on 28 July (DW). Elsewhere, a record from Brockholes Wetland, Lancashire, on 10 July (AH) is also suggestive of an established breeding colony, since the species has now been recorded from the site in most years since 2006. The great majority of British records of Lesser Emperor still however appear to refer to primary immigrants.

Sympetrum danae (Sulzer) - Black Darter

Black Darter is a potentially mobile species that can show both internal dispersal

within the UK and the occasional arrival of continental immigrants, most typically on the east coast of England. Following a good year for internal dispersal during 2009 (Parr, 2010), the year 2010 was far less noteworthy. Singles of unknown origin were however seen at Spurn Point, East Yorkshire, on 12 & 16 September, with another on 5 October (BS).

Sympetrum flaveolum (L.) - Yellow-winged Darter

It was again a very quiet year for the species, the last significant invasion having been in 2006 (Parr, 2007). On the east coast of Britain, singletons were observed at Gibraltar Point, Lincolnshire, on 4 & 5 August (via KW) and at Winterton Dunes, Norfolk, on 6 August (IR).

Sympetrum fonscolombii (Sélys) – Red-veined Darter

A major invasion of Red-veined Darter was noted during 2009 (Parr, 2010) but 2010 saw a very much quieter year. During the spring and summer, confirmed records came from only ten sites; these were mostly in eastern England and crucially did not include Middleton in Lancashire, where an apparently established breeding colony had been present for some years previously. Counts reported were typically low – often just ones or twos, though 30 were noted at Sandwich Bay, Kent, on 29 June (SBBO). Some records perhaps refer to locally-bred individuals from the 2009 influx but a small surge of records from Kent during late June suggests an additional immigration at this time. Small numbers were also seen in southern England during late July, coincident with the arrivals of Southern Emerald Damselfly and Southern Migrant Hawker discussed above.

In keeping with the low-key spring there were very few autumn records, with just single females reported from Essex at the end of August and Cornwall on 10 October. A mature male was also noted in Ireland near Caherdaniel, South Kerry, on 4 November (via BN).

Sympetrum striolatum (Charp.) - Common Darter

It was another quiet year for migration by this species, though smaller-scale movements can be hard to detect. Small numbers of individuals were seen along with several other migratory/dispersive Odonata and literally tens of thousands of the migratory Silver Y moth in the coastal dunes around Brancaster/Scolt Head, Norfolk, during the hot weather of 20/21 July (MT, NL), whilst a single was caught in an MV moth-trap at Spurn, East Yorkshire, on the night of 27 July (BS). Later in the season a male was also attracted to MV light at Bradwell-on-

Sea, Essex, on 3 November (SD). The east coast location of all sites is probably no coincidence.

Conclusions

In terms of the numbers involved, dragonfly migration during 2010 was seemingly unspectacular but what made the year special was the high incidence of rare species, many of them having their strongholds in Southern Europe. There were, for instance, more records of Southern Migrant Hawker than in all previous years put together, and Southern Emerald Damselfly also had a record-breaking season. In addition, there was evidence for continuing immigration by new colonist species such as Willow Emerald Damselfly and Small Red-eyed Damselfly. The discovery of a small breeding colony of Dainty Damselfly during 2010 clearly also deserves a mention, though in this case the damselflies must actually have arrived in 2009 or earlier.

Periods of migration occurred throughout the season, from June until early November. The most dramatic events took place during a period of hot weather around 18–22 July, when a very wide range of species were on the move. The heat was most pronounced in southeast England and East Anglia, and it is here that the bulk of migrant dragonflies were observed. Indeed the Thames Estuary area featured prominently in many of the year's events.

Many of the rare migrants discovered during 2010 showed signs of breeding activity, with Southern Emerald Damselfly being seen ovipositing at one site and Southern Migrant Hawker at two. It is quite possible that breeding colonies of these species may become established, as already appears to be the case for Dainty Damselfly, though of course the long term viability of such colonies remains to be established. Whatever the situation, Britain's dragonfly fauna is clearly going through a period of considerable flux.

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The Vagrant Emperor Anax ephippiger in Britain and Europe during early 2011

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Summary

Early 2011 saw major movements of Vagrant Emperor *Anax ephippiger* in southern and western Europe. These peaked during April and resulted in the largest arrivals of Vagrant Emperor ever seen in Britain. Oviposition was even observed at a site on the Lizard Peninsula in Cornwall on 26 April, this being the first recorded instance in the UK. British records of Vagrant Emperor during January-May 2011 are detailed and some meteorological background to the movements is presented.

Introduction

The Vagrant Emperor Anax ephippiger (formerly Hemianax ephippiger) is a common dragonfly of Africa, the Middle East and southwest Asia (Silsby, 1993). It tends to avoid woodlands, and north of the equator has a major breeding area in the Sahel and Guinea zones of North Africa (Dumont & Desmet, 1990). This region is subject to a monsoon-type rainfall pattern, with rains occurring between May and September. Breeding activity of Vagrant Emperor is thus concentrated in this period. Emergences are anticipated in October-November, by which time the temporary pools and lakes favoured by the species are beginning to dry out. Adults then disperse away in search of more suitable conditions. The migratory potential of the Vagrant Emperor is considerable - it has thus been recorded as far from its main breeding grounds as Iceland (e.g. Olafsson, 1977) and the Caribbean (e.g. Meurgey, 2006). It regularly reaches the Mediterranean region, where local breeding populations appear to be becoming increasingly important, and there have been about twenty well-documented UK records, plus a number of 'probables' (Parr, 1998; Jones, 2011). Arrivals in Britain can show various timings. Some records are during October-November, suggestive of direct immigration by recently-emerged individuals from sub-Saharan Africa under the influence of suitable wind conditions. Records from later in the winter also exist, as do sightings during spring. These records perhaps relate to individuals that began migration after emergence but which were initially unable to penetrate into Europe due to the low temperatures and unfavourable winds of the European winter. Only as conditions improved did more extensive migration then take place. There have been, for instance, reports of Vagrant Emperor 'piling up' in the southern foothills of the Atlas Mountains in Morocco during late November to mid-January (Dumont & Desmet, 1990) and these could then act as a reservoir for further invasions into Europe.

Population levels and breeding success of Vagrant Emperor in sub-Saharan Africa will be dependent on rainfall in the region, and this is known to be highly variable (Haarsma *et al.*, 2005). The potential for immigration into Europe is thus not constant and some cyclicity of sightings has already been identified (Dumont & Desmet, 1990). Recent good years have included 1989 (Dumont & Desmet, 1990), 1990 and 1995 (Askew, 2004).

The 2011 Influx into Britain

A male Vagrant Emperor was photographed during autumn 2010 near Gorran, Cornwall, on 14 October (Parr, 2011). This is a very typical date, and at the time the main interest in the record was that it apparently represented the first confirmed sighting of the species in Britain since 1998 - though a photograph of another male at Rinsey Head, Cornwall, on 11 May 2008 has subsequently come to light (per S. Jones, unpublished). As winter 2010/2011 progressed, it became clear however that the Gorran record was to be the forerunner of a very much larger invasion. Small numbers of adults were thus recorded during January-March 2011. In mid-April, there was then a dramatic increase in the number of sightings, which continued at a high level until early May. Further details of these observations are given in Table 1 and Fig. 1; in addition to records that have been verified by photographs or detailed descriptions, less well-documented reports of 'probables' have also been included. It is likely that the great majority, if not all, of these sightings also refer to Vagrant Emperor since, even by the end of the period, the only resident aeshnid likely to be on the wing would be Hairy Dragonfly Brachytron pratense, which is significantly different in appearance. Immigrant Lesser Emperor Anax parthenope would be a potential source of confusion but the first individuals did not appear to reach northwest Europe until early May (Waarneming.be, 2011a).

Records usually referred to single individuals that were seen for only a short time period – sometimes at water, but often hawking for insects well away from any water-body. These dragonflies were presumably still on active migration. There were, however, a few exceptions to this pattern. On 2 May a male at Weymouth spent much of the day resting on a gate, having presumably been inhibited from flying by the poor weather. More significantly, occasional reports of multiple individuals and/or territorial behaviour were received. At Ruan Pool in Cornwall, two males were seen on 25 April, while nearby at a site on



Figure 1. Distribution of sightings of Vagrant Emperor *Anax ephippiger* made in Britain during early 2011. Red = confirmed sightings; blue = 'probables'.

Date	Observer	Locality	Country/Region	Details
Accepted Records				
09 January 2011	M. Grey	Caer Bwely Bay	Pembrokeshire	one female
19 February 2011	T. & A. Polglase	Kennack Sands	Cornwall	one male
10 April 2011	К.	Burray	Orkney Isles	one male
15 April 2011	G. Watson	Plymouth	Devon	one male
16 April 2011	К.	Rame Cross	Cornwall	one female
18 April 2011	G. Morgan	Burabhal,	Outer Hebrides	one female
21 April 2011	S. Holmes & M.	Bardsey Island	Gwynedd	one
23-25 April 2011	J-J. 🦰 👝	Dungeness	Kent	2-3 males
24 April 2011	K. Richards	Skomer Island	Pernbrokeshire	one male
24–26 April	P. Contraction of the second second	Windmill Farm NR / Ruan Pool	Cornwall	two males
25 April 2011	S.	Mullion	Cornwall	two
26 April 2011	D.	Meadow Lakes,	Cornwal	one male
26-27 April	S.	North Predannack Downs	Cornwall	pair
27 April 2011	M. Hallett	Tarn Hows	Cumbria	one male
28 April 2011	Ρ.	Llanilid, near Pencoed	Glamorgan	one male
28 April 2011	C. Dresh	Christchurch	Dorset	one male
30 April 2011	G. Smith	Knowetop Lochs	Dumfries & Gallow	one male
02 May 2011	N. Fowler	Weymouth	Dorset	one male
05 May 2011	D. Batchelor	Cosmeston Lakes	Glamorgan	one male
08 May 2011	P. Winter	Denny Lodge Incl.,	Hampshire	one male
'Probables'				
11 January 2011	Anon	Ham Wall RSPB Reserve	Somerset	one
24 March 2011	M. Ambrose	near Bickl	Cheshire	one
06 April 2011	G. Davis	near Garras	Cornwall	one
19 April 2011	G. Littler	Kynance	Cornwall	one
19 April 2011	L. Oakes	near Nanquidno	Cornwall	one
22 April 2011	J. Foster	Lands End	Cornwall	one
23, 24 April 2011	Anon.	Portland	Dorset	2 individuals?
25 April 2011	D.	Seaton Ponds	Comwall	one male
25 April 2011	D.	Penlee	Cornwall	one
27 April 2011ª	R.	Stackpole	Pembrokeshire	one male
28 April 2011	Anon.	Dawlish Warren	Devon	one
30 April 2011	M. Rossell	Samphire Hoe Country Park	Kent	one female
01 May 2011	P	Chorley	South Lancs.	one
06 May 2011	R.	Cossington Meadows	Leicestershire	one male
08 May 2011	Α.	Cardiff	Glamorgan	one
09 May 2011	D. Sutcliffe	Brackmills Industrial Estate	Northants.	one
11 May 2011	К.	St Mary's, Isles Of Scilly	Scilly Isles	one male
16 May 2011	Anon.	Dawlish Warren	Devon	one male

 Table 1. Records of confirmed (accepted) and 'probable' Vagrant Emperor Anax ephippiger seen in Britain during early 2011.

* Record still under consideration by the National Records Committee



Plate 1. Ovipositing female Vagrant Emperor *Anax ephippiger* at a site on the North Predannack Downs on the Lizard peninsula, Cornwall on 26 April 2011. Photograph by Steve Jones.

the North Predannack Downs both a male and a female were present on 26 April and mating and oviposition were observed (Jones, 2011) (Plate 1). This represents the first record of oviposition by the species in Britain. Elsewhere, up to three males were present at Dungeness in Kent from 23–25 April, with a female also having been reported. There is much suitable habitat in the area and, although oviposition was not noted at this site, it may well have taken place unobserved.

The European Perspective

The early part of 2011 was exceptional for the numbers of Vagrant Emperor reported on migration in the Middle East and southern Europe. A male was already present at Vila do Conde, northern Portugal, on 21 January (Caldas, 2011), around the time of the first UK sightings, and the species was abundant in the United Arab Emirates during February (UAE Nature Forum, 2011; Richard Ellison, pers. comm.). Thousands were also seen on the island of Gozo, Malta, on 18 March (Sciberras, 2011). Perhaps associated with the wave of British sightings in early spring, a big migration through Portugal was then reported during early April, with a northerly movement of up to 20 per minute being noted at Mira on 6 April (Soares, 2011). Following on from this, large numbers of

Vagrant Emperor were recorded in Aquitaine, southwest France, from 13 April (Faune Aquitaine, 2011), and more were also present in the Vienne (Ransdale, 2011) and other regions of southern France (Deliry, 2011). Around this time three males were recorded from the Faroe Islands, with two on 13 April and one found dead on 15 April (Jens-Kjeld Jensen, pers. comm.). These are apparently the first-ever dragonflies identified from these islands. Continuing the theme, movements of Vagrant Emperor then reached Belgium and The Netherlands as from 22 April (Waarneming.be, 2011b; Waarneming.nl, 2011).

Other migrant species

Other strongly migratory species such as Red-veined Darter *Sympetrum fonscolombii* and Lesser Emperor *Anax parthenope* were seen in northwest Europe during spring 2011. First dates for sightings in countries such as Belgium and The Netherlands were however apparently no earlier than 7 May (e.g. Waarneming.be, 2011a), which is later than the main arrivals of Vagrant Emperor in the region. This suggests that these other species were not strongly involved in the Vagrant Emperor migrations of early 2011. Some limited comigration did however probably take place; thus in Britain small numbers of Redveined Darter were noted in southwest Cornwall during late April (the earliest UK records ever), coincident with the main appearances of Vagrant Emperor in the county. Indeed, at least two sites held both species simultaneously.

Discussion

Clearly, large numbers of Vagrant Emperor were present in the southern Palaearctic zone during winter 2010/11, most likely as a result of good breeding success further south during the previous autumn. When weather conditions were suitable, many dragonflies then moved north. Some such migration was apparent even as early as January, but April saw particularly impressive movements. Relevant to some aspects of this are observations of Saharan dust stirred up into the atmosphere over Morocco and Algeria during the early days of April 2011. This dust cloud reached Portugal on 5/6 April and was subsequently tracked into the Atlantic off southwest England and Ireland, from where it then passed across to the north of Scotland (NASA, 2011). It is likely that many Vagrant Emperor dragonflies were caught up with the dust cloud and its movements could explain the migration seen in Portugal in early April. It would also explain the unprecedented arrivals seen in the Faroe Islands a few days later, as well as rationalising the predominantly western and northern distribution of sightings in the UK during the first part of the April invasions. This Saharan dust plume, however, seems unlikely to lie behind all of the Vagrant Emperor movements seen in Western Europe during early spring 2011 - for example it doesn't directly address the major arrivals seen in the UK and

neighbouring countries during the last third of April. In Western Europe, April was dominated by extensive periods of high pressure centred over the British Isles or the near Continent (Rare Bird Alert, 2011), bringing fine hot weather and winds frequently from the southeast–southwest. In the UK, the mean April temperature was 3.7°C above the 1971–2000 average and in central England it was the warmest April for over 350 years (Met Office, 2011). These weather conditions produced not only exceptionally early emergences of many resident species but would also have provided favourable conditions for the immigration of dragonflies from North Africa/southern Europe.

Conclusions

Early 2011 saw arrivals of Vagrant Emperor in Britain which were of an unprecedented scale and major movements of the species were also noted in many other parts of Western Europe. The first UK records of anything other than a single individual at any one site, and also the first record of oviposition, were made during late April. It is hoped that successful breeding will take place but, for this strongly migrant species, there is no evidence that this has the potential to generate long-lasting breeding colonies.

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Parasites of damselflies and dragonflies: a review of recent work

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Summary

Damselflies and dragonflies are invaded by a number of parasites which occur as both endoparasites (gregarines and trematodes) and ectoparasites (blood sucking flies and aquatic mites). Recently published material brings to light new work on the impact of these parasites on their hosts, the life cycle of some of the parasites and the ecology and behaviour of their parasitic association.

Introduction

"It is an exciting time to be interested in the ecology of host-parasite interactions. Since the early 1990s, there has been a tremendous increase in interest in the effects of parasitism on hosts, effects of hosts on parasites and interactions between parasites" (Kohler, 2008).

Animal associations - defining terms.

Defining terms has sometimes proved difficult. Symbiosis, for example, has been defined in different ways. It may be defined simply as living together and is thus all embracing but in the past has also been used in a more restricted sense to mean an association in which both partners benefit, for which the term mutualism has more recently been used. There are also loose non-parasitic animal associations involving odonates such as phoresy, where one animal provides the other with transport or shelter. Thus water mite larvae are phoretic on larval odonates before becoming parasitic on adults. Anderson & Anderson (1998) working on springs in Oregon, believe that phoresy in *Arrenurus hamrumi* is extended, prior to becoming parasitic, in order to facilitate synchronization of the life cycle of parasite and host. At the other extreme, where one species is metabolically dependant on the other and is frequently but not always harmful to the host, the term parasitism is used. However, there are many exceptions to these apparent hard and fast definitions and trying to establish a parasitic association in certain cases has proved elusive. Animals from several major groups are known to be parasites of damselflies and dragonflies. These include the Apicomplexa (previously Protozoa - Sporozoa), platyhelminthes (flatworms, flukes and tapeworms) and arthropods, which are now normally divided into separate phyla and include the Uniramia (Insects) and Chelicerata (mites, spiders, scorpions), both of which include species parasitic on Odonata.

The Apicomplexa consists entirely of unicellular parasites. Some flatworms (Platyhelminthes) are free living whilst others (flukes and tapeworms) are parasitic and have complex life cycles involving two or more hosts. In flukes and tapeworms the host in which a parasite reaches sexual maturity is described as the definitive host and hosts in which the parasite undergoes developmental stages are called intermediate hosts. The intermediate stages of flukes (Trematoda) and tapeworms (Cestoda) are found in damselflies and dragonflies.

Although frequently referred to as parasites the relationship of some of these organisms, eg. nematodes, to their odonate hosts has yet to be established. There is also the issue of parasite or predator. Blood sucking flies have been regarded by some as predators rather than parasites. However, because they suck blood and are therefore detrimental to the host but do not kill it, they are classed here as parasites, despite the relatively short time they are associated with their hosts.

Corbet (1999) covered the subject of parasitism in detail but there is a need for an update and review of recent literature. Kohler (2008) carried out a literature survey and found that of 89 papers on Odonate parasites, 41 were on interactions with gregarines and 35 were on water mites (ie. roughly 85% on these two groups). The present review is by its nature a selective one, reflects current interests and attempts to cover some of the work published since Corbet's *magnum opus* (Corbet, 1999).

Apicomplexa (includes Gregarines).

Gregarines, which belong to this group, inhabit the intestine of a large number of invertebrates including odonates. They have a variable size but the trophozoite stage is around 300µm long. They may have no obvious effect, can cause damage to the gut, or have metabolic effects on the host as recent work, described here, has shown.

A number of gregarines, such as species of *Hoplorhynchus* (Plate 1A) and *Steganorhynchus* are found as intestinal parasites in the gut of adult odonates.

A new septate gregarine, Actinocephalus bradinopygi n.sp. has been described from the gut of the dragonfly Bradinopyga geminata from Andhra Pradesh, India (Narasimhamurti & Ahamed, 1980) and A. carrilynnae occurs in the USA (Bolek, pers. comm.) (Plate 1B) (see Bolek, 2011). Abro (1971, 1974, 1976, 1987, 1990) published several important pioneering papers on parasitism of zygopterans by gregarines, covering the subject in some detail, from both an ecological and histological point of view, as well as considering the impact of gregarines on damselflies. Although these have been covered by Corbet (1999) and are beyond the scope of this paper, two will be mentioned briefly. In an early paper, Abro (1974) found that larval odonates never had gregarines, that infection increased during the flight season, the majority being heavily infected, and that "discoloured, feeble" specimens captured in the field, exhibited extensive mid gut damage and reduced adult longevity. Abro (1990) dealt with observations over several years, forming an extension to previous work on gregarines and water mites. In the case of gregarines, he noted that heavily loaded individuals were advanced in age, the gregarines undergoing arrested development in cold weather, with development being dependent on the weather. No individual odonates were ever recorded carrying heavy numbers of both gregarines and mites and generally heavy loads of gregarines meant low or moderate numbers of mites.

Within the last few years further work on both the ecology and biochemical effects of parasitism by gregarines has been carried out. Locklin & Vodopich (2010) found that in 29 species of dragonfly, 41% had gregarines. Amongst commonly collected hosts, prevalence was from 18-52% with a median intensity of five gregarines per host. The authors stressed the importance of season, host species and gender in their studies. Also habitat has an effect, with prevalence and intensity different at the two reservoirs under study.

Schilder & Marden and their co-workers (Marden & Cobb, 2004, Schilder & Marden, 2006, 2007) have shown that infection with gregarines triggers immediate changes in the metabolism of the odonate *Libellula pulchella*, rendering it unable to metabolise fat. Fat accumulates around the thoracic flight muscles of the insect and this leads to reduced flight muscle performance. Changes in muscle protein composition were also noted which may, acting alone or with other changes, alter muscle contractile performance. The signalling molecule indicating stress, p38 MAP kinase, is activated in the flight muscles of parasitized dragonflies but not in healthy ones. Because gregarines can cause such metabolic irregularities as those described, these insects may be useful models for working on human obesity (Schilder & Marden, 2006).

Marden & Cobb (2004) examined territory and mating success in both gregarine parasitized and non-parasitized odonates, again using *L. pulchella*. Using

males, they tested the hypothesis that territory and mating are affected by muscle contractile performance and how gregarine parasites might affect this performance, their energy reserves and their territorial behaviour. They concluded that parasites could have a marked effect on signalling pathways and energy balance, *L. pulchella* females consistently mating with superior males. Parasites may thus affect performance and deprive the host of the energy necessary to perform high levels of muscle contraction. Tsubaki & Hooper (2004) also showed that high numbers of gregarines appear to bring about a substantial cost to the host and that the latter's survival was negatively correlated with parasite abundance, except when damselflies were fed until satiation.





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Plate 1: (A) *Hoplorhynchus acanthatholius* – A gregarine from the intestine of a damselfly. (B) *Actinocephalus carrilynnae* – Two gregarines from the intestine of a damselfly. Photographs by Matthew Bolek.

Trematoda

It has been known for a long time that flukes (trematodes) can have a life cycle which includes several hosts and that the latter may include dragonflies. Odonates can act as intermediate or carrier hosts for parasites which have amphibians as their definitive host. Recruitment of a dragonfly into the life cycle





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Plate 2: (A) Encysted metacercaria (fluke) of *Haematoloechus coloradensis* from the body cavity of a damselfly. (B) Unencysted metacercaria (fluke) of *Halipegus eccentricus* from the intestine of a damselfly. Photographs by Matthew Bolek.

transports the parasite from water to air and thus aids its distribution. Adult flukes live in the lungs, body cavity and intestine of anurans depending on the species.

Bolek and colleagues (Bolek & Janovey, 2007; Bolek *et al.*, 2009, 2010) have demonstrated the important role odonates can play in the life cycle of flukes. Bolek (2011) has published photographs of several fluke genera from the intestine and body cavity of odonates.

Lees (1953) was the first to elucidate the life-cycle of *Gorgoderina vitelliloba* in Britain. This parasite uses a small freshwater cockle and tadpoles as intermediate hosts. North American species of the same genus also mainly use tadpoles as secondary hosts but the life cycle can involve odonates, for example in *G. attenuata* (Bolek *et al.*, 2009) where certain frogs and toads ingest dragonflies infected with metacercariae. Species of *Phyllodistomum* also use arthropods as second intermediate hosts.

Frog lung flukes of the genus *Haematoloechus* use dragonflies as second intermediate hosts (Bolek & Janovy (2007). In experimental infections of the odonate host, the metacercariae of some species of *Haematoloechus* were located in the head, thorax and branchial chamber of dragonflies, whereas in other species they were located in the branchial chamber only (Bolek & Janovy, 2007) (Plate 2A). These workers have observed that some species of *Haematoloechus* are generalists, able to survive in a range of aquatic arthropods, whereas other species in the same genus only develop in dragonflies. In the case of *Haematoloechus medioplexus*, cercariae are swept into the rectum of a larval dragonfly and become metacercarial cysts in the branchial chamber and remain as cysts in the adult dragonfly. Infected larval and adult dragonflies (*Sympetrum* spp.), if eaten by frogs, develop into an adult fluke in the final host.

In *Halipegus ovocaudatus*, infected copepods are eaten by dragonfly larvae and the parasites survive as metacercariae in the gut of adult odonates. According to Kearn (1998) the dragonfly is an additional obligatory host, not just a carrier or transport host, and four hosts are required to complete the life-cycle – snail, copepod, dragonfly and frog. In the fluke *Halipegus eccentricus*, (Bolek *et al.*, 2010) (Plate 2B) the final or definitive host becomes infected by eating infected dragonflies.

Cestoda

Odonates have also been reported as intermediate hosts for tapeworms. Larvae of the tapeworm *Schistotaenia srivastavai* have been recorded in eight species of damselfly (Kukashev, 1989) from Kazakhstan. Dragonfly larvae infected with immature tapeworms have also been recorded from the Ukraine. Species within the genus of tapeworm *Joyeuxilepis* have been recorded, their larval stages being found in the haemocoel of damselflies. *J. pictus* (an unverified name) is reported as having been found in the Common Blue Damselfly *Enallagma cyathigerum* and the Large Red Damselfly *Pyrrhosoma nymphula*. A taxonomic revision of the genus *Joyeuxilepis* has been undertaken (Vasileva et al., 2003).

Nematodes

An undescribed mermithid nematode has been recorded from coenagrionid damselfly larvae. The nematode belongs to the genus *Amphimermis*. In one study it was found that 81% of damselflies were infected and it was thought to be lethal to the host (Willis, 1971).

Blood sucking flies

In Europe the biting midge *Forcipomyia paludis* (Diptera: Ceratopogonidae) is occasionally found on the wings of dragonflies and damselflies (Plate 3), where it may be found on either side of the wings, usually in the basal half (Martens & Wildermuth, 2008). It has been recorded from the middle of May to the beginning of August (Martens *et al.*, 2008). The first records were from Wicken Fen, Cambridgeshire in 1935 by Cowley (Cowley, 1936). It is widespread in continental Europe but had not been recorded from Britain for some 70 years (Martens *et al.*, 2008). Indeed, only two recent British records are known, both from Wicken Fen (Telfer, 2009). It is present in Ireland (Donnithorne, 2010) The flies are thought to suck blood from the veins of the wings and thus feed like parasitic larval mites. Wildermuth & Martens (2007) describe the feeding process. According to Martens & Wildermuth (2008), 55 Odonate species have now been recorded as hosts but only female flies have been found on adult dragonflies.

Aquatic mites

Several orders of freshwater insect are known to carry parasitic mites and the subject has been reviewed by several workers including Smith (1988) and Baker *et al.* (1991). Water mite larvae are parasitic feeders on adult odonates and are also found, but less commonly, phoretic on larval dragonflies waiting until metamorphosis when they transfer to the emerging adult dragonfly. Much of the recent work has concentrated on the ecological and behavioural aspects of the parasitic association. The mites involved almost always belong to the genus *Arrenurus* although the terrestrial mite *Leptus killingtoni* has been recorded from odonates in Britain by Killington & Bathe (1946) and Lorenzo-Carballa *et al.* (2011) have recently described the same species on parthenogenetic *Ischnura hastata* from the Azores.

Impact

Several authors have reported on host-parasite interactions, including Abro (1982, 1984, 1990), Baker *et al.* (1991, 2006), Braune & Rolff, (2001), Forbes & Baker (1990, 1991) and Leonard *et al.* (1999). There is now substantial quantitative evidence to show that water mite larvae have a considerable impact on their odonate hosts. This may include reduced survivorship (or increase in host mortality), reduction in egg production, impediment to growth, delay in maturation of the host, effects on flight patterns and physical damage. Braune & Rolff (2001) have shown that water mites and weight at emergence



Plate 3. Blood-sucking flies (Diptera: Ceratopogonidae) on the wings of the Club-tailed Dragonfly *Gomphus vulgatissimus*. Photograph by Hans-Ulrich Kohler.

of the damselflies had considerable impact on survival in parasitized females of Coenagrion puella, increasing host mortality. Forbes & Baker (1990) have shown that smaller and lighter female Enallagma ebrium carried more mites into adulthood and that differences in mass between female hosts may account for different levels of parasitism. In males, however, mass and condition of host at emergence appeared to be unrelated to mite numbers. In another paper by the same authors (Forbes & Baker, 1991), Arrenurus parasites were shown to lower the fecundity of young female E. ebrium hosts and they observed that the degree of parasitism could vary with age and size of host. Leonard et al. (1999), working with Limnochares americana arvae parasitic on E. ebrium, reported that low numbers of mites did not affect survival of teneral or mature males and females but that high numbers depressed survivorship of teneral males and females and mature males and were associated with a delay in maturation of females. There are, however, some conflicting results. For example, Andres & Cordero (1998), working in northwest Spain, found that in the case of Ceriagrion tenellum mites did not reduce damselfly survivorship but could reduce male mating success. Variations in grooming behaviour also reflect the effects of parasitism and may act to control mite numbers (Forbes & Baker, 1990). In a study of C. puella, Bonn et al. (1996) found that there was a positive and significant correlation in both sexes between fluctuating asymmetry of forewing length and the thoracic mite load, indicating a very short-term impact that is dependent on chance parasitism.

Prevalence and mite loads

Many papers have been published on prevalence and mite loads. Mite loads can vary between years, habitats, populations, host morphology and the condition of the host and these are discussed by Grant & Samways (2007). Hoffman & Anderson (2001) examined large museum collections of Odonata and found infestation levels of 16% in the Coenagrionidae and 12% in the Lestidae. Anderson (2002) found that over 95% of the mite larvae in such collections were species of Arrenurus. Zawal (2004a), in one study on nine species of odonate carrying arrenurid larvae, found the prevalence of parasitic larvae to be from 0.6% to 12.5% with an intensity of 1 - 14 and in a further paper (Zawal, 2004b) examining several zygopterans, the Common Blue Damselfly Enallagma cyathigerum (57%) and Azure Damselfly C. puella (54%) had the highest prevalence, whereas the prevalence in the two anisopterans studied was much lower, i.e. Downy Emerald Cordulia aenea (14%) and Ruddy Darter Sympetrum sanguineum (4%). Baker et al., (2007) considered several odonate and mite species together and found an overall prevalence of 21.7%. In a further paper (Baker et al., 2008), on C. puella, the mite load had a mean of 8.8%. Corbet (1999) however issued a word of warning stating that "care must [therefore] be taken in drawing conclusions from the results of isolated studies on single populations".

Site selection

Several authors have shown that different species of water mite take up different attachment positions on their host, a phenomenon referred to as resource partitioning. Now that keys are available to identify European species of *Arrenurus* larvae (Zawal, 2006a, 2006b, 2006c, 2006d, 2007), it is possible to identify different species at different sites on their host (Baker *et al.*, 2007, 2008). Often they show a clumped distribution, as demonstrated by Rolff (2000), on most of the infected specimens of *Coenagrion puella* he inspected.

In odonates, mites are sometimes found on the wings of *Sympetrum* spp. (Plate 4A,B)) and a number of odonates have them attached to their body, mainly on the underside of the thorax and/or abdomen (Baker *et al.*, 2007) (Plate 4C,D). In their study of museum collections, Hoffman & Anderson (2001) found that the most frequent attachment site was the mid-thorax, with those attaching to the abdomen most frequently found on segment seven, preferring sites where the cuticle is thin. Botman *et al.* (2002) found a specificity in host attachment sites for two species of *Arrenurus* on *Ischnura posita*. *A. major* was attached to the thorax and abdomen (segments 1 to 3) whereas A. americanus was never found on the thorax but attached mainly (77%) to abdominal segments 6 and 7. In a study of 591



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Plate 4. (A,B) A heavy infestation of water mite larvae, which appear like small red berries, on the wings of Southern Darters Sympetrum meridionale. Photographs by Hans-Ulrich Kohler. (C) Larval mites attached in the region of the intersegmental membranes on the underside of the abdomen of Coenagrion lindeni. Photograph by Richard Seidenbusch. (D) A pair of Black Darters Sympetrum danae, each with a cluster of larval mites on the underside of its thorax. Photograph by Hans-Ulrich Kohler.

zygopterans from Poland (mostly Coenagrion puella (77%) but also including C. pulchellum, Erythromma najas, Ischnura elegans, Lestes dryas, L. sponsa and Pyrrhosoma nymphula), 21.7% were found to be parasitized. 1282 mites were

found, the highest number on an individual being 101. 62.5% were recorded on the thorax, 35.3% on the abdomen and 2.25% in the intersegmental area between the thorax and the abdomen (Baker *et al.*, 2007). There was some variation in which of the seven species of *Arrenurus* identified were attached to which hosts (Table 1). In a detailed study of *C. puella* from Poland, 596 mite larvae were identified, over 90% of which belonged to one of four species -*Arrenurus cuspidator* (35.9%), *A. maculator* (32.5%) *A. bicuspidator* (14.3%) and *A. claviger* (9.4%). Six percent belonged to the *A. affinis* complex and 1.8% to *A. bruzelli*; a few could only be identified to genus. The four main species showed variation in attachment site (Table 2) (Baker *et al.*, 2008). However, most, if not all, *Arrenurus* species appear to be generalists rather than being associated with only one species of odonate host. This applies to both the anisopterans (Forbes *et al.*, 1999) and the zygopterans (Baker *et al.*, 2007).

Feeding

Arrenurus larvae feed on the haemolymph of their odonate host (Plate 5). A feeding tube or stylostome is formed in the tissues of the host and has been described in damselflies by Abro (1979, 1984). The damage caused by these events creates a cellular inflammatory response on the part of the host which involves an immigration of host haemocytes into the damaged area for the purpose of wound repair (Baker *et al.*, 1991).

Zygoptera	Arrenurus							
	bruzelli	bicuspidator	cuspidator	cuspidifer	maculator	papillator	tricuspidator	
Coenagrion puella	1	1	1	-	1	-	-	
Coenagrion pulchellum	-	-	7	-	1		-	
Erythromma najas	×	×.	1			÷	1	
Ischnura elegans	-	-	1	-	-		1	
Lestes dryas	-	÷	-	1	-	1	-	
Lestes sponsa	-	-	-	-	-		1	
Pyrrhosoma nymphula	1	T	-	а.	÷.	÷.	2	

Table 1. Arrenurus larvae found on zygopterans. (From Baker et al., 2007).

Arrenurus		Thorax	(T/A			Ab	dome	n			Total
	1/2	2/3	3		1	2	3	4	5	6	7	
bicuspidator	4	49	30		1			2				86
cuspidator	7	98	106	3								214
maculator		2	182		13							197
claviger		4	1	1	1	1	10	24	6	7	1	56

Table 2. Locations of four species of Arrenurus on adult Coenagrion puella. (From Baker et al.2008).

Detachment

Following engorgement, the larvae detach from their host and enter water to complete their life cycle (the adult mite is free living in freshwater). Several authors (Rolff, 1997; Rolff & Martens, 1997; Anderson, 2003) have studied detachment; the results are somewhat conflicting and several triggers have been suggested. Rolff (1997) looked at oviposition in *C. hastulatum* and *C. puella*, the former ovipositing on submerged vegetation and the latter at the surface. He found that mites detach at a significantly higher ratio with submerged oviposition. Rolff & Martens (1997) used *C. puella* in outside cages to test different stimuli and found that proximity to water had an impact but that a group of stimuli were involved associated with egg deposition behaviour. Anderson (2003) believes that the mite responds to cues associated with being near to water and a relatively high humidity appears to be an important factor, rather than it being exclusively associated with host oviposition or direct contact with water.

Sex biases

Sex biases in parasitism by arrenurid mites is controversial. Rolff (2000) found no differences in parasite abundance (*A. cuspidator*) due to host sex or host species. However, Robb & Forbes (2006) found sex biases in parasitism by mites, with a female bias in intensity of parasitism by larval *A. pollictus* on *Lestes disjunctus*. Two dragonfly species, parasitized by the mite *Limnochares americana*, were studied in field surveys by Lajeunesse *et al.* (2004) to investigate host use and parasitism. They found species and sex biases by the mite on the hosts, with positive male bias occurring in both odonate species. Positive male biases were also found in mature adult males, but not in tenerals, of *Xanthocnemis zealandica* by McKee *et al.* (2003). Forbes *et al.* (2004), using recapture techniques, found mature females carried more mites than mature males. However, heavily parasitized males appear to disperse or die and are not recaptured. Baker *et al.* (2008) working with C. *puella* found that larval mites



Plate 5. A scanning electron micrograph of a larval mite (Arrenurus sp.) feeding on the Northern Damselfly Coenagrion hastulatum.

show a preference for female hosts.

Conclusion.

Much work has been carried out since Corbet (1999) published his classic work. The present paper is an attempt to bring the subject up to date and help to stimulate an interest. The author believes that 'parasites of dragonflies and damselflies' forms a rich topic for further investigation in both the field and the laboratory.

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A review of notable records of Irish odonates post DragonflyIreland (2004-2010), including confirmation of the Golden-ringed Dragonfly *Cordulegaster boltonii* (Donovan) on the Irish list

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Summary

Notable records of Irish odonates in the period post DragonflyIreland (2004-2010) are presented, including confirmation of the Golden-ringed Dragonfly *Cordulegaster boltonii* on the Irish list. Range expansions of several species are documented and the occurrences of migrant species are reviewed and discussed. An updated Irish checklist is provided and reference made to the Irish Red List.

Introduction

Dragonflylreland was an all-Ireland recording project initiated in 2000 and supported by National Parks and Wildlife Service, Northern Ireland Environment Agency, Ulster Museum (National Museums Northern Ireland) and the Heritage Council. Following four years of field recording (2000-2003 inclusive) which generated 13,810 records, the results were published in the *Natural History of Ireland's Dragonflies* (Nelson & Thompson, 2004).

The DragonflyIreland project still operates but less formally and the level of recording has declined. Nevertheless, just over 5,000 verified records have been added to the DragonflyIreland database since 1 January 2004. The primary copy of the database is maintained by the Irish recorder and copies are supplied to CEDaR (National Museums Northern Ireland) and the National Biodiversity Data Centre (Waterford). Information on how to submit records is available from both data centres. This paper presents a summary of the most significant records which have been received in 2004-2010, including confirmation of the Golden-ringed Dragonfly *Cordulegaster boltonii* as an Irish species. Full details of the records can be obtained on request from the Irish dragonfly recorder or viewed on the online mapping system of the NBDC (www.biodiversityireland.ie).

Locations are recorded by county (Fig. 1) and by using the Irish Grid (Fig. 2). Where Irish or other vernacular names exist that differ from those used by the BDS they appear in Table 1.

Figure 1. The Irish Counties.

Table 1. Checklist of Irish Odonata. The order and scientific nomenclature follows Dijkstra & Lewington (2006); the vernacular names are in accordance with those of the BDS. The alternative vernacular names used in Dijkstra and Lewington (2006) (Eur) and Nelson & Thompson (2004) (Ire) are also given where different.

Scientific Name	Common Name	Alternative common names in Continental Europe (Eur) and Ireland (Ire)		
ZYGOPTERA	DAMSELELIES			
Family Calopterygidae	Demoiselles	Jewelwings		
Calopteryx splendens (Harris 1782)	Banded Demoiselle	Ire: Banded Jewelwing		
Calepteryx virge (Linnaeus 1758)	Beautiful Demoiselle	Ire: Beautiful Jewelwing		
Family Lestidae	Emerald Damselflies	Spreadwings		
Lestes dryas Kirby 1890	Scarce Emerald Damselfly	Eur: Robust Spreadwing Ire: Turlough Spreadwing		
Lestes sponsa (Hansemann 1823)	Emeraid Damselfly	Eur: Emerald Spreadwing. Ire: Common Spreadwing		
Family Coenagrionidae	Blue and Red Damselflies	Bluets, bluetails, and red damsels		
Coenagrion lunulatum (Charpentier 1840)	Irish Damselfly	Eur: Crescent Bluet Ire: Irish Bluet		
Coenagrion puella (Linnaeus 1758)	Azure Damselfly	Eur: and Ire: Azure Bluet:		
Coenagrion pulchellum (Vander Linden 1825)	Variable Damselfly	Eur: and Ire: Variable Bluet		
Enallagma cvathigerum (Charpentier 1840)	Common Blue Damselfly	Eur: and Ire: Common Bluet		
Ischnura elegans (Vander Linden 182®)	Blue-tailed Damselfly	Eur: Common Bluetail		
Ischnura numilio (Charpentier 1825)	Scarce Blue-tailed Damselfly	Fur: Small Bluetail Ire: Small Bluetin		
Pyrrhosoma nymphula (Sulzer 1776)	Large Red Damselfly	Eur: Large Red Damsel		
ANISOPTERA	Club toiled Descention	GONFLIES		
Gomphidae Gomphus vulgatissimus (Linnaeus 1758)	Common Club-tail	Ire: River Clubtail		
Aeshnidae	Hawker Dragonflies	(Hawkers and Emperors)		
Aesnna cyanea (Muller 1764)	Southern Hawker			
Aesnna grandis (Linnaeus 1758)	Brown Hawker	Ire: Amber-winged Hawker		
Aeshna juncea (Linnaeus 1758)	Common Hawker	Eur and Ire: Moorland Hawker		
Aeshna mixta Latreille 1805	Migrant Hawker	Ire: Autumn Hawker		
Anax ephippiger (Burmeister 1839)	Vagrant Emperor			
Anax imperator Leach 1815	Emperor Dragonfly	Eur and Ire: Blue Emperor		
Anax parthenope Sélys 1839	Lesser Emperor	Ire: Yellow-ringed Emperor		
Brachytren pratense (Müller 1764)	Hairy Dragonfly	Eur: Hairy Hawker; Ire: Spring Hawker		
Family Cordulegastridae	Golden-ringed			
Cordulegaster boltonii (Donovan 1807)	Golden-ringed Dragonfly	Eur: Common Goldenring Ire: Golden-ringed Spiketail		
Family Corduliidae	Emerald Dragonflies	Emeralds		
Cordulia aenea (Linnaeus 1758)	Downy Emerald			
Somatochlora arctica (Zetterstedt 1840)	Northern Emerald	Ire: Moorland Emerald		
Family Libellulidae	Chasers, Skimmers and Darters			
Libellula depressa Linnaeus 1758	Broad-bodied Chaser			
Libellula fulva (Müller 1764)	Scarce Chaser	Eur: Blue Chaser		
Libellula quadrimaculata Linnaeus 1758	Four-spotted Chaser			
Orthetrum cancetlatum (Linnaeus 1758)	Black-tailed Skimmer			
Orthetrum coerulescens (Fabricius 1798)	Keeled Skimmer	Ire: Heathland Skimmer		
Sympetrum danae (Sulzer 1776)	Black Darter			
Sympetrum flaveolum (Linnaeus 1758)	Yellow-winged Darter			
Sympetrum fonscolombii (Sélys 1840)	Red-veined Darter			
Sympetrum sanguineum (Müller 1764)	Ruddy Darter			
Sympetrum striolatum (Charpentier 1840) [syn Sympetrum nigrescens (Lucas 1912)]	Common Darter			

Figure 2. The Irish Grid System. The squares are 100 km x 100 km. Thus N665460 indicates a position 66.5 km from the western edge of square N and 46.0 km from its southern edge, giving an accuracy to the nearest 100 m.

Changes to the Irish list

The revised checklist (Table 1) includes one addition to the Irish list since Nelson & Thompson (2004), i.e. the Golden-ringed Dragonfly *Cordulegaster boltonii*.

Cordulegaster boltonii (Donovan) - Golden-ringed Dragonfly

There have been several claims of this large dragonfly in Ireland (e.g. King & Halbert, 1910; Merritt *et al.* 1996), but none have been fully verifiable and the species has been omitted from recent checklists (Ashe *et al.*, 1998, Nelson & Thompson, 2004). However, there have been three recent records (two in 2005 and one in 2008) which definitively confirm its occurrence in Ireland.

CO. KILKENNY

S6112 Ferrybank 18 August 2005, Emma Walsh, female photographed. The record came from the north bank of the Suir, which administratively is in Waterford City, but in the vice-county of Kilkenny. The circumstances of this record as reported by Emma Walsh were:

"The dragonfly came from Ferrybank in Waterford city, it was found near the building site I was working on. The particular area in which it was spotted it was a bog and a stones throw from a small stream which is very overgrown. [The dragonfly] was in a little stream and her wings were covered in silt so we moved her in order that she would dry out and survive the machinery. All the time she kept a firm hold of the stone seen in the picture, the stone was sizable in comparison to the dragon fly. The next morning when we returned she had presumably flown away."

Three photographs of the insect were supplied, which showed the dragonfly as it was found, clutching a small stone and covered in damp sand (Plate 1). Damage to all of the wings was apparent in the photographs, particularly the right forewing which was missing the tip beyond the pterostigma. The appearance and colouring of the body and wings indicated that the individual was mature.

S6613 Gorteens 20 August 2005, Kieran Fahy, female picked up dead, specimen donated National Museum, Dublin. This specimen was reported to have been in the area for several days. The appearance of the specimen clearly indicated it was a different specimen from the Ferrybank individual, all four wings being worn, but intact.

Plate 1. Golden-ringed Dragonfly *Cordulegaster boltonii*, Ferrybank, Co Kilkenny 18 August 2005, Emma Walsh. This shows the dragonfly after it had been removed from the stream in which it was found. Photograph by Emma Walsh.

CO. WATERFORD

S6906 Dromina Townland 16 September 2008, Pat Coghlan, female picked up dead on road, voucher retained National Museum Northern Ireland (accession number Mr711634). This record concerned a single specimen found dead on a minor road 10k south-east of Waterford City in 2008.

The circumstances of these three sightings raise questions about the status of the species in Ireland. As they all come from a restricted area of the southeast over a period of three years, it suggests some common factor in their occurrence. The obvious question is whether the records indicate there is an established population in the region or whether they were all immigrants.

Sympetrum nigrescens Lucas - Highland Darter

This species was not considered a valid taxon by Dragonflylreland due to the uncertainty of the reliability of the characters used to distinguish the species from the Common Darter *Sympetrum striolatum* (Charpentier, 1840) (Nelson

& Thompson, 2004). However, the species still appears in some field guides, although usually without illustration of the supposedly diagnostic features of the genitalia. New evidence has been provided by two genetic and morphological studies which shows that *nigrescens* is indistinguishable from *striolatum* (Pilgrim & van Dohlen, 2007; Parkes *et al.*, 2009).

New and notable records of established and migrant species

Calopteryx virgo (L.) - Beautiful Demoiselle

CO. DUBLIN

O105293 River Poddle, Tymon Regional Park 10 August 2007, Tim Clabon. First county record.

CO. LOUTH

O027867 Rathescar Lough 19 July 2006, Don Hodgers, male. First county record.

These two records suggest a northward expansion in eastern Ireland.

Coenagrion lunulatum (Charpentier) - Irish Damselfly

This is the rarest of the three *Coenagrion* species in Ireland and, uniquely amongst the Irish odonates, it is absent from Great Britain. *Coenagrion Iunulatum* is a species of mesotrophic small lakes with abundant floating aquatic plants (Nelson & Thompson, 2004). Records have been received from counties Antrim, Armagh, Donegal, Down, Fermanagh, Monaghan and Tyrone. The Monaghan records were gathered during a survey into this species, the results of which will be published elsewhere. The records from Antrim, Donegal and Tyrone are of particular relevance to this paper.

CO. ANTRIM

J0965 Montiaghs Moss NNR is an area of cutover raised bog with numerous flooded peat cuttings which supports a high species diversity of aquatic insects, including at least 14 species of odonate (Nelson & Thompson 2004). *Coenagrion lunulatum* was first seen at the Montiaghs in 1986 and this has become the best recorded site for the species in Ireland. The colony is within easy reach of Belfast and is relatively accessible to both local and visiting naturalists. The numbers of adult *C. lunulatum* reported by observers per visit to the Montiaghs have usually been fewer than 10 but the following high

counts were reported.

2 June 2006, 50 adults, 3 ovipositing pairs, Ian Rippey.

22 June 2007, 24 adults, Ted Rolston and David Nixon.

1 June 2007 20 males, 3 pairs copulating/mating, Brian Nelson.

1 June 2010, 60 adults, Ian Rippey.

These numbers may indicate some success in the management work at the site, which has created new pools. However, the counts and estimates were not carried out in a standardised manner and more rigorous and systematic monitoring of the population is needed.

CO. DONEGAL

C211300 Lough Napaste 15 May 2008, Brian Nelson, several males. This is the second Donegal record. The only previous Donegal record is from Ballyboe Lough (C217295), 0.6km to the south east of L. Napaste, where a single male was reported by Ralph Shepherd, Ian and David MacNeill on 1 June 2002. There have been no reported visits to Ballyboe Lough during the flight period of *C. lunulatum* since 2002, so the status of the species there remains unclear. Lough Napaste appears a more typical site for *C. lunulatum* and is considered more likely to support a colony than Ballyboe Lough (see illustration in Nelson & Thompson (2004) page 396)). It is possible that the individual seen at Ballyboe L. was a stray from L. Napaste. More visits are needed to the lakes in this area of Donegal to determine the distribution and status of *C. lunulatum*. L. Napaste and Ballyboe L. are the northernmost localities for the species in Ireland. The nearest known extant sites are 65km distant in central Co Tyrone

CO. TYRONE

H633670 Crockagarran, Gortfinbar Townland 8 July 2005, Niall Keogh and Joe Adamson, 1 male at small pool in blanket bog. Seen also on 14 June 2006, 4 males and 1 female, by Dave Allen. A new location and first records for the 10km square.

H4747 Cullentra Lough 5 May 2007, Brian and Shirley Nelson, 20 recently emerged adults. This is the earliest sighting date for the species in Ireland, the previous being 12 May (Nelson & Thompson, 2004). On 10 June 2007, in calm, warm and sunny weather conditions, very large numbers of adults were present (estimated to be many hundreds) and numerous damselfly exuviae were seen on the stems of aquatic plants and on the support posts of fishing platforms in the south west corner of the lake (Brian Nelson). No sensible estimate of the numbers of individuals present was possible but it was certainly the highest number ever seen by the author at any Irish

site. The numbers of damselfly exuviae visible on plants of Water Horsetail *Equisetum fluviatile* (many stems had several) supported this assessment of the strength of the population. As no other damselfly was present in any numbers at the time, it is assumed the majority of exuviae were of this species. The colony at Cullentra L. was assessed in 1996 as the second largest in N. Ireland (Nelson, 1999) and the numbers seen in 2007 indicate that it remains very strong and, in the opinion of the author, is currently the largest in N. Ireland

H539482 Lough McCall 3 June 2008, Brian Nelson, 50 adults, pairs in tandem.

This appears to have been the first recorded visit to this site since 1996 (Nelson 1999). Numbers present suggest the colony remains similar in size.

H530487 Cloghcor Lough 3 June 2008, Brian Nelson, 100 males, many tandem pairs and single females. Cloghcor L. is 1km NW of L. McCall. This visit appears to be the first since 2001. The colony appears to be a significant one, producing large numbers of adults. It was unknown at the time of the 1996 survey but, based on the criteria of Nelson (1999), this site would be in the second rank of sites.

These three small lakes in Co Tyrone (Cullentra, McCall and Cloghcor) are located relatively close together on the south side of the Clogher Valley. Cullentra L., the westernmost lake, is 7 km west of the easternmost, L. McCall. The first records of *C. lunulatum* in the Clogher Valley came from Annagh Lough (H505504) and Ballagh Lough (H500499). These two adjoining lakes are roughly equidistant from Cullentra and Cloghcor/McCall. Annagh and Ballagh Loughs provide sub-optimal habitat for *C. lunulatum*, both being enriched and lacking the floating aquatics which appear to be an essential requirement for this species (Nelson, 1999). The breeding populations at Annagh and Ballagh Loughs, if they exist, are certainly small but it is considered more likely that the sightings have been of wandering individuals from one of three larger colonies close by. Stray individuals of *C. lunulatum* in unsuitable habitat have been reported (Nelson, 1999) and, although the maximum distance moved by these strays is unquantified, it is likely to be several kilometres. The dispersal ability of the species needs more thorough study.

Ischnura pumilio (Charpentier) - Scarce Blue-tailed Damselfly

Records were received from counties Clare, Fermanagh, Kilkenny, Limerick, Londonderry, Mayo and Wicklow. Those from Fermanagh and Londonderry are of particular significance here.

CO. FERMANAGH

H104535 Tonnagh Quarry 6 June 2006, Ian Rippey, 20 adults, 3 tandem pairs and a teneral female. Records were also received from this site in 2005, 2007, 2008 and 2010 but the 2006 record is a high count for this site, with most of the other records having been of fewer than 10 individuals. Two immature males were present on 16 May 2008 (Ian Rippey), which is an early emergence date. This colony of I. pumilio is located in spring-fed pools and runnels on the base of a guarried limestone outcrop (see Nelson & Thompson 2004 p398) and has been known since 1987. Records have been received in most years, confirming its continued presence. There is no comparable series for any other Irish site. This damselfly has a reputation for occurring in transitory populations in Ireland and Britain and it has been termed a wandering opportunist (Cham, 1996). This opinion was challenged by Allen & Thompson (2010) who considered the species to be essentially sedentary and one that would persist in habitats that were optimal and stable. Movement undoubtedly occurs but this is in response to habitat change and loss, not as a normal activity or as part of a metapopulation strategy of the species (Allen & Thompson, 2010).

CO. LONDONDERRY

C768147 quarry at Brockagh 10 June 2007, Ian Rippey, 40 adults including mating pairs. The first positive record from this site for 20 years. Also seen here on two other dates in June 2007 by Geoff Campbell.

H974939 Lough Beg 27 June 2010, Brian Nelson, several tens of adults (males, females and tandem pairs). The first record from this site. The adults were sitting unobtrusively on the scattered low plants growing in shallow water of a sandy-bottomed bay on the western shore of Lough Beg. *Ischnura pumilio* has been seen in similar conditions on other large Irish lakes (e.g. the north shore of Lough Graney, Co Clare and Lough Gara, Co Sligo (Nelson & Thompson (2004)) and it would appear that the areas of shallow, sparsely vegetated habitat found on the shores of naturally fluctuating lakes can provide the conditions it needs. This is probably an under-appreciated habitat for *Ischnura pumilio* but one that could support large and perhaps stable colonies.

Pyrrhosoma nymphula (Sulzer) - Large Red Damselfly

CO. ANTRIM

D1051 Rathlin Island, Kinramer 18 June 2010, David Nixon and Philip

McHaffie, 2 adults. Surprisingly this is the first confirmed record of this species from Rathlin Island. Suitable habitat for it appears to be common on the island and the species is widespread in north Antrim.

Aeshna mixta Latrielle - Migrant Hawker

This late-summer dragonfly has recently colonised Ireland (Nelson *et al.* 2003). The earliest record given in Nelson *et al.* (2003) and Nelson & Thompson (2004) was from 2000 but acceptable records, given below, received since 2004, show *A. mixta* was present in Ireland from at least 1997.

Records have been received from counties Clare, Cork, Down, Dublin, Limerick, Louth, Waterford, Wexford and Wicklow. The species has clearly become wellestablished in Wexford and is now considered commonplace. A northward spread along the east coast is evident into counties Dublin, Louth and Down (Fig. 3) and it has reached as far north as Downpatrick, Co Down. which is approximately 150km further north than the 2003 limit at Kilcoole, Co Wicklow. A northward spread along the west coast has occurred to almost the same extent as on the east, reaching from west Cork to southern Clare. The most significant records are as follows:

CO. CLARE

R370600 Shannon Airport Lagoon 7 September 2007, Geoff Hunt, 2 adults. First county record. Seen again at this site in 2008 and 2010. On 3 September 2010, adults were reported by lan Rippey at Inishmurry (R2546), Ardaun Lough (R486706), Enagh (R487702) and Muckanagh (R441691 and R441696).

CO. DOWN

J532452 Lough Money 30 August 2006, David Nixon, 1 male. First county record. There have been reports from this site in each subsequent year. In 2010 there were also sightings at Ardilea (J416387), Ballydugan (J5345) and Temple Water (J574503) (David Nixon and Angus Kennedy).

CO. DUBLIN

O283366 Howth 13 September 2007, 40 adults between the Needles and the Baily and O296374, Martello, 13 September 2007, 12 adults, both Frank Smyth. First county record. Adults were reported in 2008 at Howth (O282382), Drumcondra (O157370) and North Bull Island (O231371) and in 2010 at Booterstown Marsh (O200304) and Kilbogget Park (O241248).

Breeding behaviour (tandem pairs) was reported by Peter Doyle at the last site.

CO. KILDARE

N8128 Ballinafagh 21 September 2008, Michael Linehan, 1 male. First county record. Immature and mature individuals of both sexes and tandem pairs were seen here in 2009 and 2010 by the same observer.

CO. LIMERICK

R6440 Lough Gur 3 October 2008, Geoff Hunt, 1 male. First county record. In 2010 it was reported at two other sites in the county, Aughinish (R2853, Geoff Hunt) and Glenstall Abbey (R7356, Ian Rippey).

CO. LOUTH

O094904 Keenan's Cross Pond 28 October 2007, Don Hodgers and Gerry O'Neill. First county record. Reported by Don Hodgers in 2008 from this site and at a claypit south of Ferrard Cross (O132895).

CO. WEXFORD

T0505 Tacumshin Lough 18 October 1997, Tom Kilbane and Sean Cromien. Seen at close distance, perched on low vegetation.

X9597 Great Saltee Island 9 – 15 September 2007, Oscar and Cian Merne. Adults were seen on the island on each day. The great majority were hawking around the sheltered house and garden but a few were also seen along the 1-km path to The Ring, in the SW of the island. The maximum recorded on one day was 12 individuals. Most were considered males. Sightings of *Aeshna mixta* in 1998, 1999 and 2000 are reported in the observatory log book (Oscar Merne, pers. comm.)

Anax imperator Leach - Emperor Dragonfly

The appearance of this species in Ireland in 2000 was followed by rapid spread along the south and east coasts (Nelson *et al.*, 2003) and by 2003 the distribution extended from Skull, Co Cork to Roundwood, Co Wicklow (Nelson & Thompson, 2004). Records have been received from counties Armagh, Clare, Cork, Dublin, Kildare, Laois, Limerick, Louth, Monaghan, Waterford, Wexford and Wicklow. Figure 4 shows the increase in the Irish distribution since 2003. The most pertinent records are as follows:

Figure 3. Distribution of Migrant Hawker Aeshna mixta in Ireland. D, hectads with records up to 2003; •, hectads with records in 2004-2010.

CO. ARMAGH

H928196 Cashel Lough Upper 3 August 2006, Don Hodgers, 1 male. First county record.

CO. CLARE

R370597 Shannon Airport Lagoon 29 August 2010, Geoff Hunt. First county record.

CO. DUBLIN

O1960 Balrothery Reservoir (Knock Lake) 14 July 2005, Ciarán Williams, 3 adults. First county record.

The species has since been reported along the Grand Canal and in suburban parks within Dublin city. Hugh Delaney reported adults, including an ovipositing female, in July 2006 on the Grand Canal between Bagott Street and Leeson Bridge (O1632). In 2010 Peter Doyle saw adults in Cabinteely Park (O2325) and Kilbogget Park (O2424) in the south city.

CO. KILDARE

N8128 Ballynafagh 16 June 2010, Michael Linehan, 1 male. First county record. Another male was seen and photographed here on 8 August 2010 by ML.

CO. LAOIS

N55070 Emo Park Lake 2 July 2005, Peter Doyle, 2 males. First county record.

CO. LIMERICK

R7523 Griston Bog 15 July 2005, Geoff Hunt, 1 adult. First county record. Also reported here in 2006 by Geoff Hunt.

CO. LOUTH

J133132 Windy Gap 5 July 2006, Don Hodgers, 1 male. First county record. Seen at four other sites in the county in 2006.

CO. MONAGHAN

Figure 4. Distribution of Emperor Dragonfly Anax imperator in Ireland.
., hectads with records up to 2003;
., hectads with records in 2004-2010.

H695182 unnamed lough south of Cumry 28 June 2009, Brian Nelson, 1 male. First county record.

Anax parthenope Sélys - Lesser Emperor

This migrant dragonfly was added to the Irish list in 2000 (Nelson *et al.*, 2003). During DragonflyIreland it was recorded in 2000, 2001 and 2003 from five localities on the south and east coasts. Since then it has been recorded in 2005, 2006 and 2007. The change in the distribution of the species is shown in Figure 5.

CO. ARMAGH

J053582 Craigavon North Lake 18 July 2006, Brian and Shirley Nelson, 1 male. First county record. This individual was present until 27 July.

CO. CORK

W9373 Lough Aderry 17 June 2006, Harry Hussey, 1 male. The species has been recorded here before in 2000 and 2003 (Nelson *et al.*, 2003, Nelson & Thompson, 2004).

X079761 Ballyvergan Marsh, SW of Youghal 23 August 2007, Rick Mundy.

CO. DUBLIN

O1960 Balrothery Reservoir (Knock Lake) 13 July 2005, Ciarán Williams. First county record. Reports were received up to 31 July. Most accounts indicated that there were three adults (two males and a female) at the site, but one observer suggested there may have been as many as seven. One tandem pair was seen on the 16 July and oviposition behaviour on 17 July.

O1960 Balrothery Reservoir 14 July 2006. Three males were seen on 14 July and two males on 15 July (Peter Doyle). One male was seen on 20 July (Niall Keogh and Joe Adamson). It is tempting to conclude that these individuals were locally bred progeny of the adults seen in 2005. However, it is thought that the larvae of *Anax parthenope* normally take two years to complete development (Brooks & Lewington, 2002).

CO. KILDARE

N866174 Grand Canal near Naas, north-east of Connaught Bridge 5 July 2006, Niall and Noel Keogh, one male. First county record.

CO. WEXFORD

T063058 Tacumshin, east end at Sigginstown Island 16 July 2005, Tom Kilbane, 1 male. New site, previous Wexford records were all from Lady's Island Lake.

T1005 Ring Marsh, Lady's Island Lake 11 July 2006, Killian Mullarney, 1 male. There were records at this locality in 2000 and 2001.

Sightings of this southern dragonfly have increased markedly in north-western Europe since the mid 1990s. The status of the species in Belgium, Great Britain and The Netherlands has changed from an extremely rare vagrant to an annual migrantin small numbers (Parr et al., 2004; Termaat et al., 2010). The Irish records have therefore been part of a general phenomenon seen in the nearest regions of Europe. However, the influxes to Ireland of Anax parthenope have been less regular, involving fewer individuals and, although breeding behaviour has been observed here, there is still no confirmed evidence of successful breeding. The Irish sightings in 2000, 2001 and 2003 were coincident with influxes to Britain (Nelson & Thompson, 2004) and this pattern has been maintained since 2004. The sightings in Ireland in 2005-2007 coincided with the three largest influxes in Britain (Parr, 2006, 2007, 2008). In each year, there was a correspondence in the date of the Irish observations and the waves of immigration reported in Britain (Table 2). This strongly suggests that most if not all the Anax parthenope seen in Ireland are migrant individuals and further occurrences will therefore be dependent on weather patterns and the state of the source populations.

Brachytron pratense (Müller) - Hairy Dragonfly

CO. ANTRIM

D1051 Rathlin Island, Kinramer 18 June 2010, David Nixon and Philip McHaffie, 1 male. Like the record of *Pyrrhosoma nymphula* at the same time, this is the first confirmed record of this dragonfly from Rathlin Island.

Cordulia aenea (L.) - Downy Emerald

Drinan *et al.* (2011) provides confirmation of *Cordulia aenea* in Connemara, Co. Galway and documents the first finding of larvae in Ireland.

Table 2. Summary of the occurrences of Lesser Emperor Anax parthenope in Ireland and Britain2004-2010.

Year	Ireland	Britain
2004	None reported	6, possibly 10, at six sites (Parr, 2005)
200 <mark>5</mark>	Minimum of 4 at two sites First records on 13 and 17 July	At least 30 seen. Arrivals in two periods 21- 23 June and 9-11 July (Parr, 2006)
2006	Minimum of 7 at 5 sites. One first seen 17 June, others were first seen 5-18 July	At least 90 seen. There were considered to be three waves of immigration (4-10 June, 2-8 July and 30 July – 5 August) (Parr 2007)
2007	One reported 23 August	Seen at over 20 sites but numbers down on 2006. One major arrival 3-11 August (Parr, 2008)
2008	None reported	Low numbers, a minimum of 8 at eight sites (Parr, 2009)
2009	None reported	Numbers greater than in 2008. Seen at 16 sites (Parr 2010)
2010	None reported	Minimum of 20 from 11 sites (Parr, 2011)

Somatochlora arctica (Zetterstedt) - Northern Emerald

CO. KERRY

V915802 Galway's River valley 10 June 2005, Brian Nelson, 5 recently emerged adults, 3 exuviae. This is the site where egg laying was observed during DragonflyIreland (Nelson & Thompson, 2004). It remains the only confirmed breeding site for this species in Ireland.

V932850 Dinish 7 July 2005, Brian Nelson, 3 males flying over suitable habitat. This is the first confirmed record of *S. arctica* from Dinish since it was collected here by J.J.F.X. King in 1887 (Nelson & Thompson, 2004). The habitat consists of wet heath with some flushes and long-abandoned peat cuttings.

Orthetrum cancellatum (L.) - Black-tailed Skimmer

The range of this species in Ireland is chiefly in western and central Ireland (Nelson & Thompson, 2004). A spread into the south east and east has been

Figure 5. Distribution of Lesser Emperor Anax parthenope in Ireland. D, hectads with records up to 2003; •, hectads with records in 2004-2010.

apparent since 2003. The species remains absent from Northern Ireland.

CO. DUBLIN

O1960 Balrothery Reservoir 16 July 2005, Peter Doyle and 14 and 15 July 2006, Peter Doyle, Don Hodgers, Enda Flynn, Dave Dillon. The first records from Dublin since 1955 (MacNeill, 1956).

CO. LAOIS

N55070 Emo Park Lake 2 July 2005, Peter Doyle, 3 adults and a mating pair. The first records from this lake since 1950 (MacNeill, 1950).

CO. LOUTH

O095904 Keenan's Cross Pond 17 and 24 June 2007, Don Hodgers and Gerry O'Neill. First county record. Also seen at this site in 2008.

CO. WEXFORD

T056068 Tacumshin Lough, Sigginstown Island 10 July 2005, Niall Keogh, Hugh Delaney and Joe Adamson. First county record. Records also received in 2006, 2008 and 2010.

CO. WICKLOW

T2998 Cronykeery 9 July 2005, Angus Tyner. First county record.

Sympetrum fonscolombii (Sélys) - Red-veined Darter

This is a rare and irregular migrant but one that is being recorded more frequently in north western Europe including Ireland (Ott, 2010). Breeding of this species is widespread in Britain but there has been no confirmed evidence of successful breeding in Ireland. Specimens of this migrant dragonfly were reported in 2006, 2007, 2008 and 2010 in counties Dublin, Kerry, Wexford and Wicklow. The distribution of the records is shown in Figure 6. The records were as follows

CO. CORK

W9373 Lough Aderry 2 July 2006, Harry Hussey, 1 male.

CO. DUBLIN

O1960 Balrothery Reservoir (Knock Lake) 14 and 15 July 2006, Peter Doyle, 1 male.

CO. KERRY

V6161 Skehanagh 4 November 2010, Caitriona Douglas, 1 male. First county record and the latest ever record in Ireland. The weather in early November 2010 was dominated by a mild southerly airflow with the maximum temperature reaching 17°C in places on 4 November (Met Eireann monthly weather summaries).

CO. WEXFORD

T0305 Tacumshin Lough 3 July 2006, Niall Keogh, 1 male.

T1005 Ring Marsh, Lady's Island Lake 11 July 2006, Killian Mullamey, 2 males.

T0305 Tacumshin Lough 19 July 2006, Chris Wilson, 2 adults.

T1204 Carnsore Point 28 August 2006, Tom Shevlin, 1 male.

T0407 Tacumshin Lough 24 October 2006, Killian Mullamey, 1 male.

T112274 Culleton's Gap 6 July 2007, Chris Wilson, 1 male.

T0305 Tacumshin Lough 10 June 2008, Niall Keogh, 1 male

CO. WICKLOW

T2998 Cronykeery 12 July 2007, Angus Tyner, 1 male. First county record.

Table 3 summarises the occurrences of *S. fonscolombii* in 2004-2010 in Ireland and Britain. Unlike *Anax parthenope*, the pattern of occurrence of *S. fonscolombii* in Ireland does not mirror closely the pattern in Britain. The influx in Ireland in 2006 can clearly be linked to the large influx observed in Britain (Parr, 2007). The reduced numbers in 2007 would also appear to correspond with the events documented in Britain (Parr, 2008). One could speculate that the Irish records were the progeny of breeding by immigrants in Ireland or western Britain or the result of fresh immigration from Europe. However, none were reported in Ireland in 2009 when Britain experienced at least two periods of significant Table 3. Summary of the occurrences of Red-veined Darter Sympetrum fonscolombii in Ireland andBritain 2004-2010.

Year	Ireland	Britain
2004	none reported	'a quiet year' with only small immigration (Parr,2005)
2005	none reported	More than in previous year mainly in June and July in eastern England (Parr, 2006)
2006	9 individuals seen at 7 sites in Cork, Dublin and Wexford. Most seen 2-19 July with singles in August and October	The largest ever immigration recorded in Britain with at least 900 adults reported. The main influx was in mid June to mid July (Parr, 2007). A locally bred generation was noted in a few places.
2007	Singles at 2 sites, Wicklow and Wexford, in early and mid July	Numbers well-down on 2006. An influx apparent in early June but pattern confused by locally bred individuals (Parr, 2008)
2008	One record, Wexford, June	Small numbers of individuals mostly in June and on south coast of England (Parr, 2009)
2009	None reported	A very large immigration, starting in early May and with a second influx in late June and early July. A new generation of adults was evident at some sites in late summer (Parr 2010)
2010	One record, Kerry, November	Few reported and from only 10 sites. No late summer/autumn records (Parr, 2011)

immigration (Parr, 2010). This apparent absence could of course be simply the lack of recording, which is impossible to determine. However, there are also mismatches in the timing of the Irish records in 2008 and 2010 which do not appear coincidental with any significant arrivals in Britain (Parr, 2009, 2011). This evidence is suggestive that the circumstances of the immigration of *S. fonscolombii* to Ireland may be different to those of *Anax parthenope*. This may be related to the different life history of the two species, the different source area of the immigrants and differences in detection of the two species in Ireland.

Discussion

This review has presented evidence of continuing range change in several species of Irish odonates. The species concerned are all southern species of odonate and three of the species have only been present in Ireland for 15 years or less (Nelson *et al.,* 2003, Nelson & Thompson, 2004). These new species inevitably attract more attention as they are novel features in the fauna but,

Figure 6. Distribution of Red-veined Darter Sympetrum fonscolombii in Ireland.
., hectads with records up to 2003; •, hectads with records in 2004-2010.

 Table 4. The Red List of Irish odonates (Nelson et al., 2011). Only resident species were assessed;

 the other species included in Table 1 were not assessed.

Species	Assessment	Trend
Somatochlora arctica	Endangered	Stable
Cordulia aenea	Éndangered	Stable
	Vulgereble	Decrease
Coenagrion lunulatum	Vuinerable	Decrease
Ischnura pumilio	Vulnerable	Decrease
Lestes dryas	Near threatened	Decrease
Coenagrion pulchellum	Least Concern	Decrease
Coenagrion puella	Least Concern	Possible decrease
Calopteryx splendens	Least Concern	Stable
Lestes sponsa	Least Concern	Stable
Enallagma cyathigerum	Least Concern	Stable
Ischnura elegans	Least Concern	Stable
Pyrrhosoma nymphula	Least Concern	Stable
Aeshna grandis	Least Concern	Stable
Aeshna juncea	Least Concern	Stable
Aeshna mixta	Least Concern	Stable
Anax imperator	Least Concern	Stable
Brachytron pratense	Least Concern	Stable
Libellula quadrimaculata	Least Concern	Stable
Orthetrum cancellatum	Least Concern	Stable
Orthetrum coerulescens	Least Concern	Stable
Sympetrum danae	Least Concern	Stable
Sympetrum sanguineum	Least Concern	Stable
Sympetrum striolatum	Least Concern	Stable
Calopteryx virgo	Least Concern	Possible increase

whilst they are increasing and spreading, what is happening to our resident species? The most recent assessment of these species is the Irish Odonata Red List which was published in 2011 (Nelson *et al.*, 2011). The assessments for the 24 resident odonate species are provided in Table 4. Four species were assigned a threat status *Somatochlora arctica* – Endangered; *Cordulia aenea* – Endangered; *Coenagrion lunulatum* – Vulnerable; and *Ischnura pumilio* – Vulnerable. *Lestes dryas* was considered Near Threatened. The first three of the red listed species are central and northern European species and the

Irish populations are close to their southern limits. The future for these species in Ireland must be considered uncertain given the widespread evidence that climate change is affecting the odonate fauna of western Europe (Kalkman *et al.*, 2010). There is evidence from Germany that northern species and species of oligotrophic waters are losing ground in southern parts of their ranges (Ott, 2010). The list of the retreating species in Germany includes *Aeshna juncea* and *Lestes sponsa*, two of the commonest and most widespread Irish odonates (Nelson & Thompson, 2004). Also on the list was the Northern Damselfly *Coenagrion hastulatum* (Charpentier, 1825), a north Eurasian damselfly that is ecologically similar to *Coenagrion lunulatum* (Dijkstra & Lewington, 2006). Irish dragonflies therefore provide a signal of the changes occurring in our freshwaters in response to climate change and they provide useful species to include in monitoring programmes.

It appears that climate change is currently the main driver of change in the Irish odonate fauna, as it is in much of Europe (Goffart, 2010, Kalkman *et al.*, 2010). Species are also being impacted by negative trends within Ireland that are reducing the habitat quality of individual sites or groups of sites, in particular nutrient enrichment which is a widespread problem affecting Irish rivers and lakes (McGarrigle *et al.*, 2010). However, the range changes that are being documented in response to climate appear to be so rapid and significant that these local impacts become irrelevant. This will test the effectiveness of current conservation measures within Ireland.

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Maiden Flight Behaviour in the Hairy Dragonfly Brachytron pratense (Müller)

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Summary

An account is presented of observations of recently emerged Hairy Dragonfly *Brachytron pratense* taking maiden flights immediately on wing opening, followed by extended periods resting in trees with wings closed.

Introduction

Most species of anisopteran dragonflies take their maiden flight some time after ecdysis is complete, only when their wings have hardened sufficiently to provide the necessary lift and avoid damage. For example, Four-spotted Chaser Libellula quadrimaculata can remain with wings open for 30 min - 1 hour before taking their maiden flight (Tyrrell, pers. obs.), although this is strongly temperature dependent (Corbet, 1999). B. pratense is known to emerge during daylight hours at its peak time, while other large Anisoptera, such as Emperor Dragonfly Anax imperator and Southern Hawker Aeshna cyanea, emerge overnight and remain with wings open until the morning temperature rises sufficiently to allow flight. Anisoptera often take flight vertically to clear the emergent vegetation and provide a view of the surrounding habitat (Corbet, 1999), followed by flight towards areas of safety, such as trees, bushes or long grass for a period of rest. Immature adults of B. pratense begin their synchronised emergence at around 0800hrs in late April and early May (Tyrrell, 2006) and have often completed the process by midday. This makes observations of maiden flight easier than for other species.

Observations

During observations and recording of *B. pratense* emerging in Northamptonshire during the warm spring of the 2011 seasor_i, the following observation was

noted.

While filming an emerging *B. pratense* at Ditchford Lakes & Meadows Reserve, Northamptonshire during the warm April of the 2011 season, one author (GB) noted that, when the wings were fully inflated and at the point of wing opening, the adult took its maiden flight almost immediately with limited wing vibrations. It then flew into surrounding trees, which were searched using binoculars and the adult was readily located. It was then noted that it had rested with its wings in the closed state, where it remained for about 1 hour before taking its second flight.

The author who observed this (GB) communicated his observation to MT, who then observed similar behaviour at Yardley Chase SSSI, Northamptonshire during another synchronised emergence.

Analysis

In late April and early May, the peak emergence period for *B. pratense* (Tyrrell, 2011), the low levels of marginal plant growth and daylight emergence expose the vulnerable insect to predation from birds. A mechanism to provide protection to the teneral adult would therefore be advantageous for survival. While trees close to the emergence site are not a prerequisite for *B. pratense* (Tyrrell, 2011), dense vegetation of some kind is. This behaviour could therefore be a survival mechanism to accommodate the emergence characteristics of this species.

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INSTRUCTIONS TO AUTHORS

Authors are asked to study these instructions with care and to prepare their manuscripts accordingly, in order to avoid unnecessary delay in the editing of their manuscripts.

- Word processed manuscripts may be submitted in electronic form either on disk or by e-mail.
- Manuscripts should be one and a half spaced, on one side of the page only and with margins at least 25mm on both sides and top and bottom. Footnotes should be avoided.
- Use of these terms is acceptable: 'exuvia' for cast skin (plural: 'exuviae'); 'larva' (instead of 'naiad' or 'nymph'); 'prolarva' to designate the first larval instar.
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- Legends for figures, plates and tables should be presented together in sequence on separated, unnumbered pages.
- The legend for each table and illustration should allow its contents to be understood fully without reference to the text

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ZYGOPTERA Calopteryx splendens Calopteryx virgo Lestes barbarus Lestes drvas Lestes sponsa Lestes viridis Sympecma fusca Coenagrion armatum Coenagrion hastulatum Coenagrion lanulatum Coenagrion mercuriale Coenagrion puella Coenagrion pulchellum Coanagrion scitulum Erythromma najas Ervthromma viridulum Pyrrhosoma nymphula Enallagma cyathigerum Ischnura elegans Ischnura pumilio Ceriagrion tenellum Platycnemis pennipes

ANISOPTERA Aeshna affinis Aeshna caerulea Aeshna cyanea Aeshna grandis Aeshna isosceles

SCIENTIFIC AND ENGLISH NAMES OF BRITISH ODONATA

DAMSELEUES Banded Demoislle Beautiful Demoiselle Southern Emerald Damselfly Scarce Emerald Damselfly Emerald Damselfly Willow Emerald Damselfly Winter Damselfly Norfolk Damselfly Northern Damselfly Insh Damselfly Southern Damselfly Azure Damselfly Vanable Damselfly Dainty Damselfly Red-eyed Damselfly Smail Red-eyed Damselfly Large Red Damselfly Common Blue Damselfly Blue-tailed Damselfly Scarce Blue-tailed Damselfly Small Red Damselfly White-legged Damselfly

DRAGONFLIES Southern Migrant Hawker Azure Hawker Southern Hawker Brown Hawker Norfolk Hawker

Aeshna juncea Aeshna mixta Anax ephippiger Anax imperator Anax junius Anax parthenope Brachytron pratense Gomphus flavipes Gomphus vulgatissimus Cordulegaster boltonii Cordulla aenea Somatochlora arctica Somatochlora metallica Oxygastra curtisii Leucorrhinia dubia Leucorrhinia pectoralis Libellula depressa Libellula fulva Libellula quadrimaculata Orthetrum cancellatum Orthetrum coerulescens Crocothemis erythraea Sympetrum danae Sympetrum flaveolum Sympetrum fonscolombii Sympetrum pedemontanum Sympetrum sanguineum Sympterum striolatum* Sympetium vulgatum Pantala flavescens

Common Hawker Migrant Hawker Vagrant Emperor Emperor Dragonfly Green Damer Lesser Emperor Hairy Dragonfly Yellow-legged Clubtail Common Club-tail Golden-ringed Dragonfly Downy Emerald Northern Emerald Brilliant Emerald Orange-spotted Emerald White-faced Darter Large White-faced Darter Broad-bodied Chaser Scarce Chaser Four-spotted Chaser Black-tailed Skimmer Keeled Skimmer Scarlet Darter Black Darter Yellow-winged Darter Red-veined Darter Banded Darter Ruddy Darter Common Darter* Vagrant Darter Wandering Glider

* Includes dark specimens in the north-west formerly treated as a separate species, Sympetrum nigrescens Highland Darter.

Species list in accordance with Davies, D.A.L. & Tobin, P. (1984 & 1985) The Dragonflies of the World: A systematic list of the extant species of Odonata. Vols 1 & 2.

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