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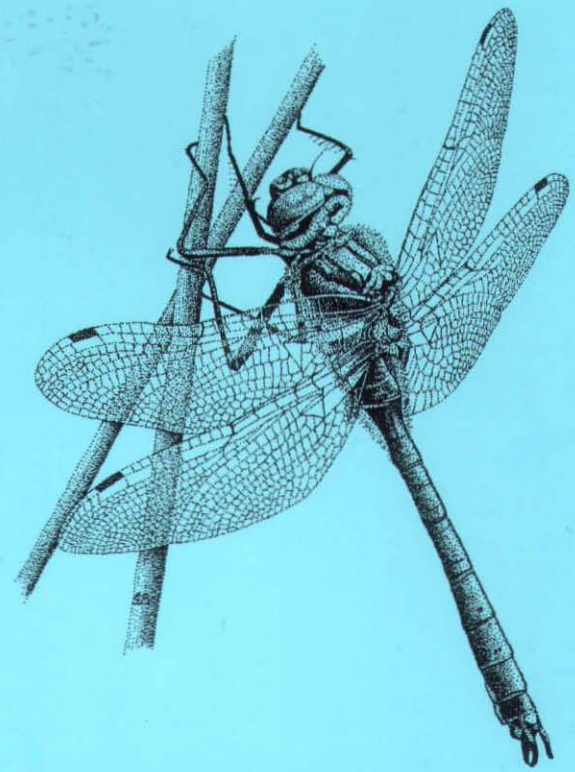

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Front cover illustration: Male Downy Emerald *Cordulia aenea* at Ashdown Forest, Dorset, 31 May 1991, by Gill Brook

Overwintering of larvae of the Common Darter *Sympetrum striolatum* (Charpentier) in the North of England

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On 10 December 2001, whilst dipping for aquatic microscopical fauna on a local nature reserve, what appeared to be very small mites were recovered. Microscopical examination showed the creatures to be *Sympetrum* larvae. The larvae could not be identified to species, as they were only 1.5mm in length. Both Common Darter *Sympetrum striolatum* (Charpentier) and Ruddy Darter *Sympetrum sanguineum* (Müller) are recorded from this site.

During 2001, both species had an extended flying season in this area, which may account for non-diapause eggs being laid so late in the year. The larval growth of overwintering *S. striolatum* has been recorded at a pond in the New Forest (P. S. Corbet, in Corbet *et al.*, 1985). However, at the same time of year these larvae were twice the size of the Yorkshire ones, i.e. 3mm in length. Research to discover whether such small larvae could withstand a Yorkshire winter was undertaken. I decided to measure the larvae approximately every two weeks. This entailed pond dipping, measuring the larvae at home and then returning them to the pond. On only two occasions did thick ice inhibit access to open water.

It was assumed that, as the larvae were only 1.5mm in length when first collected, they were in the second stadium, i.e. the first stadium after the prolarva. As expected, from 10 December 2001 to the end of February 2002, no growth took place. The rate of growth of the larvae until emergence of the adult insect matched that of the New Forest larvae, but was three to four weeks later in the year, this time difference being constant throughout the study. On 13 July 2002, no larvae were found and in fact *S. striolatum* was on the wing. Further visits have been made and exuviae collected. All were
S. striol
S. sanguineum.

Reference

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Four long term studies on dragonfly populations

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Introduction

Few long term studies on dragonfly populations have been published anywhere in the world. Six are referred to in Moore (1991). The most notable one in Britain was the 20-year study of the Large Red Damselfly *Pyrrhosoma nymphula (Sulzer)* and the Common Blue Damselfly *Enallagma cyathigerum* (Charpentier) larvae at Hodson's Tarn in the Lake District by Macan (1974). As so few long term studies have been published it seems worthwhile to summarize the four I have undertaken since 1949.

Long term studies can be carried out deliberately to measure changes in dragonfly populations due to seral development of their habitats or to measure the changing status of species over time. They can also be carried out incidentally, as when studies on behaviour have been done in the same place for several years running. The studies described below belong to both categories. They were made possible by the fact that I only had to move house twice during the last 54 years. In this paper I shall describe the four studies briefly and then draw some specific and general conclusions from them.

List of the long term studies

Each research site is listed, together with its time span, the nature of the research undertaken on it and the principal references to the research. At each site counts of adult male dragonflies were made on transects whenever weather etc. permitted. The records were supported by other, generally incidental, observations on exuviae and female and immature insects.

1. A small canalized river (the Portbury River) in the Gordano valley, Avon (previously Somerset), 1949–1952.
   General studies on the behaviour and ecology of dragonflies and development of the transect technique. In these studies quantitative observations were confined to Anisoptera.
   References: Moore (1953a, 1953b)
2. Water-filled bomb craters, Arne Heath, Dorset, 1954–1960. Studies on dragonfly behaviour, notably on highest steady density.
   Reference: Moore (1964)
3. Experimental ponds, Woodwalton Fen National Nature Reserve Cambridgeshire (previously Huntingdonshire). Intensive observations 1962–1988, less intensive 1989 onwards.
   Studies on changes in populations due to seral development and management of the ponds, and on territorial behaviour.
   References: Moore (1991, 1995, 2001)

4. Large pond in small private nature reserve, Swavesey, Cambridgeshire. 1984 onwards. Studies on population changes due to habitat development and on the origins of the fauna, on territorial behaviour, and on the behaviour of immature insects.
References: Moore (2000, 2001, 2002a,b)

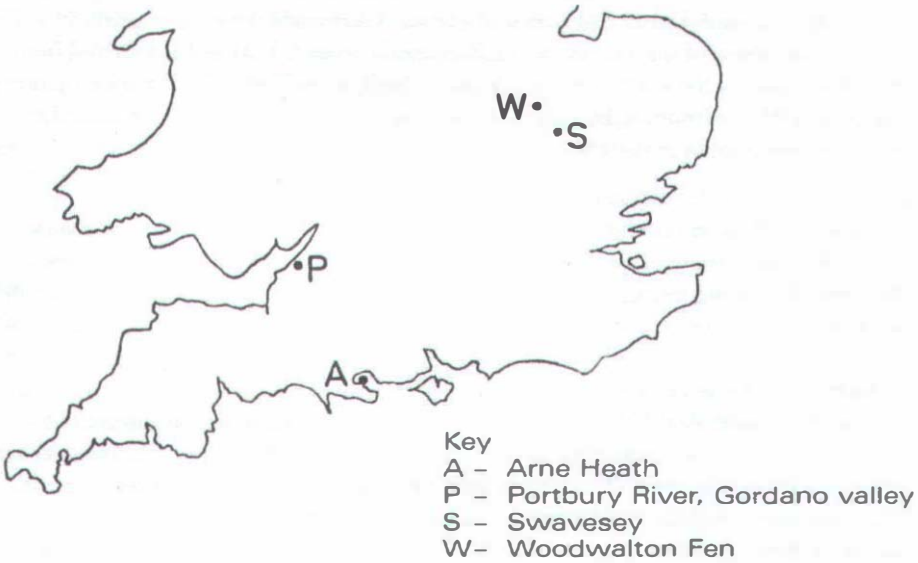

Figure 1. Geographical positions of the four long term study sites

Implications of each study for long term research

Each study area with the research undertaken on it is described. Observations carried out subsequently are recorded and the long term implications are noted.

1. Portbury River in the Gordano Valley, Avon

The meadows in the Gordano valley form a detached bit of the Somerset levels. Their watercourses, like those of the Somerset levels, support a rich dragonfly fauna. I recorded 17 species, of which 11 were proved to breed.

In 1949 very little quantitative work had been done on dragonfly populations or on territorial behaviour. My first task was to discover what dragonflies actually did in the day. My observations showed that males were most abundant by wate
that weather affected numbers. I realized that transects, on which mature male dragonflies were counted at about noon on fine days, could provide a useful population index. Thus, if transects were made on the same site each year comparisons could be made between years, and also comparisons could be made with transects carried out on other sites using the same method.

Transects of male Anisoptera were made by the Portbury River for the period 1949–1952. The results showed that, while the sequence of the appearance, peak numbers and disappearance of males remained approximately the same, the pattern did vary slightly from year to year. A base line for the site had been obtained. My records enabled me to record the effects of a rare event: the flooding of the whole valley at the peak of the Common Darter *Sympetrum striolatum* (Charpentier) season in 1950. No effects on the status of the species were subsequently observed. After I left Bristol in 1954, I returned to the site on several occasions. Sadly it was virtually destroyed by the dumping of fly-ash from the Portishead Power Station on the meadows adjoining the river. The only species remaining appeared to be *S. striolatum*.

In 1987 the Nature Conservancy Council declared the meadows upstream of my work site as an NNR. It still contains the species observed on my site, including the Hairy Dragonfly *Brachytron pratense (Müller)* and the Ruddy Darter *Sympetrum sanguineum* (Müller). Thus a big reduction in the area of the total site has not changed its dragonfly fauna so far.

2. Water-filled bomb craters, Arne Heath, Dorset

During the Second World War, Arne Heath was used as a decoy so that it would be bombed instead of the Admiralty's establishment the other side of Poole Harbour. Where the bombs fell on clay their craters filled with water and they became permanent pools. They supported 15 species including the Common Hawker *Aeshna juncea* (L.), the Keeled Skimmer *Orthetrum coerulescens* (Fabricius), the Black Darter *Sympetrum danae* (Sulzer) and the Small Red Damselfly *Ceriagrion tenellum* (Villers).

My work on the Portbury River had suggested that the maximal population density of different species varied greatly. From 1954 to 1960, I used the different sized bomb holes of the Arne Heath to determine more exactly the maximal population density of male dragonflies of the species present. I then tested the values obtained by experiments in which I added or subtracted individuals to known populations. As a result I obtained a value of Highest Steady Density for each species. These could be used in assessing the suitability of habitats for the different species elsewhere. In the course of making these studies on behaviour, I incidentally recorded the populations of the nine water-filled bomb craters for seven consecutive years and, as on the Portbury River, I thus made a base line for future studies. Fortunately I have been able to make some subsequent observations thanks to the R.S.P.B. who have owned and managed the site for many years. Management changes to this part of their Arne Reserve have been minimal, so the ponds have been able to develop naturally. One is now (in 2002) virtually surrounded by tall scrub and supports very few dragonflies. The other ponds have remained almost unchanged. All the 15 species of dragonfly present from 1953 to 1960 are still present, but there are indications that the Southern Hawker *Aeshna cyanea* (Müller) has increased at the expense of *A. juncea* (L.). The Migrant Hawker *Aeshna mixta* Latreille, which was

never recorded between 1953 and 1960, is now commonly observed. Thus at Arne we have evidence of the relative stability of the dragonfly fauna of small heathland ponds, as well as evidence of changes in the status of three aeshnid species.

3. Experimental ponds, Woodwalton Fen, Cambridgeshire

While working at Monks Wood Experimental Station I had 20 small round ponds dug at the Woodwalton National Nature Reserve, in a field which had been reclaimed for growing crops in the War. The ponds were dug to study the effects of aquatic herbicides on their flora and fauna. The circumference of each pond was about 16m. Nineteen species of dragonfly have been recorded on one or more of the ponds since they were dug in 1961.

I have used the ponds to study the development of their dragonfly populations for over 40 years and to carry out experimental work on dragonfly behaviour (Moore, 1995). After a brief pioneer stage, when there were no higher plants in the ponds, and only the Blue-tailed Damselfly *Ischnura elegans* (Vander Linden) and *S. striolatum* bred, the fauna developed rapidly. The ponds were protected from grazing by fences, and as a result scrub began to colonize the edges of nearly all the ponds. What happened next depended on pond management. Where scrub was not controlled, the ponds lost their dragonfly faunas in periods which varied from 26 to 39 years. By contrast, those whose scrub had been controlled have retained their dragonfly fauna almost unchanged. The Woodwalton Fen study, like those on the Portbury River and on Arne Heath, has shown the effects of rare events. the great floods of 1968, which flooded the land between the ponds, enabled at least one pond to be colonized by 10-spined Sticklebacks (*Pungitius pungitius* (L.)) but, like those in Portbury River, the floods had no appreciable effect of the ponds. On the other hand the exceptional drought of 1976 had huge immediate effects: 18 out of the 20 ponds dried out. Nevertheless *S. striolatum*, *S. sanguineum*, the Emerald Damselfly *Lestes sponsa* (Hansemann) and *I. elegans* all emerged from the ponds the following year. These species must have survived as eggs or larvae in moist mud at the bottom of the ponds. The Azure Damselfly *Coenagrion puella* (L.) emerged from some of the ponds two years later, and the Four-spotted Chaser *Libellula quadrimaculata* L. and *A. cyanea* emerged from some of the ponds three years later. The dependence of much of the dragonfly fauna of the Twenty Ponds on sources outside them was very clear.

The long term studies at Woodwalton Fen also showed up unexplained changes in the fauna, whose causes are not known and would be interesting to follow up. *P. nymphula* bred in the ponds from 1964 to 1972 but then disappeared. This species returned in 1992 and has bred there ever since. *L. sponsa*, which bred regularly since 1963, disappeared in 2000 but returned in 2001.

I hope to continue these observations for a little longer, but when I have to stop them, a useful base line on a national nature reserve will have been established for future work.

4. Pond in small private nature reserve, Swavesey, Cambridgeshire
This pond, dug in 1983, was designed specifically to support as many species of dragonfly as possible. It was dug in heavy clay, and is about 38m long and about 13m wide at its widest point. Nineteen species of dragonfly have been recorded, of which 13 breed regularly.

As at Woodwalton Fen, I have used the pond to record the development of a dragonfly fauna in a newly created habitat, and to study behaviour. Whereas only two species bred in the Woodwalton ponds in the first year, seven did so at Swavesey. This was probably because I planted aquatic plants in the Swavesey pond in its first year. *S. sanguineum*, which depends on well-established emergent plants, appeared at the pond in the season following its formation, but did not breed until eight years later. The records show that the dragonfly population of the pond is remarkably constant and that it consists of species that breed every year, for which the pond is self-supporting, and also species which breed irregularly or in very small numbers. These species must depend on periodic topping-up from neighbouring habitats. *E. cyathigerum*, an extremely abundant species in gravel pits about two miles away, is one of these. Unlike the Woodwalton ponds, the Swavesey pond has never dried up despite the long droughts in the 1990s. Like the Woodwalton ponds, a good base line has been established, which could be built upon, if future owners of the site allowed observations to be made there.

Conclusions

I shall go on recording dragonflies at the four sites as long as I can, but by the nature of things that will not be for very long! The observations at all four sites have already produced some useful conclusions and the Arne, Woodwalton and Swavesey sites now all have base line information which could be useful to those studying changes which take longer than one human lifetime.

It is not easy for individuals to carry out long term studies, at least before they retire. Such studies are time-taking and are inevitably interrupted by other commitments. For professional scientists, long term studies are unrewarding because they rarely result in startling new discoveries and, by their nature, produce few publications. On the other hand, conservation organizations, whose nature reserves have a long term future, should be ideally suited for such work. Generally they fail to do it. Even monitoring of the immediate effects of conservation management is often poorly done. The reason is lack of staff time, made worse nowadays by the stultifying effect of excessive bureaucracy, and by rapid turnover of staff. The lack of long term recording of the flora and fauna of nature reserves is a serious matter and urgently needs to be assessed and remedied.

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Migrant and dispersive dragonflies in Britain during 2002

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Summary

The year 2002 was a year of contrasting fortunes for migratory species. Some traditional migrants such as the Yellow-winged Darter *Sympetrum flaveolum* (L.) were absent and others occurred in only low numbers. On the positive side, there was yet another major immigration of the Red-veined Darter *S. fonscolombii*, with at least one Scarlet Darter *Crocothemis erythraea* also being seen. Possibly the highlight of the year was the discovery of yet another species new for mainland Britain, the Southern Emerald Damselfly *Lestes barbarus*, recorded from a site in Norfolk during late July/August. This species is perhaps a candidate to colonize southern England, much in the way that the Small Red-eyed Damselfly *Erythromma viridulum* now appears to be doing. On a more local scale, there was also evidence to suggest that during 2002 there was a greater than normal dispersal of some resident British species, particularly in south-west England.

Account of Species

Significant records reported to the BDS Migrant Dragonfly Project during 2002 are outlined below. Irish records have been referred to only where they complement the story from Britain. The internet site of Nelson *et al.* (2003) is recommended for a full account of events in Ireland. A report of events in Britain during 2001 was published by Parr (2002).

***Calopteryx virgo* (L.) – Beautiful Demoiselle**

During August, individuals were noted from unexpected localities near the coasts of south Cornwall and south Devon. Given that this species is not normally considered a long-distance migrant, this suggests greater than normal dispersal in the region during the period, perhaps as a response to local weather conditions.

***Calopteryx splendens* (Harris) – Banded Demoiselle**

As with its sister species, *C. virgo*, some unusual records were received from Cornwall during August, with individuals occurring up to 20km from the nearest known breeding sites (LT). One at Dungeness, Kent, on 10 September was the first record for this site. Another on the island of Skomer, off the Pembrokeshire coast, on 15 September was a new record for the Island (via JD/JH). Clearly there was significant late-season dispersal during 2002.

***Lestes barbarus* (Fabricius) – Southern Emerald Damselfly**

The first ever records for Britain were received during 2002 (Nobes, 2003):

30 July & 7 August: One male (photographed) on 30 July at Winterton NNR, Norfolk and two different males on 7 August at the same site (G. Nobes)

L. barbarus is a species that has been expanding its range in central and northern Europe over the last two decades (Ott, 2000), so new British records are not entirely surprising. During the first half of the twentieth century *L. barbarus* was recorded on occasions from the Channel Islands, though it then went unseen for many years. During 1995 the species however reappeared on Jersey, with 2 small colonies being established (Long & Long, 2000). In The Netherlands, several new populations were established in the coastal dunes following major immigrations in 1994 and 1995 and the species is currently doing well there (Dijkstra *et al.*, 1999; Ketelaar, 2001 and *pers. comm.*). The weather conditions during late July/early August 2002 suggest that the Dutch colonies are perhaps the source of the British individuals (Nobes, 2003). It will be interesting to see whether *L. barbarus* will begin to colonize Britain in the same way that *E. viridulum* has done.

***Ischnura pumilio* (Charpentier) – Scarce Blue-tailed Damselfly**

I. pumilio is well-known to have good powers of dispersal and there were a number of unexpected observations of this species during 2002. One individual at a quarry on the Isle of Portland, Dorset, on 23 June was only the second record for this site (KD). The first confirmed county record for Warwickshire occurred on 1 June (GC) and the first records for Somerset also occurred during June (via TW). Since major arrivals of *Sympetrum fonscolombii* were also noted in south-west and west-central England during June (see below), and the individual at Portland was actually seen in the company of *S. fonscolombii*, it is possible that some of the records of *I. pumilio* refer to immigrants rather than to local wanderers.

***Erythromma viridulum* (Charpentier) – Small Red-eyed Damselfly**

The year 2002 saw continued consolidation of this species as a British 'regular'. Rigorous proof of successful breeding in Britain was at last obtained when exuviae were discovered in Kent (JGB) and on the Isle of Wight (DDa). During the year there were reports from most areas in south-east England where the species had been seen in the past, including inland sites in Bedfordshire (Cham, 2003). In particular, records from Essex, the region of first colonization in 1999, have now become widespread. A series of new records from the coastal zone of Kent, including sightings from wet ditches in the Elmley area, and the first record for Sussex (at Icklesham, near Rye, on 10 August (IH) and on later dates) suggest that fresh immigration from the Continent may have taken place during the year, although this was clearly much less extensive than the immigration of 2001 (see Cham, 2002). Dispersal from existing colonies also appeared to take place, with several records being received during 2002 from regions adjacent to past foci of

colonization. *E. viridulum* has now been recorded from the Isle of Wight, East Sussex, Kent, Essex, East Suffolk, West Suffolk, East Norfolk, West Norfolk, Bedfordshire and Hertfordshire (Cham, 2003).

***Aeshna mixta* Latreille – Migrant Hawker**

There were indications of a substantial migration of this species in Europe during August. In Finland, the first ever records for the country occurred during August, with initial arrivals being noted on 7 August (S. Karjalainen, *pers. comm.*). In Britain, single fully mature individuals seen in previously uncolonized areas of Northumberland on 3 August and 17 August (HE) could well have been migrants, as could the 'thousands' noted in the Benacre and Waveney Valley areas of Suffolk in mid August, when up to 200 were counted along a single hedge (TA). An even more clear-cut movement took place on 29 August, when 4000 were reported from Hickling, Norfolk, and a further 1000 from Winterton (PHe). A substantial arrival was also noted at Gibraltar Point, Lincolnshire, on this day (TS). At New Romney, Kent, five individuals were caught in UV moth traps between 11 August and 1 September (SC). There appeared to be less movement later in the season, though in Ireland, where the species is a very recent colonist, the period mid September to early October was notable for a series of records from the southern counties, many of which coincided with conditions suitable for immigration (Nelson *et al.*, 2003). A single *A. mixta* was caught in a UV moth trap at Portsmouth, Hampshire, on the night of 21 October (IT).

Anax imperator Leach – Emperor Dragonfly

At Dodman Point, Cornwall, the dragonfly fauna is normally limited, but four *A. imperator* were observed on 24 August, during a day of visible butterfly migration (PHi). There were also a series of reports of late-flying individuals from Devon and Cornwall, with the latest record being from The Lizard on 17 October (MT). Historically the main flight period of *A. imperator* in Britain normally extends only as far as late August/early September. Any developing larvae that enter the final instar after June enter a diapause that inhibits late season emergence (Corbet, 1960). Such larvae then emerge synchronously during the following spring. The potential origin of individuals seen in October is thus unclear. One possible explanation is that they are immigrants, or the locally-bred progeny of immigrants, that may show a different pattern of seasonal regulation. A somewhat similar situation is already known in the case of Green Darner *Anax junius* Drury in southern Canada, where there is a resident population with a generation time of one year that emerges each June/July, and a faster-developing immigrant population able to produce offspring that emerge in September following oviposition in early summer (Trottier, 1971).

***Anax parthenope* Sélys – Lesser Emperor Dragonfly**

It was a relatively quiet year for this migrant species by recent standards, with only four records.

24 June	Male at Titchwell RSPB Reserve, Norfolk (T. Plowden & A. Rowlands)
15 July	Male at Stoke Gifford, Somerset (J. Aldridge)
16 July	Male at Netherfield, Nottinghamshire (R. Woodward)
13 August	Male at Dungeness RSPB Reserve, Kent (P. Akers *et al.*)

This is the lowest number of records for a year since 1997, though this perhaps simply reflects poor conditions for immigration in general during July and August, the time period when most *A. parthenope* are normally seen in Britain. It should also be remembered that prior to 1996 there were no substantiated records of this species from Britain.

[*Hemianax ephippiger* (Burmeister) – Vagrant Emperor Dragonfly]
No confirmed sightings of *H. ephippiger* were made in 2002. Single unidentified dragonflies seen on 28 January at Poole, Dorset, and on 29 January at Shipton Bellinger, Hampshire, (via DDe) may refer to this species, which is occasionally recorded in winter (Parr, 1998).

***Libellula quadrimaculata* L. – Four-spotted Chaser**
Small numbers were seen in unexpected localities in Northamptonshire and Gloucestershire on 15 July. Mid-July saw a significant influx of *A. parthenope* and *S. fonscolombii* into southern England and it is possible that some migration of *L. quadrimaculata* may have occurred at the same time, with most going unnoticed due to the simultaneous presence of larger numbers of resident individuals.

***Orthetrum coerulescens* (Fabricius) – Keeled Skimmer**
As with a number of other species (see above) there were some unusual records received from Cornwall during late summer. A single *O. coerulescens* was seen at the unexpected locality of Dodman Point on 24 August, during a day of obvious insect migration (PHi). Another was also observed near Pentewan on 17 September, away from known breeding sites (RL).

***Crocothemis erythraea* (Brullé) – Scarlet Darter**
The year 2002 saw the fifth British record of this spectacular species, the first having occurred only as recently as 1995:

19 June	Male at Upper Crockford, New Forest, Hampshire (K. Goodyear)

In addition an individual seen on 17 June together with *S. fonscolombii* at Winterton, Norfolk may possibly have been a male of this species. However, sub-optimal views were obtained and, although the simultaneous presence of *S. fonscolombii* would have served to reduce possible confusion with this species, no firm record was claimed. As yet no females have been observed in Britain, but the continuing appearance of the species must raise hopes that breeding will soon occur, as it has in some other areas of Northern Europe (e.g. The Netherlands, Luxemburg and Germany) in recent years (Ketelaar, 2001; Ott, 2000).

***Sympetrum striolatum* (Charpentier) – Common Darter**
There was little evidence of any major movements of this species during the year, though there appeared to be a small arrival on Dursey Island, County Cork, Ireland in late September (DS). This coincided with an obvious influx of migrant Lepidoptera to the island and with appearances of *A. mixta* in other parts of County Cork.

***Sympetrum fonscolombii* (Sélys) – Red-veined Darter**
The year 2002 was a very good one for the species, with records received from 50 sites in Britain covering some two dozen counties (Isles of Scilly, Cornwall, Devon, Dorset, Isle of Wight, Hampshire, Sussex, Kent, Somerset, Herefordshire, Gloucestershire, Wiltshire, Worcestershire, Hertfordshire, Essex, Suffolk, Norfolk, Lincolnshire, Leicestershire, Nottinghamshire, Lancashire, East Yorkshire, North Yorkshire, Glamorgan and Gwynedd). There were also several records from Ireland, principally in County Wexford, but also from County Dublin and County Down (Nelson *et al.*, 2003). *S. fonscolombii* now seems to be showing major influxes roughly every other year, previous invasion years being 1996, 1998 and 2000.

The first spring sighting on 17 May was of an immature on Bryher, Isles of Scilly (via KP). This could perhaps have been a locally-bred individual. The first few days of June then saw a substantial immigration of *S. fonscolombii*, concentrated in south-west England. The largest numbers recorded were in Worcestershire, with records from a number of sites including a count of 50 from near Pirton on 8 June (SW). Few further records were received by mid June, but the second half of the month saw further immigration, with perhaps two separate waves of arrivals. Yet another wave of immigration then took place in mid July.

Mating and oviposition were observed widely during the early summer immigrations and, by 31 August, locally-bred individuals were starting to appear. Over the next few weeks, tenerals and immatures were observed from single sites in Cornwall, Wiltshire, Worcestershire, Hampshire and Norfolk (the Brecks). Numbers were however low. It seems probable that weather conditions had not been conducive to rapid larval development and many individuals, both at these sites and elsewhere, probably over-wintered as larvae.

In contrast to the extensive spring and early summer migrations, there was little sign of major movement during the autumn. Solitary individuals were at Birling Gap, East Sussex, on 15 September and at Dungeness, Kent, on 24 September, while single immatures were observed at Rame Head, Cornwall, on 28 September and at Start Point, Devon, on 1 October. Individuals were also observed in County Wexford, Ireland, in late August and on 28 September. These low numbers may well reflect the small size of the autumn generation in Britain, and perhaps elsewhere in Europe.

***Sympetrum danae* (Sulzer) – Black Darter**
There was a very early record of a fully mature male from Poole, Dorset, on 2 June (AS)

and as this was a time of major insect migration, this individual could perhaps have been an immigrant. Single individuals seen at Hertford Heath, Hertfordshire between 28 July and 4 August (AR); at Spurn Point, East Yorkshire, on 13 August (BS); and at Coalville, Leicestershire on 8 September (IM) were away from expected localities. These records indicate considerable movement of *S. danae* during the year. The Spurn individual coincided with a period of immigration into eastern England, but the other records probably refer to wanders from the British population.

Conclusions

In overall terms the year 2002 was one of contrast. Some traditional migrants occurred in low numbers. *Sympetrum flaveolum*, for instance, after having been seen annually during the mid to late 1990s was not recorded at all during the year (now for the second season in a row). *Anax parthenope* also had its poorest year since 1997, though four individuals of this recent addition to the British list were observed. In contrast to the fortunes of these species, others did well. There was a major invasion of *S. fonscolombii* (the fourth in seven years) and a further British record of *Crocothemis erythraea*. The new colonist damselfly *Erythromma viridulum* continued to do well, and the first British records of *Lestes barbarus* were forthcoming. Clearly the range expansions that have characterized several of the European dragonflies and damselflies in recent years are continuing apace. It will be interesting to monitor further appearances of *L. barbarus* since this would appear to be another potential colonist. The likelihood of finding further new species for Britain also seems to be increasing; perhaps other lestids such as the Willow Emerald Damselfly *Chalcolestes viridis* (Vander Linden) or the Common Winter Damselfly *Sympecma fusca* (Vander Linden) are candidates.

In addition to immigration into Britain, the year was also characterized by internal dispersive movements of some species (and indeed the two phenomena seemed to merge in a few instances). Such internal movements are already well know in many cases, but seemed particularly well-represented during 2002. This may perhaps reflect a reaction to particular weather conditions operating throughout the year, though it may just be that such movements are now being detected more efficiently due to the increased numbers of enthusiasts out in the field. Whatever the reasons, these local movements have considerable potential conservation significance and deserve to be thoroughly documented.

Acknowledgements

Thanks go to all the people who submitted records during the year. The following have been identified in the text by their initials: T. Abrehart (TA); J. & G. Brook (JGB); S. Clancy (SC); G. Clarke (GC); D. Dana (DDa); D. Dell (DDe); J. Darke (JD); K. Dolbear (KD); H. Eales (HE); J. Hayden (JH); P. Heath (PHe); P. Hill (PHi); I. Hunter (IH); R. Lane (RL); I. Merrill (IM); K. Pellow (KP); A. Reynolds (AR);

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Factors influencing the distribution of the White-legged Damselfly *Platycnemis pennipes* (Pallas) in Great Britain

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Introduction

The White-legged Damselfly *Platycnemis pennipes* (Pallas) is common and widespread throughout much of central and eastern Europe (Askew, 1988). In Britain it occurs south of the Wash (latitude 53°N), and its distribution is associated with linear habitats, i.e. the larger rivers and their tributaries (Merritt *et al.*, 1996). It is absent from Ireland. It occurs in 6.4 per cent of the 10km squares from which Odonata records are available (Merritt *et al.*, 1996). As such *P. pennipes* fits the criteria for a 'key species' in the Dragonfly Recording Network, defined as presence in 10 per cent or fewer of recorded squares (BDS, unpublished). This paper examines some of the factors influencing the distribution of *P. pennipes* with reference to its often-quoted susceptibility to pollution (e.g. Gibbons, 1986; Hammond, 1983; McGeeney, 1986).

Methods

Between 1986 and the present day, regular recording of dragonflies was undertaken in Bedfordshire by the author. The presence or absence of *P. pennipes* on the county's rivers was recorded with particular note taken of associations with the type and 'architecture' of emergent and bankside vegetation. Population assessments were made according to the estimated numbers detailed on the RA70 recording card (Merritt *et al.*, 1996) and proof of breeding was sought by searching for exuviae, larvae and emergent adults. In addition to fieldwork, historical records for Bedfordshire were used to assess changes or trends in populations and their distribution (Figure 1).

Coincidence with other species was examined, especially the Banded Demoiselle *Calopteryx splendens* (Harris), to investigate factors affecting riverine species (Figures 2 & 3). Water quality data for Bedfordshire was downloaded from the Environment Agency website as a text file and sorted in an Excel spreadsheet according to class (Table 1). This takes into account the various properties of river water such as biochemical oxygen demand, levels of dissolved oxygen, the concentration of chemicals such as ammonia, and its suitability for fish. Damselfly distribution patterns were compared with the river quality data.

To place Bedfordshire records into a national context, numerous visits were made to

running and stillwater sites across southern England in search of *P. pennipes*. A number of recorders were contacted and county surveys and atlases were consulted in order to make comparison to the situation in Bedfordshire.

Table 1. Classification of River Quality (Source: Environment Agency Website 2002, NRA 1993)

Description	Class	Potential Use
Very Good Quality	A	Water of high quality suitable for all abstractions Very good salmonid fisheries, Cyprinid fisheries Natural ecosystems
Good quality	B	Water of less high quality than Class A but usable for all abstractions. Salmonid fisheries, Cyprinid fisheries Ecosystems at or close to natural
Fairly good Quality	C	Potable supply after advanced treatment. Other abstractions Good cyprinid fisheries Natural ecosystems, or those corresponding to good cyprinid fisheries
Fair Quality	D	Potable supply after advanced treatment. Other abstractions Fair cyprinid fisheries Impacted ecosystems
Poor Quality	E	Low grade abstraction for industry. Fish absent or sporadically present, vulnerable to pollution. Impoverished ecosystems
Bad quality	F	Very polluted rivers which may cause nuisance. Severely restricted ecosystems

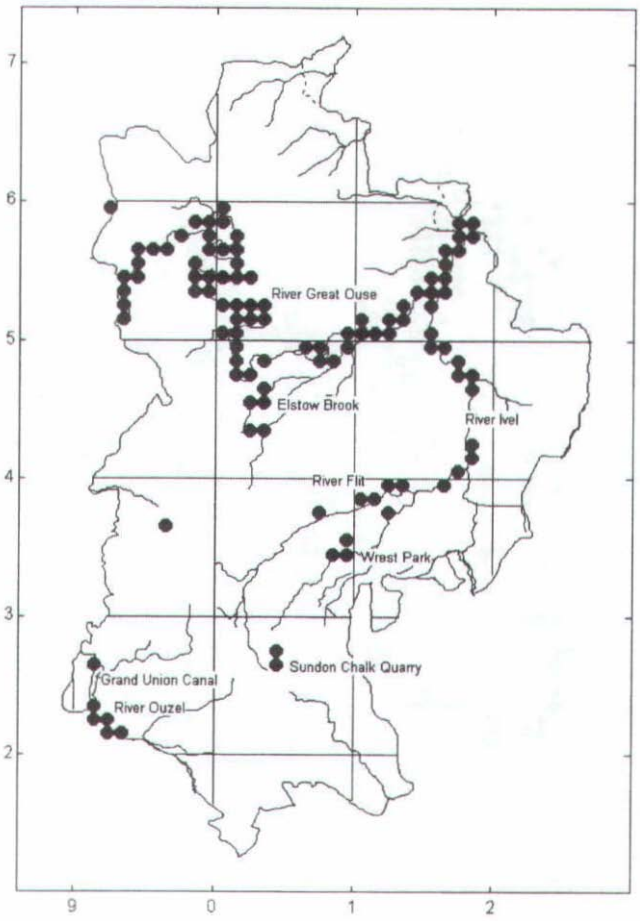
Results

Regular recording in Bedfordshire showed *P. pennipes* to be present on suitable stretches of the Rivers Great Ouse, Ouzel, Ivel, Campton Brook, Elstow Brook and River Flit as well as the Grand Union Canal (Map 1). It was found to be absent from the River Lea and other smaller streams in the county. *C. splendens* was found to occur on all of the rivers and many of the small streams (Map 2). Wherever *P. pennipes* was recorded *C. splendens* was always present, except for a short stretch of the River Ouzel (Map 3). Along the River Great Ouse, which is the major river in Bedfordshire, and the River Ivel, the presence of *P. pennipes* was found to be patchy. It was present along some stretches and absent from others. Lush bankside vegetation is favoured, especially Reed Sweet-grass (*Glyceria maxima*). *P. pennipes* was either absent from stretches with some types of vegetation, such as Club-rushes (*Schoenoplectus*) and Bur-reeds (*Sparganium*), or in very low numbers, and proof of breeding was not confirmed. It was also found to avoid areas of bankside shading; a 'pattern' found elsewhere.

P. pennipes occurs along stretches of the River Ivel. This river flows through intensively cultivated agricultural land, which is amongst the richest in Bedfordshire. Much of the river was canalized during the 1960s and, as bankside vegetation recovered, Common Nettles (*Urtica dioica*) predominated. These stretches appear unattractive to *P. pennipes*

and also support relatively low numbers of other species such as *C. splendens*. Past records show that it was during the early 1990s that *P. pennipes* started to colonize the river. The first record was at South Mills in 1992. Over subsequent years it colonized the river moving along River Flit to the Chicksands Base by 1996. There are no records for these areas before these dates despite regular visits that recorded *C. splendens*. The current distribution along these two rivers is very disjointed with extensive lengths of river unoccupied. Such patterns are attributed to changes in bankside vegetation.

In recent years *P. pennipes* has started to colonize smaller streams such as the Elstow Brook, which is a small tributary of the River Great Ouse. Its range now extends some 5km as far as Kempston Hardwick Brickworks. This stream is utilized as a drainage

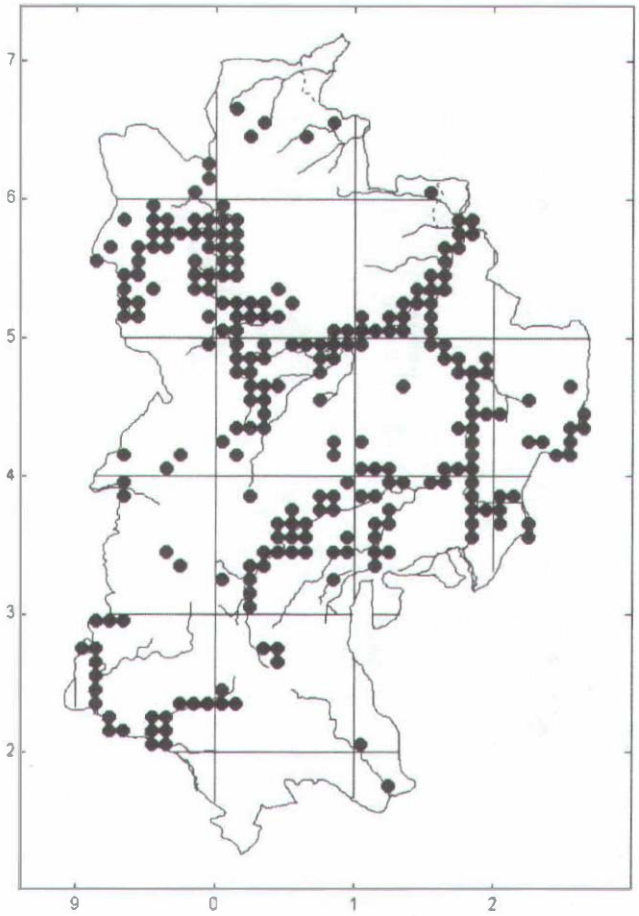


Map 1. The distribution of the White-legged Damselfly *Platycnemis pennipes* in Bedfordshire

ditch and has been subjected to varied agricultural activities and bank clearance. The water quality is somewhat suspect although the banks now support dense vegetation.

Along the River Ouzel it was a common species in the 1940s. It then appeared to decline to the point where it could no longer be found. Despite searching, no records were obtained from the area again until 1990 when small numbers of *P. pennipes* were discovered between Slapton and Grove.

Similar observations have been made by the author on the River Stour in Suffolk where *Glyceria maxima* predominates along the stretches of river where *P. pennipes* occurs. Similarly, extensive areas of nettles and disturbed banks are avoided.



Map 2. The distribution of the Banded Demoiselle *Calopteryx splendens* in Bedfordshire

Wherever it occurs it is reported as being highly localized, e.g. in Powys (Peers, 1985) and Essex (Benton, 1988), or having a patchy or disjunct distribution, e.g. in Essex (Brooks, 1993), Oxon (Brownett, 1996; Campbell, 1988), Dorset (Prendergast, 1988), Kent (Wilson, pers. comm.) and the Montgomery Canal (Wistow, 1989). Lush fringing and bankside vegetation appear important (Peers, 1985; Lockton *et al.*, 1996). Prendergast (1988) found that it was absent from stretches of the River Wey where there was very little submerged vegetation or where emergent and shading indices were highest. As well as lush bankside vegetation, the surrounding hinterland may have an important role. 'In abundance in areas of long dense grasses and herbage' (Brook & Brook, 2001) and 'woods and cornfields adjacent to rivers can appear full of these damselflies' (Averill, 1996).

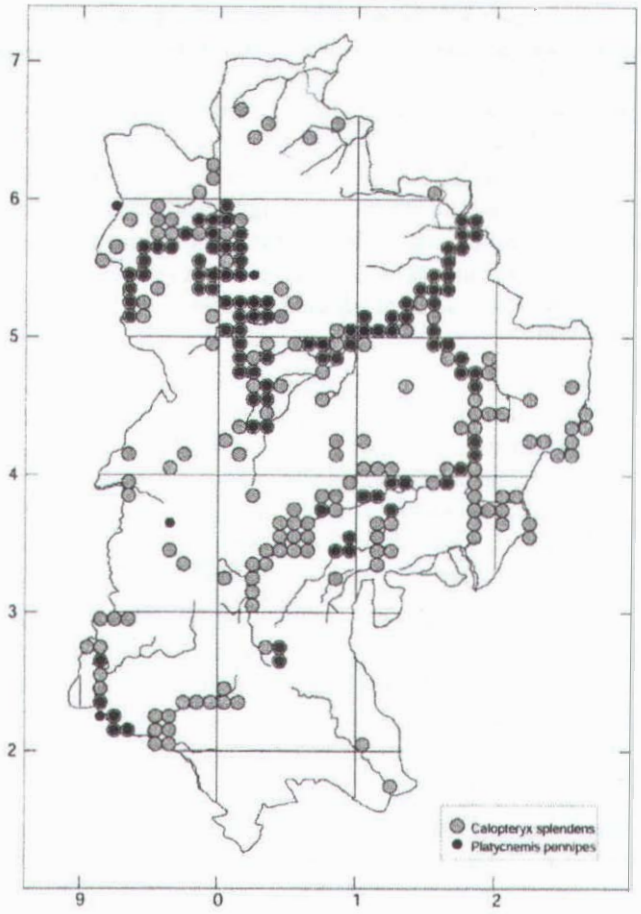
Heavy boat traffic along the River Great Ouse in Bedfordshire and Huntingdonshire creates turbidity in the water yet does not have a negative effect on the species. In Warwickshire, a similar situation is found 'Tolerant of high traffic density and water turbidity it can on occasion be prolific on stretches of canal' (Reeve, 2002). The river quality data for Bedfordshire revealed that whilst there had been some improvement in water quality over the period of recording, all stretches of river where *P. pennipes* or *C. splendens* occurred were classified as either B or C (see Table 1).

In some areas it has disappeared from sites where it was previously common. In the New Forest it was common until the 1940s. Today it is restricted to a short stretch of the Ober Water (Fraser, 1950; Welstead & Welstead, 1984; Cham, pers. obs.). Winsland (1994) suggests that its decline parallels that of the Club-tailed Dragonfly *Gomphus vulgatissimus* (L.) in the New Forest and is due to stream channeling and the consistent removal of emergent vegetation.

Nationally, *P. pennipes* has a strong association with linear habitats, namely rivers, streams and canals (Merritt *et al.*, 1996), although there are a few records of confirmed breeding at still water sites in Great Britain. These include Surrey (Follett, 1996), Kent (Brook & Brook, 2001), Surrey and Sussex (Cham, pers. obs.), Surrey and Hants (D. & J. Dell, pers. comm.) and Suffolk (I. Johnson, pers. comm.). At Felmersham N.R. in Bedfordshire, a site well studied by the author, numerous tandem pairs have been observed ovipositing in some years but neither exuviae nor emergence have ever been observed. This suggests the failure of eggs or larvae to develop. More recently *P. pennipes* was discovered at Sundon Chalk Quarry where tandem pairs were observed ovipositing into floating vegetation around the main lake. Proof of breeding at this site has now been confirmed following the discovery of exuviae in 2003. Similarly, it has also been found breeding at Wrest Park, Bedfordshire at a series of ornamental lakes with lush bankside vegetation.

Discussion

D. W. Snow considered it 'the commonest damselfly on the Ouse' in Bedfordshire



Map 3. Coincidence of the distributions of *Platycnemis pennipes* and *Calopteryx splendens* in Bedfordshire

during the 1940s and it was also common on the Ouzel near Leighton Buzzard. Canalization of the River Great Ouse downstream of Bedford in the 1970s appears to have dramatically affected populations. For some years it was virtually absent (Dawson, 1988). During the summer of 1983, J. Rowe (pers. comm.) carried out survey work along the Rivers Ouse, Ouzel and Ivel. The only records for *P. pennipes* were from two tetrads at Willington and Great Barford. Rowe reports that the River Ouzel had been affected by management work during this period. Interestingly the Red-eyed Damselfly *Erythromma najas* (Hansemann) was also absent in all tetrads during the survey period. Both species have now recovered and occupy all tetrads through which the river flows.

On occasions *P. pennipes* is recorded from bankside vegetation that is considered to be

sub-optimal. Such observations are usually at the peak of the flight season when high population densities have forced individuals to disperse along these stretches. *P. pennipes* is not found in these sub optimal areas until well into the season.

P. pennipes is currently being recorded from new sites and in increasing numbers, e.g. Northamptonshire (R. Eden, pers. comm.) and Warwickshire (P. Reeve, pers. comm.). Pumping of large volumes of water by water companies may explain the sudden appearance of the species at previously unrecorded sites (Mendel, 1992 and pers. comm.).

In the Kent and Sussex Weald, *P. pennipes* breeds at stillwater sites. At some of these sites they lay eggs into the leaves of Rushes (*Juncus*) and other plants that are bent over and lying on the surface of the water. This area is especially interesting as many of the stillwater sites also support breeding populations of the Brilliant Emerald *Somatochlora metallica* (Vander Linden).

A review of literature showed that *P. pennipes* is often quoted to be more susceptible to pollution than others species (Hammond, 1983; McGeeney, 1986; Gibbons, 1986), yet there is an absence of published information to support this view. Only in a few local cases have other species remained whilst *P. pennipes* disappeared (N. Moore, pers. comm.).

More recently a number of authors have either expressed surprise at the quoted susceptibility to pollution, or have provided records to the contrary. These include 'there is no apparent effect either from water traffic nor from enrichment immediately downstream of sewage works outlet' (Prendergast, 1988); 'pollution . . . cannot be the sole reason why in Dorset it is almost confined to the River Stour and some of its tributaries . . . despite the existence of purer waters elsewhere' (Prendergast, 1991); 'occurs on rivers which are not regarded as particularly clean and is absent from rivers which appear to offer suitable conditions' (Randolph, 1992); 'it has been recorded along canals which typically possess unclean water. It seems more likely that (*it*) is just fussy about the habitat where it breeds' (Grover & Ikin, 1994); and 'can be found on rivers that are not of the highest quality' (Averill, 1996).

On the River Roding in Essex, Raven (1987) found that the numbers of adults of all 11 species (including *P. pennipes*) had recovered the year following organophosphate insecticide pollution, which wiped out all odonate larvae along the affected stretch. K. Wilson (pers. comm.) regarded *P. pennipes* to be fairly tolerant of ammonia pollution, based on observations on the Eden Brook in West Kent. Wilson also observed that populations remained unaffected following various pollution incidents that led to large kills of fish in the Rivers Medway and Grom. Elsewhere in Europe it has been recorded from streams and ditches downstream of raw sewage outflows, e.g. in Greece and southern France (H. Mendel, pers. comm.) and Corfu (Cham, pers. obs.).

The evaluation of river quality data for Bedfordshire did not provide an explanation for differences in the distribution of *P. pennipes* and *C. splendens*. From the discussion above there is little evidence to support the view that this species is more susceptible to pollution than other species. It would appear to be more influenced by the habitat and nature of the vegetation. Populations in Britain have recovered over the last decade and when suitable conditions exist it is quick to colonize from nearby colonies and can sometimes be the most abundant species of Odonata.

Acknowledgements

I am especially grateful to Keith Wilson for summarizing his observations regarding water quality and *P. pennipes* whilst working as the Southern Water Authority Fisheries and Conservation Officer in the Kent and east Sussex area of south-east England. Andy McGeeney, Peter Miller, Brian Milne and Norman Moore have provided useful information and shared thoughts and observations on factors affecting *P. pennipes*. The distribution maps were plotted from data in BioBase for dragonflies (DARTER) software using Alan Morton's DMAP software.

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Management of small dug ponds for Odonata conservation and colonization in an area of valley mire and wet heathland (Bourne Valley, Dorset)

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Summary

Since 1996, and possibly earlier, around 30 small ponds have been dug for nature conservation purposes at a variety of locations within a six hectare area of valley mire and wet heath within the Bourne Valley Local Nature Reserve, Dorset. The site is nationally important for its dragonfly community, supporting 65 per cent of British species of Odonata, and is also noted for its other heathland flora and fauna, including all six British reptile species. To investigate the pattern of colonization over time by Odonata and other aquatic fauna, six ponds were sampled with all Odonata, Trichoptera, Coleoptera and newts (*Triturus*) identified and recorded. Odonata were more abundant and diverse in ponds six or more years old. Coleoptera also increased with age of pond, while Trichoptera decreased. Overall abundance and diversity of aquatic fauna were closely related with the greatest increases within the first three years after pond creation. After this, there was less increase in overall abundance and diversity and changes in community structure were seen. Therefore, to maximize the biodiversity of Odonata and other aquatic invertebrates, a full spectrum of pond ages is required. As some fill and dry, others are newly dug and there is a continual rotating succession of pond habitats. As well as increasing structural diversity within the pond system, more specific aims of heathland pond management are presented which may promote colonization by diverse Odonata populations.

Site description

The site is located at O.S. Grid Reference SZ 061936 within the Bourne Valley Local Nature Reserve, which lies at the eastern edge of the Borough of Poole close to the Borough boundary with Bournemouth (Figure 1). It can be separated into two main areas, namely 'Bourne Bottom' and 'Talbot Heath', with Alder Road as the dividing line. The area is approximately 80 hectares. In 1985 much of the valley was designated as a Site of Special Scientific Interest (SSSI) and was re-notified in March 1995 to include additional areas. The majority of the site is included in the 'Dorset Heathlands' Special Protection Area (SPA) declared by the UK Government in October 1998. This

recognizes the site as internationally important for birds. Except for areas that are not associated with the main part of the valley, the site is also included in the 'Dorset Heathlands' RAMSAR site declared by the UK Government in October 1998 and an internationally important wetland. The majority of the site is included in the Candidate 'Dorset Heathlands' Special Area of Conservation (SAC) and recognized for its internationally important heathland habitats and associated flora and fauna. Note that, although 'Candidate' SAC status indicates that designation is not finalized, Government instructions are to treat it as such and thus there is no practical difference between this and full SAC status.

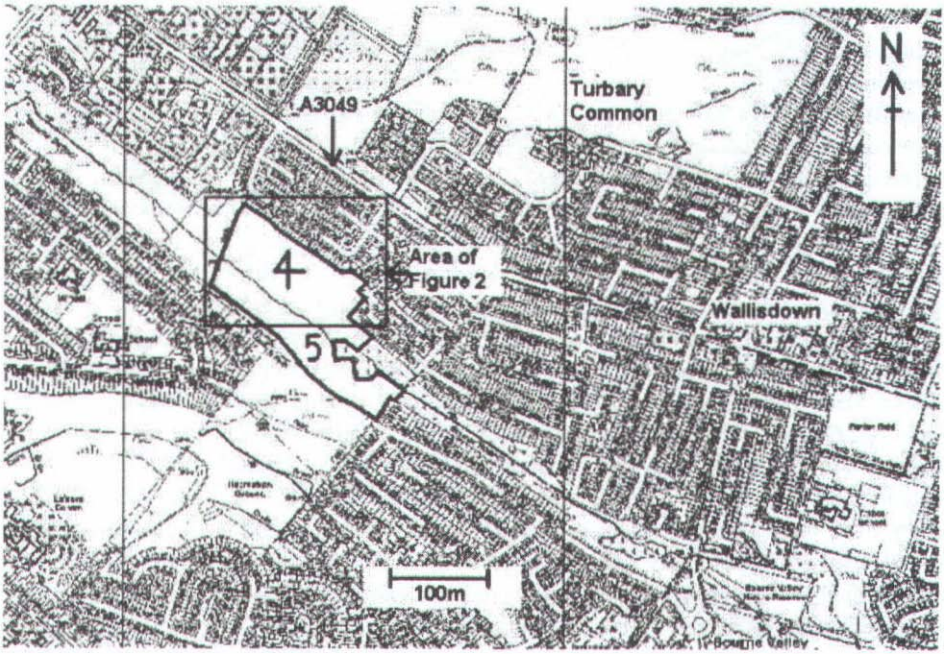

Figure 1. Location of study site in Poole, Dorset showing compartments 4 and 5

Geology, Topography and Hydrology

Bourne Valley is a shallow valley running south-east from Canford Heath, with the Bourne stream running through it. The site is at low altitude, lying between 25 and 50 metres above sea level with the lower section in the south. The underlying geology consists of marine beds called the Poole Formation (formally Bagshot Beds) which are largely sands with seams of pebbles and beds of clay. On the higher areas these are overlain by plateau gravels. The sands of the dry heath are free draining, while the valley bottom remains wet all year around. The stream enters the site at the Ringwood Road through three culverts. The water is believed to originate from a variety of sources: from

road run off, from the Bournemouth and West Hampshire Water works at Francis Avenue and water coming from Canford Heath. The hydrology is further complicated by various culverts and drains joining the stream at several points and wet heathland flushes. Recent work in partnership with the Environment Agency and Wessex Water has improved the understanding of the effect on site, although the complex hydrology warrants further investigation.

Ecology

Bourne Valley is predominantly a heathland site, having nutrient poor acidic soils. It does however support a variety of habitat types, namely dry acid dwarf shrub heath, wet heath, valley mire, flush, bog pools, ponds, running water, willow carr, secondary oak/birch woodland, acidic grassland, pasture grassland and amenity grassland. The site is of international importance for its heathland communities with the wet heath and valley mire communities being of particular importance. The dry heath is dominated by Heather (*Calluna vulgaris*) with Western Gorse (*Ulex gallii*) and associated plants. The site supports a large number of invertebrate species including Red Data Book and notable species. It is nationally important for its populations of dragonfly species including Small Red Damselfly *Ceriagrion tenellum* (Villers) and Keeled Skimmer *Orthetrum coerulescens* (Fabricius). The survey by Brooks (1989) reported that 25 species of Odonata had been recorded in recent years, including several locally or nationally rare species. This constitutes some 65 per cent of the British dragonfly fauna, and the survey itself positively recorded 19 species, 14 of which were breeding, plus unconfirmed sightings of Migrant Hawker *Aeshna mixta* Latreille. Further individual records expand the total number of Odonata species to 27 (see Appendix 1), of which approximately 20 may be seen in any given year (Hubble & Demopolous, 2002). The heath is also particularly important for reptiles with all six British species present including permanent populations of the rare Sand Lizard (*Lacerta agilis*) and Smooth Snake (*Coronella austriaca*). The site supports a wide variety of birds including over-wintering species and the rare Dartford Warbler (*Sylvia undata*) as a breeding species.

Survey area

The ponds surveyed in this study are located in nature reserve Compartments 4 and 5, comprising an area of approximately six hectares of valley mire and wet heath with blocks of willow near the Bourne stream which runs centrally through the site (Figure 2). With reference to National Vegetation Classification (NVC) communities (Rodwell, 1998), the habitat is a mixture of M21 Bog Asphodel (*Narthecium ossifragum*) - *Sphagnum papillosum* mire in the wetter species-rich areas, M25 Purple Moor-Grass (Molinia *caerulea*) – Tormentil (*Potentilla erecta*) mire in the wetter species-poor areas and M16 Cross-leaved heath (*Erica tetralix*) – *Sphagnum compactum* wet heath towards the edges of the mire leading up into H8 *Calluna vulgaris* – *Ulex gallii* heath on the dry heath.

The ponds are small (up to approximately 10m^2) and shallow (1 metre or less in depth)

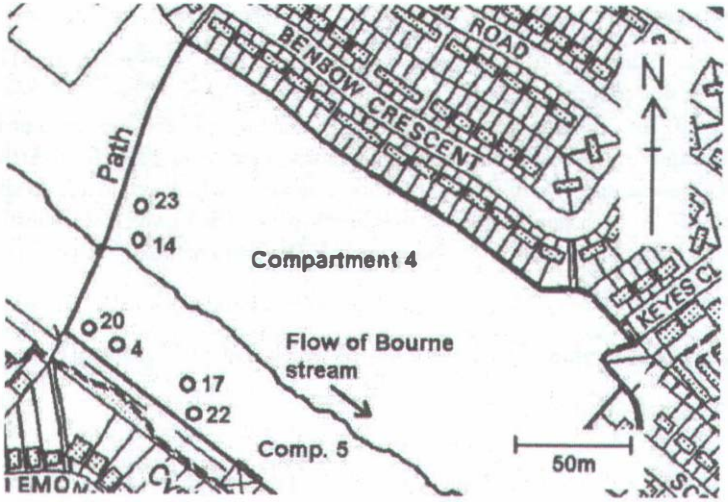

Figure 2. Location of numbered ponds within the Bourne valley study site

and were dug in a single day by volunteers using hand tools, with material being removed from the main area of the heath and deposited at the edge of the heath, either in degraded areas of Bramble (*Rubus fruticosus*) and Bracken (*Pteridium aquilinum*) or beneath tree cover. There are over 30 ponds on the site, although some have become too densely vegetated to sample effectively or are of unknown age. Those sampled were chosen to give a useful range of ages amongst those ponds which could be practically sampled and these six are as follows;

Pond 14 – spring 1996. *Sphagnum*, Pondweed (*Potamogeton*) and reeds.
Pond 17 – spring 1996. Much graminaceous vegetation and *Sphagnum*.
Pond 20 – spring 1998. Some floating algal mat cover, a little submerged vegetation.
Pond 22 – spring 2002. This pond was dug only two weeks before the survey date and is taken as a control near the start point of colonization, being devoid of vegetation.
Pond 23 – spring 1999. Floating algal mat and emergent reeds with a little *Sphagnum*.
Pond 4 was also sampled and existed on the site prior to 1994 although, unlike the other sampled ponds, it is not known to have been dug specifically for conservation purposes. It contains *Sphagnum* beds and emergent reeds, and is situated in what is now an area of species rich M21 habitat. All ponds were dug in areas that were species poor and characterized by either being strongly dominated by thick clumps of *Molinia caerulea* as an M25 community, or where recent tree and scrub clearance had taken place with a subsequent transition towards an M25 community. More species rich areas of M21 community were always present nearby, within approximately 20 metres.

Sampling method

Sampling was undertaken using a 30cm diameter net with a 2mm mesh size. For each pond, the net was dragged through the water and along the pond bed 10 times at different points for 30 seconds at each point. Organisms collected were retained for the duration of sampling to prevent recapture and subsequent over-recording. Arthropods and newts (*Triturus* spp.) were retained for identification, which was made to species level where possible. At each pond, pH was measured twice with a universal indicator testing kit. Where statistical correlation has been used, a Pearson coefficient (Cp) is presented.

Results

All ponds had a pH value of 6 except Pond 14 which had a pH value of 5.

Table 1. Odonata sampled at each pond

Species	Pond number (age in years)				
	22 (0)	23 (3)	20 (4)	14/17 (6)	4 (8+)
Pyrrhosoma nymphula (Sulzer)		1	3	5.5	2
Coenagrion puella (L.)			1		1
Enallagma cyathigerum (Charpentier)		1			
Ischnura elegans (Vander Linden)				0.5	1
Ceriagrion tenellum (Villers)		6		6	8
Aeshna cyanea (Müller)				0.5	
Aeshna juncea (L.)				1.5	
Brachytron pratense (Müller)				0.5	
Libellula depressa L.			1	0.5	
Orthetrum coerulescens (Fabricius)			2	4	1
Sympetrum striolatum (Charpentier)		1		0.5	

Ponds 14 and 17 are included together as they are of the same age.
Numbers in bold type are the most abundant for each taxon where such a distinction can be made and include those found at only one site. The same pattern is seen if these single-site taxa are omitted.

Table 2. Total numbers of Odonata and other taxa sampled

Totals sampled	Pond age (years)				
	0	3	4	6	8+
Individual Odonata	0	9	7	19.5	13
Individual Coleoptera	7	10	3	12	28
Individual Trichoptera	0	17	15	8	2
Individual *Triturus*	2	2	4	3	1
Taxa within the Odonata	0	4	4	6.5	5
Taxa within the Coleoptera	4	4	3	5.5	9
Taxa within the Trichoptera	0	5	5	4	1
Overall number of taxa	9	17	17	19.5	18
Overall number of individuals	14	42	38	50.5	53

Table 2 shows that Odonata are prevalent in more mature (age six+ years) ponds, with maximal abundance (number of individuals) and diversity (number of taxa) in the six year old pond. These data also show a negative correlation between Coleoptera and Trichoptera diversity, with Coleoptera increasing with age of pond and Trichoptera decreasing. This relationship between Coleoptera and Trichoptera diversity is not statistically significant ($C_P = -0.475$, $r^2 = 0.226$, $p > 0.05$, d.f. = 8) when considering the full range of data. However, removing year 0 data (the newly dug pond), the trend becomes clear ($C_P = -0.981$, $r^2 = 0.962$, $p < 0.001$, d.f. = 6). Hence there is a strong negative correlation between the diversity of Coleoptera and Trichoptera in mature and colonized ponds. Newt abundance is effectively constant throughout the age range of ponds present as they are mobile and migratory. The change in diversity of selected insect orders with age of pond is illustrated in Figure 3 which clearly indicates the inter-related changes in Coleoptera and Trichoptera diversity as well as the increase in Odonata diversity in more mature ponds.

The data also show an overall increase in both diversity and abundance for all organisms collected with increasing age of pond. Correlating total numbers of taxa and individuals found gives a highly significant positive correlation ($C_P = 0.964$, $r^2 = 0.929$, $p < 0.001$, d.f. = 8). This indicates that the abundance and diversity of aquatic fauna are closely related in the ponds sampled. The greatest increase in abundance and diversity is within the first three years after pond creation when there is pioneering colonization of new

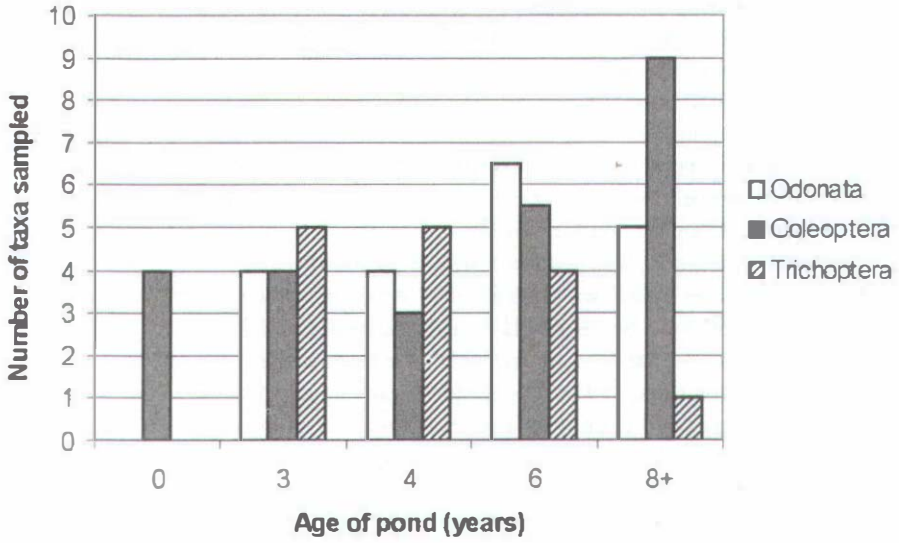

Figure 3. Change in number of selected taxa with age of pond

habitat. After this, there is less increase in overall abundance and diversity. Instead, there are changes in community structure with reduction in pioneer species and increases in those adapted to more mature ponds. Note that at the time of sampling, ponds were not available between the 0–3 year age range, although subsequently there has been further pond creation which should allow investigation of this period of pond development.

Discussion

Much conservation work is undertaken on British ponds but little is known about the effects of such dredging, clearing and desilting and there are a number of misconceptions about pond habitats (Biggs *et al.*, 1994). The features seen in natural systems can help to clarify what constitutes a valuable pond. Natural ponds cover a wide range of sizes, depths and levels of shading with most being small and less than 0.5m deep and many being shaded by surrounding trees. In fact, the habitats provided by nearby dead wood, leaves and living woody vegetation are exploited by a variety of aquatic plants and animals (Biggs *et al.*, 1992) whilst larval dragonfly communities are known to change greatly with differences in water depth in otherwise similarly vegetated ponds (Wissinger, 1988). Many ponds are relatively ephemeral, created and filled in within centuries or even decades, whilst some (particularly bog pools) can be much more stable, showing little change over thousands of years. As ponds will always be common in wet areas, or those areas where the water table is close to the surface, a natural system is likely to contain ponds covering a range of stages of succession and associated habitat characteristics. As the successional processes of loss of open water and reduction in depth are natural for most ponds, all stages of pond succession, from newly created to those which have become marsh or wet woodland, are exploited by wildlife. Therefore, although the community supported by a pond will change as it undergoes successional change, its conservation value does not necessarily decline (Pond Action, 1994a). This is even the case for ponds which temporarily dry out as this is part of the natural range of fluctuation in most pond systems, especially given that the majority are shallow and many have a regular annual dry phase which can in fact increase their persistence as it reduces the silting rate. Although ponds do need to be protected from land drainage and groundwater abstraction, seasonal drawdown is a natural characteristic of most water bodies. Dry summer drawdown areas are themselves valuable habitats for a variety of invertebrates such as the Southern Hawker *Aeshna cyanea* and Brilliant Emerald *Somatochlora metallica* (Vander Linden) which use them as egg-laying sites, possibly to avoid fish predation (Fox, 1991). The simplest way to manage the drawdown effectively is to undertake any pond work from a restricted number of points and to ensure that the area is neither removed to deepen the pond nor used to dump pond dredgings. Careful pond design can even create shallow-angled undulating drawdown areas which themselves provide useful habitat. Management activities should therefore focus on maintaining the broad natural spectrum of pond types and avoid unnecessary interference with existing ponds. This suggests digging new ponds of various sizes and

depths, allowing existing ones to develop with little interference, and managing surrounding vegetation so that some ponds are shaded whilst others are open to sunlight.

Water quality is obviously of importance to aquatic species and the pH measurements made during this study contrast with pH values of 4 found previously by Brooks (1989) and imply an input of less acidic water. Such water quality considerations are important for the conservation of many invertebrate species including the Odonata. For example, the Scarce Chaser *Libellula fulva* Müller, which is a rare Red Data species found in Bourne Valley, cannot tolerate increased flow rates. pH is also an important factor in habitat suitability for a number of dragonfly species (Hubble & Demopolous, 2002). The study site is noted for its diversity of Odonata and it is useful to note that Odonata showed increased diversity and abundance in the more mature ponds (age 6+ years).

Therefore, to maximize the biodiversity of aquatic invertebrates across a site, it is necessary to have a full spectrum of pond ages, from newly dug ponds that encourage pioneering colonization, to mature ponds, some of which may be allowed to fill in without interference. Thus there is a continual rotating succession of pond habitats, with the production of new ponds necessary to replace those that have been allowed to completely fill. This is even more important given that the requirements of many species are not fully understood, and in some cases, such as the larvae of the Hydrophiliidae (scavenger beetles), may not even be well-recognized (Fitter & Manuel, 1994). Therefore, to ensure the maintenance of a rich aquatic fauna, pond structural diversity should be maximized where site management makes this possible. There are a number of management issues which need to be considered before digging new ponds. As in Bourne Valley they should only be created where the hydrology is suitable, preferably adjacent to existing wet areas to encourage colonization, and spoil should be removed (Michael, 1993). If possible, the aquatic and marginal species of existing ponds should be surveyed before any management work is undertaken. If surveys can not be performed, drastic changes should be avoided, especially clearance of leaf litter, dead wood and surrounding woody vegetation if these are present. This not only ensures that aquatic species have a continual supply of wood and leaf detritus, but also that birds and amphibians have enough cover to approach the pond safely. Again as seen at Bourne Valley, as well as promoting structural diversity within the pond system, heathland pond management should have the following aims if it is to promote colonization by diverse Odonata populations:

1. Maintain some areas of permanent open water.
2. Manage surrounding trees to maintain a variety of shading conditions across different ponds. If a pond is to be kept unshaded, trees and bushes up to approximately 20m away from the pond margin provide important feeding habitat. Removal of trees is likely to have the most beneficial effect around those ponds where conditions have changed greatly in a short period of time. An example of this would be ponds on heathlands where trees have grown due to cessation of grazing (Biggs *et al.*, 1994).

3. Prevent colonization by fish, or if present, control their numbers. In such cases, scrub clearance may result in the reappearance of a number of important plant species.
4. Encourage submerged, floating and emergent fringing vegetation. It is better to have too many aquatic plants than too few, even if it appears that a pond is becoming 'choked'. Most pond guides consider plants as nothing more than food or habitat for animals, but they are themselves important. Ponds provide an essential refuge for wetland plants, particularly given that over half of Britain's submerged and floating-leaved plants are no more than 'locally common' due to the array of threats to wetlands, particularly water pollution (Pond Action, 1994b). Aquatic plants are also essential to pond invertebrates, providing food, refuge, egg-laying and emergence sites and case-building materials. All stages of development of aquatic invertebrates may use all types, ages and parts of wetland plants and in many cases these plants are vital for the completion of invertebrate life-cycles.

Heathland ponds are especially valuable for Odonata species and one of the main aims of digging the study ponds was to increase the population of *Ceriagrion tenellum* by providing new ponds to which individuals could migrate. Therefore it is important to investigate the success of this technique and, in turn, to consider whether there is a difference in conservation value between the digging of new ponds and the renovation of older ones. *C. tenellum* breeds in boggy pools and peaty runnels, favouring sphagnum bogs and marshy margins of heathland ponds. It flies weakly, from rush to rush, settling low on rushes or on heather near the breeding site (Hammond, 1983). In this study it was found to be most abundant at pond age 8+ years, but there was no clear trend, indicating that newer ponds of at least three years old were acceptable habitats. Weed-choked ponds may also be particularly valuable as invertebrate habitat, even if there is no visible open water (Michael, 1993). This further supports the argument that a diversity of pond habitats is the preferred situation leading not only to increased overall biodiversity, but also to increased success of individual target species such as *C. tenellum*. This is particularly important as a mosaic of small ponds can provide a source of biodiversity within a much larger heathland and wetland system. A series of such ponds can replace or restore habitats lost throughout a wider area to drainage, development and neglect, and further threatened by habitat fragmentation, falling water tables, water pollution and a lack of technical advice on wetland management (Plowman, 1995). It can also provide passive recreation and education benefits for people in the surrounding densely populated community. This is put into even greater perspective given that lowland heathlands are categorized as being both highly threatened and of high importance for insect species, amongst other organisms (Wynne *et al.*, 1995). For example, in many of Britain's lowland heathland areas, numbers of *C. tenellum*, a target species at Bourne Valley, were greatly reduced by drainage, reclamation and pollution of their clean water habitats (Hazel, 1983).

Evaluation

Although there were some strong data correlations, the range of data collection was limited by the time available to complete the study. Only one pond was sampled for most ages investigated, and no environmental parameters other than pH were measured. This may therefore be considered a pilot study as it would be preferable to sample a greater number of ponds. It would be particularly valuable to investigate colonization patterns within the first three years after pond creation as this appears to be the period when there is the greatest change in overall abundance and diversity of aquatic fauna. A more detailed study could also consider variation in other pond parameters such as size, depth, vegetation cover, light penetration and nutrient levels. Therefore, although the conclusions drawn are valid given the available data and its statistical significance, further work should be undertaken to allow investigation of other environmental factors. This could also provide a greater body of data on the diversity and abundance of the taxa sampled.

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Appendix 1. Odonata species recorded at Bourne Valley.

All Odonata species recorded at Bourne Valley	Recorded by Brooks (1989)	Recorded by Hubble & Hurst (2002)	Various individual records
Calopteryx virgo (L.)			✓
Calopteryx splendens (Harris)			✓
Lestes sponsa (Hansemann)	✓ (B)		✓
Platycnemis pennipes (Pallas)			✓
Pyrrhosoma nymphula (Sulzer)	✓ (B)	✓	✓
Erythromma najas (Hansemann)	✓ (B)		
Coenagrion puella (L.)	✓ (B)	✓	✓
Enallagma cyathigerum (Charpentier)	✓ (B)	✓	✓
Ischnura elegans (Vander Linden)	✓ (B)	✓	✓
Ceriagrion tenellum (Villers)	✓ (B)	✓	✓
Aeshna juncea (L.)	✓ (B)	✓	✓
Aeshna mixta Latreille	?		
Aeshna cyanea (Müller)	✓	✓	✓
Aeshna grandis (L.)	✓ (B)		✓
Anax imperator Leach	✓ (B)		✓
Brachytron pratense (Müller)		✓	
Cordulegaster boltonii (Donovan)	✓ (B)		✓
Cordulia aenea (L.)	✓		?
Libellula quadrimaculata L.	✓		✓
Libellula fulva Müller			✓
Libellula depressa L.	✓	✓	✓
Orthetrum cancellatum (L.)	✓ (B)		✓
Orthetrum coerulescens (Fabricius)	✓ (B)	✓	✓
Sympetrum striolatum (Charpentier)	✓ (B)	✓	✓
Sympetrum flaveolum (L.)			✓
Sympetrum sanguineum (Müller)			✓
Sympetrum danae (Sulzer)	✓		✓

(B) indicates confirmed breeding status. This was not recorded for the 2002 survey as this was part of a more general study of macroinvertebrate pond colonization rather than a detailed specific survey of Odonata. Thus, the 2002 study also records fewer Odonata species. The individual records, mostly from Borough of Poole Leisure Services conservation staff between 1998 and 2000 inclusive, similarly do not report breeding status. ? indicates unconfirmed sightings.

A significant migration of the Red-veined Darter *Sympetrum fonscolombii* (Sélys) in southern Spain

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Summary

In October 2002, near the port of Tarifa, situated in Andalucia at the southern-most tip of Spain, the author observed a significant migration of the Red-veined Darter *Sympetrum fonscolombii* (Sélys). During a two and half hour period between 1500h and 1730h local time, an estimated total of 450,000 individual insects were observed migrating along the coast.

Introduction

On Tuesday 15 October 2002, my wife and I visited Tarifa which is a port situated at the very southern tip of Spain. At approximately 1500h local time we visited an expansive beach west of the town at 36° 01' N, 5° 36' W. This area is known for its windy conditions and is a favourite location for wind and kite surfers. The weather conditions throughout the afternoon were sunny with some patchy cloud. The temperature was *c.* 20°C and throughout the visit there was a stiff sea breeze blowing from sea to land, of which the wind and kite surfers were taking full advantage.

Observations

Immediately on arrival we noticed a large number of dragonflies both on the beach and in the adjacent scrubby woodland composed of stunted (*c.* 3.0m high) pine trees. There were a few aeshnids (probably Migrant Hawkers *Aeshna mixta* Latreille) but we soon realised that the majority of the insects were darters (*Sympetrum* spp.) and all of them seemed to be moving in one direction.

At approximately 1515h we walked from the car park to the edge of the sea; a distance of about 100m. The dragonflies were not being carried by the wind but were all flying at an angle of approximately 90° to the wind. The insects appeared to be the same species comprising fully coloured red males and browner females. They were all flying west along the beach and at a height of between 0.3m and 0.5m above the sand. I was equipped with only a small aquatic net used for collecting larvae, with which I managed to catch seven specimens: three males and four females.

The specimens all proved to be *S. fonscolombii*. The males were fully mature with very conspicuous red wing veins, which are often difficult to see in immature specimens. The females were all exuding eggs.

During the period of our visit, which was between 1500h and 1730h, the stream of insects remained constant until the numbers started to decline after 1715h. I estimate that at any one time there were *c.* 50 insects moving across the beach in a front some 100m wide. They were all moving at a rate of *c.* 1m per second. My assessment of 50 insects deals only with the beach and car park area and excludes any insects that were passing through the scrubby woodland. The figure must be considered as a conservative estimate. On the basis that the insects were passing through the area at a constant rate of 1m per second, I estimate that *c.* 450,000 insects passed through during our visit.

Earlier in the day when we visited the town of Tarifa I do not recall seeing significant numbers of dragonflies. At the start and the end of the day we visited a viewpoint 5km east of Tarifa and *c.* 100m above sea level. Dragonflies were present here, but not in any significant numbers.

Discussion

S. fonscolombii is a well-recognised migrant species occurring annually in small numbers in southern Britain (Parr, 2002). It is also one of few European species, which are thought to produce more than one brood in any given year (Askew, 1988). Corbet (1999: pp.646–647) cites four cases of migration for this species. In three cases the insects were immature and in one case he states that 'insects arriving (in Switzerland) in spring were always mature'. Corbet (1999: p.395) further states that when odonates have been seen migrating *en masse*, all or almost all are immature.

The insects observed here were in very large numbers and those captured and examined were fully mature and in very good condition. I do not know where these insects came from but there is certainly no shortage of lowland wet habitat in the area. During the period of my observation I saw only one pair *in copula*. In addition, all the female insects captured were exuding eggs. It has to be assumed that these insects had already mated and were ready to oviposit the moment suitable habitat was encountered.

Acknowledgement

I would like to thank both Professor Philip Corbett and Bryan Pickess for their helpful suggestions in the preparation of this short paper.

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The Azure Damselfly *Coenagrion puella* (L.) attacking the Common Blue Butterfly *Polyommatus icarus* (Rottemburg)

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At *c.* 1230h GMT on 6 June 2003, at Westhay Moor Reserve, Somerset, I observed a mature male Azure Damselfly *Coenagrion puella* L. fly towards a male Common Blue Butterfly *Polyommatus icarus*, which was flying low over a grassy patch adjoining a reed-bed by a lake. The damselfly flew repeatedly at the butterfly, buffeting it at times, and so preventing it from settling. This aggressive behaviour, which occurred during a brief sunny spell, continued for one minute, after which the butterfly flew off. Male *C. puella* were numerous in the area at the time (several were in either the ring or tandem position) but, apart from the one individual, they all disregarded the Common Blue Butterfly.

According to Brooks (1997), *C. puella* is not territorial and doubtless, this is normally the case. Possibly this damselfly had was exhibiting territorial behaviour, although it was not observed to attack any other damselflies. Alternatively, the visual impact of the butterfly's relatively large blue wing expanse could have triggered sexual attraction. Female *C. puella*, most commonly, are heterochromic but the homechromic andromorph form certainly does occur (Askew, 1988).

Corbet (1962) described how a Large Red Damselfly *Pyrrhosoma nymphula* (Sulzer) repeatedly darted at a spot of red paint with which he had marked a perched Four-spotted Chaser *Libellula quadrimaculata* L. Male *P. nymphula*, however, are normally territorial, so maybe this type of behaviour is not surprising, assuming that they have good colour vision. Gardner (1953) also gave an account of a male Broad-bodied Chaser *Libellula depressa* L. that attacked and seized a Hornet *Vespa crabro* L. Presumably the reddish brown and yellow colours, somewhat similar to those of the female *L. depressa*, provided the stimulus for the assault. Of course, the male *L. depressa* is highly territorial. Why the male *C. puella* behaved in the way described remains uncertain. I suggest, however, that the reason was sexual in nature, occasioned by the butterfly's blue wings.

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Common Blue Damselfly *Enallagma cyathigerum* (Charpentier) capturing the Rush Veneer *Nomophila noctuella* (Denis & Schiffermuller), a pyralid moth, as a prey item

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On 8 June 2003, at Bake Fishing Lakes, Trerulefoot, Cornwall, I observed a Common Blue Damselfly *Enallagma cyathigerum* (Charpentier) capturing a Rush Veneer *Nomophila noctuella* (Denis & Schiffermuller). The damselfly quickly alighted, possibly because of the weight of the prey, and had already removed one of the moth's forewings. However, not much time was spent tackling the prey and the damselfly flew off after about twenty seconds without the Rush Veneer.

This (attempted) prey item is by far the largest I have ever noted. This is not a large moth (the wing length of this individual was only approximately 10mm), but it is still huge compared with the tiny prey items normally caught by this and other damselflies. Adrian Parr (pers. comm.) has mentioned that there are some records of damselflies taking larger prey, such as the Emerald Damselfly *Lestes sponsa* (Hansemann) tackling a crane-fly. However, in most of the literature referring to the diet of adult Odonata, the prey of damselflies is usually described as small flies or similar, so prey of this size would appear to be very unusual.

Acknowledgements

Thanks to Adrian Parr for his advice and to Steve Nash for confirming the identity of the prey.

Inverted emergence recorded in the Common Darter *Sympetrum striolatum* (Charpentier)

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On Sunday 18 August 2002, whilst leading the British Dragonfly Society afternoon walk around the Bennerley Marsh recording area, we came to the de-acidification pits where the group looked for exuviae. I came across the inverted exuvia of a Common Darter *Sympetrum striolatum* (Charpentier) which was attached to a dried leaf of a Bulrush *Typha latifolia* approximately 150mm above the water level. This is the first time that I have observed such an indication of inverted emergence in this particular species and I have not come across this being noted in any of the literature.

The domestic cat: a new dragonfly predator

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On Saturday 10 August 2002, at approximately 1430h GMT, I witnessed what I thought was a very unlikely dragonfly predator. Two of our domestic cats acted together to chase a Migrant Hawker *Aeshna mixta* Latreille which was hawking over our garden pond. The chase took two or three minutes and the *A. mixta* did not seem to want to leave the area despite being chased by the cats. It eventually settled on the vegetation around the edge of the pond it was at this point that one of the cats pounced and caught the insect and consequently killed it. Once they had killed the insect they just left it on the lawn.

Identification of the exuvia of the Small Red-eyed Damselfly *Erythromma viridulum* (Charpentier)

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Askew (1988) states that Conci and Nielsen (1956) describe the Small Red-eyed Damselfly *Erythromma viridulum* (Charpentier) as having unpigmented and slightly pointed lamellae. Also Cham (2002) illustrates the lamellae of *E. viridulum* and the Red-eyed Damselfly *Erythromma najas* (Hansemann) from Gerken & Sternberg (1999) (see Figure 1). As we had no previous experience of the exuviae of *E. viridulum*, our first attempts to identify them were long and laborious, having to tease out the lamellae in water as these were often folded and crumpled. In the field, the exuviae of *E. viridulum* look very similar to those of the Common Blue Damselfly *Enallagma cyathigerum* (Charpentier), especially if the narrow, transverse black-brown bands on the caudal lamellae of the latter are not very clear, and so our first 'hopeful' *E. viridulum* exuviae turned out to be those of *E. cyathigerum*.

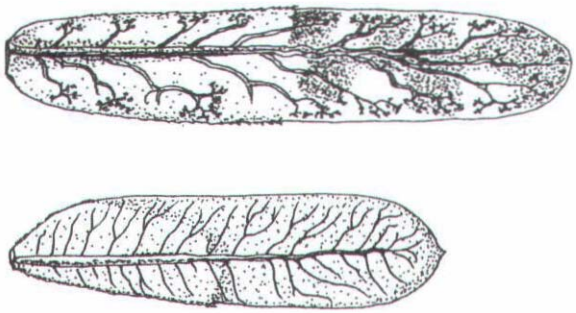

Figure 1. Comparison of the caudal lamellae of *Erythromma najas* (top) and *Erythromma viridulum* (bottom). Redrawn from Gerken & Sternberg (1999).

It was with the help and information given by Stephen Butler and Graham Vick that identifying *E. viridulum* exuviae was found to be easier than originally thought. Unfortunately it is almost impossible to identify the exuviae in the field as they require scrutiny under a microscope with a minimum of 15 times magnification and with the aid of good lighting. With reference to the exuviae of *E. viridulum*, Gerken & Sternberg (1999) state: 'sternite of 1st abdominal segment with a row of sharp-spined, small setae'. *E. najas* has stout setae on the first abdominal segment and also on the metasternum of the thorax (see Figure 2a). It is the absence of these stout setae on the metasternum of

the thorax which is characteristic of *E. viridulum* (see Figure 2b). Gerken & Sternberg (1999) also state that these stout setae are 'best visible on dry exuviae'. Although *Cercion lindenii* (Sélys) does not occur in Britain, with the arrival of so many migrants, the identification features of its exuviae need to be mentioned as they resemble those of *E. viridulum* and so a distinction between the two needs to be made. According to Gerken & Sternberg (1999) the exuviae of *C. lindenii* are 21–24mm long and the metasternum has stout setae. The lamellae are longer and narrower than those of *E. viridulum* and the basal part of the caudal lamellae is longer than the distal part (see Figure 3). The exuviae of *E. viridulum* are 19–21mm long and lack the stout setae on the metasternum. Never discount a species because it does not occur in Britian (see Brook & Brook, 2003). With the ever increasing numbers of migrants, the possibility of new species to Britain should always be considered. The examination of the stout setae on the ventral abdominal surface of an exuvia of *E. najas* will give some indication of what to look for when identifying those of *E. viridulum*. As *E. najas* exuviae are easily recognizable in the field because of their distinctive lamellae, they are perhaps very rarely, if ever, looked at through a microscope.

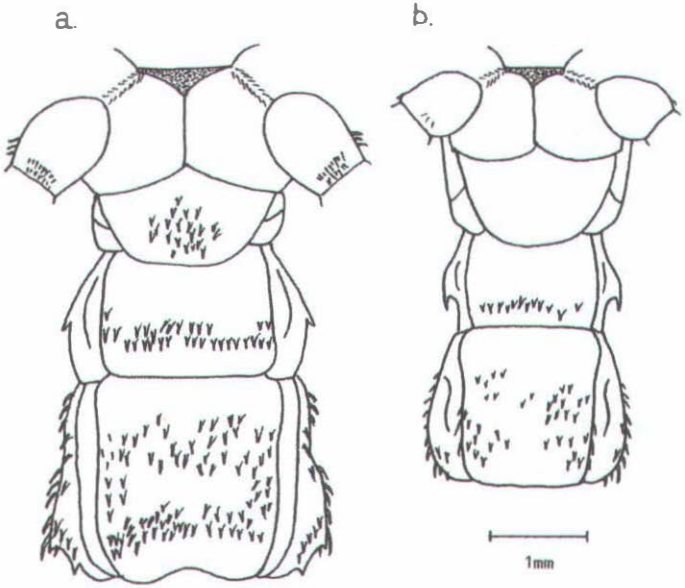

Figure 2. Part of the underside of the thorax and abdomen of *Erythromma najas* (left) and *Erythromma viridulum* (right) showing the stout setae. Redrawn from Heidemann & Seidenbusch (1993).

Bluewater near Dartford, Kent was a site where *E. viridulum* was known to oviposit, so it seemed a reasonable place to search for exuviae. Of all the coenagrionid exuviae collected on 29 July 2002 at this site from reeds, rushes and other vegetation, both in the water and on the land, only two were of *E. viridulum*. The identification features were

Figure 3. Caudal lamella of *Cercion lindenii*. Redrawn from Gerken & Sternberg (1999).

compared with specimens from Greece (Etiro, Thesprotia, Karterion) collected on 23 August 1980 and determined by M. Pavesi, now in the possession of Graham Vick. Is it possible that most of these damselflies emerge on the floating vegetation well away from the water's edge and so not many exuviae are found? If so, it is also possible that after rain most of the exuviae could be washed off the vegetation into the water. Exuviae on the floating vegetation would also not be easy to collect and therefore would be overlooked.

A simple key for the identification of the exuviae of Erythromma viridulum adapted from Gardner (Hammond, 1983) and Gerken & Sternberg (1999).

Suborder ZYGOPTERA

Key to families

1 Antennae with scape as long as remaining 6 segments taken together. . . . . CALOPTERYGIDAE

– not as above 2

2 Labium with prementum much contracted basally . . . . . LESTIDAE

– not as above 3

3 Caudal lamellae denodate with apices produced into long narrow points . . . . . PLATYCNEMIDIDAE

– not as above . . . . . COENAGRIONIDAE

Family COENAGIONIDAE

Key to genera (and species)

1 Head with postocular region rectangular in outline . . . . . *Pyrrhosoma*, *Ceriagrion*

– not as above 2

2 Stout setae on sternite of 1st abdominal segment 3

– not as above . . . . . *Ischnura*, *Enallagma* and *Coenagrion*

3 Sternite of metathorax with stout setae. Exuviae usually more than 21mm (in total length) . . . . . *Erythromma najas* and *Cercion lindenii*

– Sternite of metathorax smooth and lacking stout setae. Total length 21mm or less . . . . . *Erythomma viridulum*

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Communication between the sexes at the end of copulation: a study of three species of Anisoptera

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Introduction

'There are many aspects of signalling that we know little about. For example how does a female signal to a male in tandem that she has completed oviposition? What signals are exchanged between the sexes at the end of copulation?' (Miller, 1995).

The camcorder can be a useful aid in the observation of the behaviour of Odonata, as suggested by Miller (1995) and used in the investigation of mate guarding of the Common Blue Damselfly *Enallagma cyathigerum* (Charpentier) by Cham (2002). The behaviours reported in this paper were recorded whilst gathering material for a video of the life cycle of Odonata, mainly in South Yorkshire. Three species were studied: the Migrant Hawker *Aeshna mixta* Latreille, the Common Hawker *Aeshna juncea* (L.) and the Common Darter *Sympetrum striolatum* (Charpentier).

Methods

The camcorder used was a Sony TR7000E, recording digitally onto Hi8 tape. It has a zoom range of 20:1, with a maximum magnification of *c.* 16 times. A Sigma 3 times teleconverter, when attached in front of the camcorder lens, gives a magnification of *c.* 50 times, with closest focus at *c.* 1.5m from the front of the lens. A 2-dioptre close-up lens brings closest focus to *c.* 40cm and then a dragonfly head will fill the field of view. Use of a tripod is essential.

The recorded sequences were played into an iMac computer. Poor sequences were removed and the remainder downloaded onto digital tape. Interesting aspects of behaviour can be noted and examined more closely when viewing sequences on a monitor. With digital recording, the date and time are recorded with every frame and this information enables the time interval between short events in a long sequence to be deduced, even if the full sequence is not recorded or retained.

Odonata will often allow a close approach with a camcorder when this equipment is slowly moved forward. As Miller (1995) suggests, movement is more readily tolerated when the observer is very close and filling the insect's field of view. Disturbance is then more likely from someone 'coming to see what you are doing'. Experience suggests that, of the species studied in South Yorkshire, *S. striolatum* is the most confiding.

Wing clapping behaviour in *Aeshna mixta*

On 12 Setember 1999, a pair of Migrant Hawkers *Aeshna mixta* were observed in copulation, perched upright, the female below the male, on a rush stem at Old Moor Wetland Centre, South Yorkshire. Copulation had been in progress for an unknown length of time when recording began. Examination of the recording shows that five times before uncoupling by the female, the male raises his abdomen until it is nearly at right angles to the vertical and this raises the female's head to just below that of the male's second abdominal segment. The male slowly brings his hindwings back until they mantle or envelop the head and thorax of the female. He then brings his forewings back very quickly to 'clap' against his hindwings. The forewings are then returned very quickly to their normal position. The hindwings are returned more slowly. On the first occurrence, 21min 21s before uncoupling, the male gave a single clap. On the other four occurrences, at 18min 42s, 16min 47s, 14min 47s and 13min 19s before uncoupling, two claps were given in quick succession.

In a separate sequence, recorded on the same day and possibly of the same pair, uncoupling occurred and the female was observed to begin to lower her abdomen, but at a point midway to completing uncoupling, she raised her abdomen as if to recouple. The male responded immediately with a single clap in the manner described above. The female then lowered her abdomen to the vertical position and, almost immediately, the pair flew off.

Wing touching in *Aeshna mixta*

Further examination of the recording referred to above showed wing touching behaviour occurring in an almost continual phase from 2min 38s to 6s before uncoupling. The female, continuing to hold the abdomen of the male with her front and middle legs, used her hind legs to make stroking movements under the hindwings of the male. Wing movements by the male indicate clearly that the wings were being touched. After wing touching ceased, no other form of movement was observed before the female uncoupled.

Wing clapping in *Aeshna juncea*

On 30 August 2000, at Ramsley Reservoir, north Derbyshire, a pair of Common Hawkers *Aeshna juncea* were observed to land in bracken at the bottom of the reservoir banking. A close approach was made, and the pair filmed in copulation. On play back, the short sequence obtained before they flew off, still in the 'wheel', showed a single instance of wing clapping by the male, in a manner identical to that described above for *A. mixta*.

Wing lifting in *Sympetrum striolatum*

On 11 September 2002, a pair of Common darters *Sympetrum striolatum* were filmed in copulation at ground level on wooden decking at Rother Valley Country Park, South Yorkshire. Copulation had been in progress for an unknown length of time when

recording began. At 2min 17s before uncoupling, the sequence shows the male supporting himself on all six legs and the female with fourth and fifth segments touching the ground and all six legs clasping the abdomen of the male in the usual manner for Anisoptera. At 10s before uncoupling, the female disengaged her hind legs and tapped the left hindwing of the male twice, moving it upwards a short distance before lifting it and holding it in a significantly raised position. At 4s before uncoupling she let the wing droop before twice tapping it upwards and raising it again. This behaviour may be mirrored on the right side, but the recording is not clear enough to be certain. At 4s after the female had disengaged her abdomen from the male, he pulled her along and then lifted her into flight.

Discussion

The wing lifting behaviour described here provides a possible answer to the question 'how does the female indicate to the male that she is ready to oviposit?' The video sequences seen in slow playback (not true slow motion) do seem to show that the female action of wing touching and lifting is a definite signal to the male. Since uncoupling and flight soon follow, it is possible that it is a 'ready to oviposit' signal. The case is strongest for *S. striolatum*, where the male's wings are positively lifted rather than stroked, and where uncoupling and flight occur almost immediately on the cessation of wing lifting. This behaviour does not seem to be referred to elsewhere.

The significance of the wing clapping is less obvious, but it is clearly a signal from the male to the female. Occurring, as it did, shortly before wing lifting, it might mean 'I have finished sperm transfer'. The third and last stage in prolonged copulation is the transfer of sperm within the female, although the stage is not as clear in darters as in some other Odonata (Miller, 1995). The male has no control over this stage and may be anxious to depart to avoid predators and interference from other males. Again, this behaviour does not seem to be referred to elsewhere.

Although the equipment used to record these activities is firmly in the amateur range, it is a useful and valid way of recording behaviour. The camcorder was set on 'auto' and so the shutter speed was usually quite slow. Although this was satisfactory for the main purpose of the recordings (to make a life-cycle video) it is not ideal for detailed behaviour analysis. Making recordings at high shutter speeds, so that each individual frame is sharp, is not appropriate for normal filming because movements appear jerky when played back. However, the absence of facilities for high-speed video recording does not preclude behaviour analysis.

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Recent problems regarding the collection of voucher specimens

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The collection of voucher specimens has been an essential part of the scientific process since naturalists first began to record their observations. Probably the best known examples are those collected by Charles Darwin, who used these specimens to develop what was arguably the most ground-breaking theory of the modern era, the theory of evolution. Voucher specimens and insect collections *per se* have been used to provide a wealth of information, and have proved to be extremely useful as indicators of the considerable changes that have occurred to the British countryside and its fauna over the last century, the health and current status of (particularly rare and threatened) habitats, and latterly, as sensitive indicators of global climate change.

However, the collection of voucher specimens has become the subject of scrutiny in recent times, and the appearance of certain press articles disagreeing with this practice has precipitated the amendment of collecting codes to reflect these new sensitivities, notably with regard to the collection of voucher specimens in the presence of an 'audience'. These press articles have generally described the emotive objection to the collection of vertebrate voucher specimens such as the Red-backed Thrush (Robinson-Dean *et al.*, 2002), but members of this society may also remember recent objections raised to the collection of a vagrant specimen of the Green Darner *Anax junius* (Drury). This was to some extent understandable since the specimen would have been taken away from enthusiasts, some of whom had made a specific journey to see and photograph this new and spectacular addition to the British list. (This may also reflect another relatively recent phenomenon regarding the use of 'hotlines', which report the presence of rare species, usually migrants, at various locations. Such is the fervour of some observers, that they can often resemble a group of Barbour-clad fans at a rock concert. On one occasion, I can remember watching the wholesale destruction of reed-bed habitat at Slapton Lea, as a large group of enthusiasts, who appeared to be more interested in putting a 'tick' in their book than showing any concern for the natural environment, clambered to get good views of a Grey-cheeked Thrush.) Nevertheless, it must be assumed that those who object to the collection of voucher specimens do so with the welfare of that specimen at heart.

Why do we need voucher specimens?

The study of entomology, probably more than any other discipline, requires the collection of voucher specimens when the identification of a species is not possible in the field. As any coleopterist will tell you, this is generally the case when encountering similar species which require microscopic analysis to ensure a correct taxonomic determination.

It is through the correct identification of specimens and the acquisition of reference collections that vital information about the species assemblages associated with different habitats can be obtained. Without this information, we would not be in the position that we are in today with respect to understanding the impact that changing agricultural practice has had on UK biodiversity, and the conservation measures that need to be taken to ensure that our remaining biodiversity can be successfully managed and hopefully enhanced. As mentioned above, insects are key indicators of the health of habitats, and the correct identification of species allows conservationists to determine the current status of those habitats. For instance, the re-appearance of key heathland indicator species will assure conservationists that their attempts to restore that habitat (currently a multimillion pound UK initiative) have been successful. In addition, recent recording efforts, which have relied heavily on the collection of voucher specimens, have revealed the urgent need to conserve Thames Gateway 'brownfield' sites. (Some of these sites, whose biodiversity boasts an outstanding array of rare and threatened species, have already been earmarked for housing development.)

Voucher specimens are also required to correctly identify and describe species which are new to science. We are familiar with this concept with regard to the myriad of insects that remain undescribed in remote habitats around the world, but it is by no means confined to invertebrates. The recent discoveries of several south-east Asian mammals such as the Giant Muntjac (Schaller & Vrba, 1996) have all required the collection of voucher specimens for taxonomic/scientific purposes.

The collection of voucher specimens becomes particularly important when attempting to confirm the presence of undesirable alien species. The classic examples are the Elm Bark Beetle *Scolytus scolytus*, which wreaked havoc by transmitting a non-native and more aggressive strain of the pathogen responsible for causing Dutch Elm Disease within the UK population of Elms, and the Colorado Beetle *Leptinotarsa decemlineata*, a serious pest of potato crops which is currently threatening to become established as a UK resident by natural means as climatic amelioration continues, as well as turning up regularly with imported vegetables. (Presenting a voucher specimen of this latter species at a police station in years gone by would have earned its discoverer a respectable financial reward.) Whether or not the recent UK colonization of the Bryony Ladybird, *Epilachna argus*, will have implications for growers of the Cucurbitaceae (courgettes, *etc.*) has yet to be confirmed, but a more immediate threat comes from the Asian Longhorn Beetle *Anoplophora glabripennis*, a species which was responsible for instigating significant tree

felling operations in America in a desperate attempt to eradicate this devastating pest before it could become a permanent United States resident.

There are many other reasons for the collection of voucher specimens, from the analysis of DNA to determine the long-term effects of genetic isolation of the newly discovered Scaly Cricket *Pseudomogoplistes vicentae* colonies in Britain, to the forensic (if grisly) analysis of insects as indicators of the time a homicide victim has been decomposing. What is clear is that the use of voucher specimens for scientific purposes should be continued if progress is to be maintained on a variety of fronts.

What are the alternatives?

As part of accepting '*A Code of Conduct for Collecting Insects and other Invertebrates*', which is issued by Invertebrate Link (2000) (formally known as the Joint Committee for the Conservation of British Insects), entomologists are encouraged to consider alternative methods to the collection of specimens, when the correct identification of a species can be clearly established by doing so. I am sure that the majority of entomologists began their interest, as I did, through the collection and study of insects. That should not change. The 'hands-on' familiarization of the younger generation with wildlife is a vital part of understanding the importance of the need to conserve wildlife, and from a personal viewpoint, I will rue the day that any form of legislation comes between a young enthusiast, their net and bucket, and a developing passion for natural history which inevitably leads to an appreciation of conservation issues. In time, and in accordance with the responsible practice advocated by this code of conduct, these entomologists will, like the rest of us, begin to collect the majority of their records in note-books or in digital or photographic form.

What do the codes of practice say?

A continuing theme in the codes of practice for the collection of insects, as issued by the JCCBI, British Dragonfly Society (BDS) and Buglife – The Invertebrate Conservation Trust, is recognition that the collection of voucher specimens is an essential part of obtaining data for conservation purposes. The Buglife Position Statement on the Collection of Invertebrates states that 'Collecting is essential for the study of most invertebrate taxa, including the acquisition of records of crucial value for conservation.' This is a message that needs to be conveyed to an appropriate audience, and Buglife has recently joined forces with the Partnership for Action Against Wildlife Crime (PAW) to ensure that the need for collection of invertebrates is fully appreciated by policy makers and conservationists in all disciplines.

All codes of practice are concerned with infringements of wildlife law and stress the need to observe legislation and guidelines as provided by The Wildlife and Countryside Act 1981, and its subsequent amendments.

The codes also appreciate the fact that the collection and study of insects has a significant role to play in the education of the younger generation, and that failure to allow this interaction could have a detrimental effect with regard to the number of individuals who may subsequently fail to gain an appreciation of conservation issues.

Of course there are those who will remain opposed to the collection of voucher specimens regardless of any attempt to explain their necessity, and they are perfectly entitled to do so. Some of the concerns that they may feel, in particular regarding human respect for all living things, are increasingly addressed by the codes of conduct, which represent a degree of restraint well beyond the need to respect the law or conserve species and their habitats. Within this context of restraint, the collection of voucher specimens will continue to play a pivotal role in the accumulation of data for conservation purposes.

Acknowledgement

Sincere thanks to Dr David Lonsdale for useful discussion and advice.

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The Willow Emerald Damselfly *Chalcolestes viridis* (Vander Linden) in Kent: a case of mistaken identity

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Many years ago, back in the last century, on the 29th day of the month of June in the year 1992, two novice dragonfly enthusiasts searched the wide open wasteland of Cliffe Marshes, Kent looking for the elusive Scarce Emerald Damselfly *Lestes dryas* Kirby. Under huge skies these intrepid searchers scoured the dykes and rushes in search of the insect once thought to be extinct in Britain until its rediscovery across the Thames Estuary in 1983 (Benton & Payne, 1983). Many exuviae were collected and taken home to be closely scrutinized; all were obviously of the family Lestidae, but were they of the common Emerald Damselfly *Lestes sponsa* (Hansemann) or the rare *L. dryas*, after all there were no species but these two to consider in those far off days. On close examination under a powerful (times 15!) and expensive (£60!) binocular microscope, the two amateur odonatists found that the lamellae of one of the exuviae were definitely different from the rest, which were *L. sponsa*, and therefore they assumed that this specimen had to be of the rarer of the two species, *L. dryas*. So this amazingly successful expedition passed into history and the record books.

Recent research, however, has raised questions about some aspects of this expedition. Our intrepid and embarrassed dragonfly enthusiasts now bring startling new revelations concerning their discovery.

After a light-hearted introduction, we would now like to continue this article in the light of a recent discovery. In May of this year (2003) we were asked by a fellow amateur naturalist to help with the identification of dragonfly exuviae. Using a combination of keys, Gill's display boxes of mounted exuviae, and newly collected exuviae, we began explaining how to identify them. All went well until it came to the family Lestidae, the emerald damselflies. Gill picked up the box of mounted zygopteran exuviae and began to point out the characteristic lamellae and labium of this genus. Immediately Gill realized something was wrong with the specimen labelled '*L. dryas*'. The labium (Figure 1a), which was mounted separately, was not the expected narrow 'spoon' shape (Figure 1b). It was very much like a miniature aeshnid labium! If not a specimen of *L. dryas* then what could it be? Still puzzled, the next day John looked in our book of European exuviae (Gerken & Sterberg, 1999) and decided the correct identification should have been the Willow Emerald Damselfly *Chalcolestes viridis* (Vander Linden)! Realizing that the identification needed to be verified by acknowledged experts, excited phone calls were

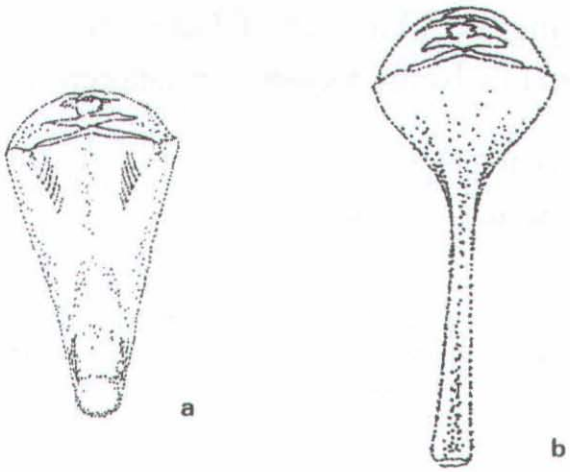

Figure 1. a) Labium of *Chalcolestes viridis*
b) Elongated labium typical of *Lestes sponsa* and *Lestes dryas*

made to Graham Vick and Dave Chelmick. We took the exuvia to Dave and then to Graham who both confirmed that it was indeed that of *C. viridis*.

The characteristics of the specimen were as follows. It has lamellae of the normal lestid shape but the labium is not narrowed and stalked or racket-shaped like most lestids. The labium is broad and tapers gradually distally as occurs in Coenagionids. The only lestid species in Europe which have this character of the labium are *C. viridis*, *Sympecma fusca* (Vander Linden) and *Sympecma paedisca* Brauer. An examination under the microscope revealed that the shape of the distal margin of the labial palps is clearly in agreement with the key and figures in Gerken & Sternberg (1999) for *C. viridis*. In particular the distal margin of the labial palps is almost linear in *C. viridis*, while it is irregularly dentated in the two *Sympecma* species. This determination was confirmed by Graham Vick and David Chelmick. The material was compared with the following specimens of exuviae in Graham Vick's collection:

1♂ *Chalcolestes viridis* France, Cher, Dun-su-Auron 27 July 1982
(G. S. Vick determined and collected)
3♂ *Chalcolestes viridis* France, Herault, R. Herault 26 July 1979
(G. S. Vick determined and collected)
1♀ *Chalcolestes viridis* France, Gard, R. Crieulon, Quissac 30 July 1979
(G. S. Vick determined and collected)
1♂ *Sympecma fusca* Sicily, Piana di Catania 25 June 1975
(M. Pavesi determined and collected)
1♂ *Sympecma paedisca* Germany, Schleswig-Holstein, Gnarrenburg 10 August 1991
(S. G. Butler determined and collected)

Why did we make a mistake in 1992? We were novices in those days and this was just at the beginning of our interest in exuviae. Our only key was that of A. E. Gardner in *The Dragonflies of Great Britain and Ireland* (Hammond, 1983). Recognizing the exuvia as a lestid by the lamellae, we concentrated on the characteristics of this feature (on page 74). With only two pigmented bands on the lamellae (Figure 2), we wrongly assumed that it must be an exuvia of *L. dryas*. Incidentally, we do now have exuviae of *L. dryas* collected recently from that same location.

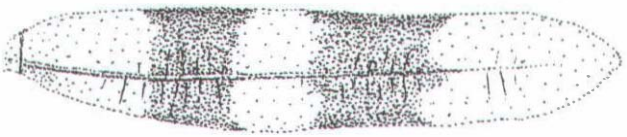

Figure 2. Lamella of *Chalcolestes viridis*

Since the discovery of our mistake, we have again 'scoured the dykes and rushes' accompanied by Graham Vick and Don Tagg, this time in search of *C. viridis*. Although no adults, larvae or exuviae of this species were found, this habitat does look suitable, and to quote Graham – 'we have not proved that it doesn't occur here'. We have, however, proved that it has bred in Britain on at least one occasion. It is one of the species thought to be worth looking for in southern counties and 'odonatists should make a point of checking closely a proportion of all damselflies that they encounter' (Merritt, Moore & Eversham, 1996).

Although similar to our two native species, the male *C. viridis* does not develop the blue pruinescence of *L. sponsa* and *L. dryas* males. The superior appendages are also different being yellow with black tips, and the inferior appendages are very short. The preferred habitat for *C. viridis* is ponds, lakes, slow flowing rivers (Askew, 1988) and stagnant waters (d'Aguilar, Dommanget & Préchac, 1986). Overhanging trees and shrubs are required for oviposition, especially willows but several other species have also been recorded including hawthorn and some fruit trees. The female inserts eggs into the bark of overhanging twigs or branches causing some damage that may still be visible for two to three years after. the optimum flight period is August and September, but this period can begin as early as late June and continue into November.

Acknowledgements

We thank Graham Vick and Dave Chelmick who verified the identification of the exuvia, and Graham Vick and Don Tagg who allowed us to accompany them at Cliffe Marshes in the quest to determine whether *C. viridis* still occurs there.

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Obituary: DAVID ALLEN LEWIS DAVIES

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By now, many of you will have heard the sad news that Allen Davies died on 2 March 2003, at the age of 79. Allen will be a great loss to the odonatological world and he will be missed by his many friends, both amateur and professional. He was a person of immense talent, not just in the study of dragonflies. He seemed to be successful in most things he attempted. He had a highly successful army career in the war and as a young officer he was a tank commander at D-Day and he saw action from Juno Beach to the Rhine. He later had a role at the Nuremberg Trials. However, he was a professional research biochemist for most of his working life and an amateur interest in dragonflies provided him with some nice balance to his busy life. As his career was drawing towards its end, he gently allowed the odonatological side of his life to expand until it became a major commitment. When one spoke to him and implied that he was lucky to have so much time to carry out his dragonfly work now he was 'retired', he always replied that he had never had so little spare time.

Allen believed in the ability of the natural world to enrich the human experience and he retained into adulthood a childlike excitement with insects and especially dragonflies: their colours, shapes, diversity, behaviour and habitats all fascinated him. He believed that much of this would be lost due to human greed, unless steps were taken to conserve what we have. However, he believed that conservation could only be based upon sound taxonomy and faunistic knowledge. He had little time for identification of tropical species by photograph. He was fascinated by odonate evolution, and the puzzles that it presented: the survival to the present day of ancient relics, usually adapted to very specialised habitats ('bizarre niches'), under-utilised by modern and successful taxa, needed explanation. He was prepared to travel to distant regions to rediscover a 'lost' species. As an eminent collector of dragonflies, he placed great store on the value of a synoptic collection and he made every effort to obtain representatives of as many of the world's genera as possible. By the end of his life, he probably had obtained representatives of about one half of the world's species, mostly collected personally. If he was unable to obtain a species himself he was always very adept at exchanging material with one of us who had just returned from a successful expedition. The phone-call on our return was almost a certainty! Many of us have been 'squeezed' by Allen for a phylogenetically interesting specimen! This has now benefited the Cambridge University Museum of Zoology to whom the Davies Collection has been bequeathed.

He had an exceptionally keen eye for habitat and behaviour, and he had a talent to 'think like a dragonfly' and predict where the different sexes would be at any particular time and weather condition. He was very adept with the net, having the natural ability to 'follow through' with a stroke as an insect flew up and went off at an unpredictable angle. He was an exceptional field worker almost to the end of his life.

He was a great practical joker. Once, when leaving Madagascar, he clambered into a wheelchair at the airport to try, unsuccessfully, for an 'upgrade' to business class. Above all, Allen was a really sociable person and a great raconteur. He spoke with considerable knowledge and sparkle on such things as dragonfly biogeography to the British Dragonfly Society. He encouraged many younger embryonic odonatologists to stretch their wings overseas, and expand their interests beyond the confines of the county survey. A number of enthusiasts, not just in Britain, but also in China, Australia and New Caledonia owe a lot to Allen's lively and enthusiastic encouragement. On the global level, Allen will be best remembered for his generic and specific lists, and his work in New Caledonia and Australia. He also offered considerable assistance and advice to Jill Silsby when she was preparing her 'Dragonflies of the World'.

A fuller and more detailed obituary, with a full odonatological bibliography is included in the September 2003 issue of *Odonatologica*. This international dragonfly journal was very dear to Allen and he made some major contributions to it.

Graham is the UK representative for *Odonatologica*

Book review

Oaks, Dragonflies and People: creating a small nature reserve and relating its story to wider conservation issues

Harley Books, Colchester, Essex CO6 4AH, UK (2002) 19 x 24cm, 132pp. plus illustrations on inner front and back covers
£15.95 (softback). ISBN 0 946589 71 2

Text and colour plates and many of the black-and-white illustrations by **Norman W. Moore**

Conservationists and odonatologists are always likely to welcome a book by Norman Moore. This book, presented from a very personal perspective, is no exception. Its title describes the contents well: Part I of the text (comprising 8 chapters, 73 pages and 3 appendices) treats local issues (one cannot get more local than one's own garden!) and Part II (7 chapters and 24 pages) addresses national and global matters. Part I describes, in minute, blow-by-blow detail, the gradual transformation of Norman's Cambridgeshire property into a 1.5-acre nature reserve over a period of about 40 years. Here we learn of Norman's objectives and of the steps by which most of them were achieved. The account is comprehensively amplified by lists of species of trees, flowers, vertebrates, dragonflies and butterflies, together with their chronology of appearance, population fluctuations and reproduction. (Norman is expert in ornithology as well as odonatology.) Successes and setbacks are given equal exposure and scrutiny, in order to reveal their underlying causes. This Part, with its chronological tables and personal anecdotes about family and friends, is presented in a leisurely style reminiscent in places of a naturalist's diary, imparting an informality to the account that will appeal to many readers, especially those acquainted with the *dramatis personae*. The pearl in the oyster for odonatologists will undoubtedly be section E of Chapter 8 which describes, again in great detail, the chronology of the creation and colonization of the pond that Norman designed, constructed, and subsequently managed expressly as a habitat for dragonflies. This section, and the relevant part of Appendix 1, vindicate Norman's detailed approach to describing the minutiae of his conservation projects. I expect that naturalists and conservationists with a practical bent will find Part I of the book especially useful and encouraging. It stands as convincing testimony to Norman's legendary skills as a naturalist and to his ability to apply ecological principles to habitat management.

In Part II Norman aims to examine, and prescribe, strategies for conservation on a national and then a global scale. He examines the apparent dilemma faced by elected politicians in a parliamentary democracy, and their reluctance to address other than short-term issues. Recognizing that nature conservation is the loser as long as this attitude (exacerbated by human greed and timidity) prevails, Norman proposes a concept in politics to be known as 'Future Care', exponents of which would urge their constituents

to advocate and pursue policies that address the demands of the two 'real worlds': daily life, commerce etc. on the one hand, and the natural world and its life-support systems on the other. Norman, himself a pioneer in demonstrating the value of long-term studies (e.g. Moore, 1991, 2001), is well qualified to advocate such an initiative. Most thinking individuals, be they ecologists or not, nowadays agree that the near-universal short-termism that characterizes political decisions constitutes a serious deficiency in national and international planning.

There are two points on which I would have welcomed a different emphasis in this book.

The first concerns the impact of domestic cats on wildlife. Cats kill large numbers of small mammals and birds and thus directly and seriously frustrate the objectives of conservationists. To the dismay of many, the cultural norm in Britain is to turn a blind-eye to this form of environmental impact; indeed few conservation bodies will risk offending (and so possibly losing) members by advocating legislation to limit the damage on wildlife inflicted by cats. Accordingly, the cause of nature conservation would benefit were spokesmen of Norman's iconic status to 'call a spade a spade.' Yet, although on page 60 Norman surmises that 'tame cats from neighbourhood homes' were the main predators of small mammals, including water voles, living on his reserve, on page 59 he comments, apparently without embarrassment, that his family's cat, by virtue of her 'hunting skills' provided him with records of at least eight species of mammal, including bats. The paradox here is impossible to ignore.

The second point concerns Norman's analysis in Chapter 13 'Conserving wildlife conserves humans.' Here he avers (page 96) that 'Clearly, if humans wish to survive they must give top priority to ensuring that both abundant and "key" species are not seriously damaged by pollution or excessive exploitation.' Then in Chapter 14, 'Care for the future in the present' he identifies the main obstacle to progress as the commitment to short-term goals and the neglect of the precautionary principle, declaring that people need to recognize and reconcile priorities from the two 'so-called "real worlds"' (as defined earlier in this review). On page 95 he notes that the world's human population is set to increase for at least several decades and acknowledges that 'this will reduce conservation options for most other species.' Nowhere else in his enumeration of obstacles or solutions is the human population mentioned. Here would have been another opportunity for transmitting a valuable message. Ecologists and many others have long agreed that the greatest threat to the ability of the biosphere to sustain life, including of course human life, is the size and unrestrained growth of the human population.(e.g. Cloud, 1969; Ehrlich & Holdren, 1971; Southwood, 1972). This situation becomes more, not less, serious by being side-stepped. This primary threat therefore needs to be given prominence, or at least acknowledged, at every opportunity, especially when an ecologist of recognized authority presents an analysis of menaces to the future welfare of *Homo sapiens*. Only by such exposure and advocacy can we hope that, eventually, national governments, international councils and NGOs (Non-Governmental Organizations) will

acknowledge the need for policies designed to retard or halt this ominous trend. Many ecologists will be disappointed that this thought-provoking and attractive book does not identify human population pressure (at its present, as well as projected, levels) as the pre-eminent threat to the integrity of the biosphere.

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Philip Corbet

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 manuscrips may be submitted in electronic format either on disk or by e-mail.

Typewritten manuscripts should be produced using black ribbon, double-spaced, on one side of the page only and with margins at least 25mm at the left, top and bottom. Text pages should be numbered and footnotes avoided.

Words that are to appear in italics (e.g. names of genera and species, though not of families) should be underlined if an italic font is not available.

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.

Dates in the text should be expressed in the form: 24 July 1994.

References cited in the text should be in the form '(Longfield, 1949)' or '... as noted by Longfield (1949)'. All references cited in the text (and only these) should be listed alphabetically at the end of the article in this form:

Hammond, C. O. 1983. *The dragonflies of Great Britain and Ireland.* 2nd edition (revised by R. Merritt). Harley Books, Colchester. 116 pp.

Longfield, C. 1949. The dragonflies of the London area. *The London Naturalist* 28: 90--98.

Titles of journals should be written out in full.

Tables should be presented, each on a separate, unnumbered page.

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Figures should be prepared in black ink, and scaled to allow a reduction of 1.5 to 3 times.

The legend for each table and illustration should allow its contents to be understood fully without reference to the text. The approximate position of each table and figure should be indicated in the text.

SCIENTIFIC AND ENGLISH NAMES OF BRITISH ODONATA

ZYGOPTERA	DAMSELFLIES
Calopteryx splendens	Banded Demoiselle
Calopteryx virgo	Beautiful Demoiselle
Chalcolestes viridis	Willow Emerald Damselfly
Lestes dryas	Scarce Emerald Damselfly
Lestes sponsa	Emerald Damselfly
Ceriagrion tenellum	Small Red Damselfly
Coenagrion armatum	Norfolk Damselfly
Coenagrion hastulatum	Northern Damselfly
Coenagrion lunulatum	Irish Damselfly
Coenagrion mercuriale	Southern Damselfly
Coenagrion puella	Azure Damselfly
Coenagrion pulchellum	Variable Damselfly
Coenagrion scitulum	Dainty Damselfly
Enallagma cyathigerum	Common Blue Damselfly
Erythromma najas	Red-eyed Damselfly
Erythromma viridulum	Small Red-eyed Damselfly
Ischnura elegans	Blue-tailed Damselfly
Ischnura pumilio	Scarce Blue-tailed Damselfly
Pyrrhosoma nymphula	Large Red Damselfly
Platycnemis pennipes	White-legged Damselfly
ANISOPTERA	DRAGONFLIES
Aeshna caerulea	Azure Hawker
Aeshna cyanea	Southern Hawker
Aeshna grandis	Brown Hawker
Aeshna isosceles	Norfolk Hawker
Aeshna juncea	Common Hawker
Aeshna mixta	Migrant Hawker
Anax imperator	Emperor Dragonfly
Anax junius	Green Darner
Anax parthenope	Lesser Emperor
Brachytron pratense	Hairy Dragonfly
Hemianax ephippiger	Vagrant Emperor
Gomphus vulgatissimus	Club-tailed Dragonfly
Cordulegaster boltonii	Golden-ringed Dragonfly
Cordulia aenea	Downy Emerald
Oxygastra curtisii	Orange-spotted Emerald
Somatochlora arctica	Northern Emerald
Somatochlora metallica	Brilliant Emerald
Crocothemis erythraea	Scarlet Darter
Leucorrhinia dubia	White-faced Darter
Libellula depressa	Broad-bodied Chaser
Libellula fulva	Scarce Chaser
Libellula quadrimaculata	Four-spotted Chaser
Orthetrum cancellatum	Black-tailed Skimmer
Orthetrum coerulescens	Keeled Skimmer
Pantala flavescens	Globe Skimmer
Sympetrum danae	Black Darter
Sympetrum flaveolum	Yellow-winged Darter
Sympetrum fonscolombii	Red-veined Darter
Sympetrum nigrescens	Highland Darter
Sympetrum pedemontanum	Banded Darter
Sympetrum sanguineum	Ruddy Darter
Sympetrum striolatum	Common Darter
Sympetrum vulgatum	Vagrant Darter

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A full checklist can be found on the inside back cover of Dragonfly News.

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