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Front cover illustration: Damselfly Erythromma viridulum by Gill Brook.

Oviposition behaviour of the two British species of Red-eyed Damselflies *Erythromma najas* (Hansemann) and *E. viridulum* (Charpentier)

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Summary

A study of the oviposition behaviour of the Red-eyed Damselfly *Erythromma najas* (Hansemann) and the Small Red-eyed Damselfly *Erythromma viridulum* (Charpentier) was carried out during July and August 2003 and 2004 at sites in Bedfordshire. With the relatively recent colonization of Britain by the latter, there is very little published information on its natural history. This study presents observations on oviposition behaviour, including group oviposition in response to the threat of predation.

Introduction

Both species of *Erythromma* oviposit in tandem immediately after copulation. Tandem pairs of *E. najas* are known to submerge to varying degrees. Observations show that sometimes the female submerges completely, with the male contact guarding above the surface of the water. On other occasions the male may submerge to accompany the female. In contrast, females of *E. viridulum* have not been reported to submerge when ovipositing in tandem. Previous work on oviposition behaviour of species of *Erythromma* suggests that *E. viridulum* shows a much greater tendency to oviposit in groups (from observations in the Camargue, France) when compared to *E. najas* (in Oxfordshire) (M. Elvidge, pers. comm.; Elvidge, 1984). Group oviposition behaviour is known from a number of species of Zygoptera and is thought to increase breeding success and survival (Corbet, 1999 (Section 2.2.6); Elvidge, 1984). The discovery of *E. viridulum* at several sites close to the author's home in Bedfordshire has provided an opportunity to study this behaviour.

The study site

Wrest Park is an English Heritage estate at Silsoe, Bedfordshire. It comprises a series of artificial lakes and ponds that attract 16 species of Odonata. Of particular note is the exceptionally large population of *E. najas* numbering many thousands of adults. *E. viridulum* was recorded for the first time at two ponds in the park during August 2002. The appearance of this species had been expected, as the habitat appeared visually ideal. The lakes and ponds contain large expanses of Hornwort (*Ceratophyllum demersum*) and Yellow Water-lily (*Nymphaea lutea*) favoured by this species. During the summer of

2003 the increased numbers of *E. viridulum*, following successful breeding at the site, enabled detailed observations to be made. In 2004, populations had increased further with the species now present on all the lakes in the park.

At the larger lakes, the very high numbers of damselflies present made detailed study difficult. The 'Leg of Mutton', one of the smallest ponds in the park, was particularly suited to detailed observation. It is a relatively small rectangular pond with boarded edges. In addition to the above plants, small patches of Broad-leaved Pondweed (*Potamogeton natans*) were present. All parts of the water can be observed through binoculars allowing favoured oviposition areas to be quickly identified and observed in detail. During study visits at the peak of the flight periods 100–200, *E. najas* and 20–30 *E. viridulum* would be present at the pond and its immediate surrounds. In 2004, the numbers of the latter had increased to around 50–100 individuals, including tandem pairs. Other species included Common Blue Damselfly *Enallagma cyathigerum* Charpentier, Blue-tailed Damselfly *Ischnura elegans* (Vander Linden), Black-tailed Skimmer *Orthetrum cancellatum* (L.) and Brown Hawker *Aeshna grandis* (L.). The 'Leg of Mutton' pond is stocked with fish comprising Carp (*Cyprinus carpio*) up to 40cm and large shoals of small Rudd (*Scardinius erythrophthalmus*). These are both potential predators of dragonflies.

Whenever possible all oviposition behaviour at the study site was photographed at approximately

Observations

Under suitable weather conditions for adult activity, the males of both species would typically take up resting positions on floating vegetation from 0900h and await the arrival of females. Both species were observed ovipositing during all visits to the site at the peak of the season. On days with

conditions warmed up. Furthermore, if conditions changed, *E. viridulum* would 'disappear' during dull periods, unlike *E. najas*, which usually remained. Oviposition behaviour usually started at about 1100h and continued through to late afternoon.

The following observation on the main lake (17 July 2003) is a typical for *E. viridulum*:

- 1000h Males present and distributed around the site, resting on floating plants
- 1045h Female observed resting on floating plants within 3m of bank
- 1048h Exploring male flying low over water detects female and takes her in tandem. The pair rests on lily pad for approximately one minute. Pair then moves further from bank to another lily pad.
- 1 101h Male transfers sperm to secondary genitalia (ST) whilst in tandem
- 1105h Copulation commences. Pair moves further out onto Hornwort.
- 1115h Copulation finishes and oviposition into Hornwort commences in tandem.

Tandem pairs of both species would frequently approach within 0.5m of the bank on the study pond searching for oviposition sites. This facilitated clear observation of plant selection and photographs of this oviposition behaviour were taken above and below water. *E. najas* was observed to utilise both Hornwort and Broad-leaved Pondweed for oviposition, whereas *E. viridulum* would only oviposit in Hornwort.

Tandem pairs of *E. najas* exhibited a marked tendency for the female to partially or fully submerge to oviposit. When numbers were high, and hence there was more competition for females, the tandem pair would completely submerge. *E. najas* is one of the few species of damselfly in Britain where the male submerges in tandem during oviposition. This behaviour is understandable as single males would often attack tandem pairs in an attempt to dislodge the male.

Both species showed a tendency towards group oviposition, both intra- and interspecific. Ovipositing tandems of each species appeared to attract both conspecific and heterospecific tandems to form ovipositing groups. On a number of occasions pairs would be within a few centimetres of each other and would even touch or crossover. During one observation in 2003, six ovipositing tandems (five pairs of *E. najas* and one of *E. viridulum*) were photographed on a small clump of Hornwort of no more than 15 cm^2 . In 2004 up to ten pairs could be seen together in key areas.

During the course of observations it became apparent that whenever fish approached the tandem pairs they would be detected and the pairs would take off. The tandem pairs were able to detect either the underwater movement of the fish, or the ripples they caused. Carp were easily avoided due to the large bow wave they create. It is unlikely that this species was actually hunting damselflies. However, small Rudd appeared to actively hunt damselflies and would make swift dashes towards ovipositing pairs. When ovipositing in groups, the escape response of one pair would result in a similar response by the others. It was difficult to quantify the exact response times yet tandem pairs of *E. viridulum* tended to be more 'skittish' than *E. najas* and would react to the slightest disturbance. This was particularly noticeable whilst trying to take close-up photographs of the two species ovipositing alongside each other. *E. viridulum* would always be the first to fly away when disturbed.

When tandem pairs first arrive to oviposit the male hovers in the sentinel position (Corbet, 1999), whilst the female commences oviposition. This may enable the pair to remain ready to escape should a predator attack occur. After 30–120 seconds the male would settle to a horizontal posture using one pair of legs resting on the plants or water surface. This behaviour was observed for both species.

On several occasions fish attacks on ovipositing females were observed. One such attack, by a small Rudd, resulted in the loss of a female *E. najas*. The tandem pair was attacked from below with the fish grabbing the female. The male was able to escape. The female

was partially swallowed by the Rudd as it swam away, leaving the tip of the abdomen projecting from its mouth.

On another occasion a female *E. najas* was observed on the Hornwort, apparently attracting the attention of other males. This female was in some distress and retrieved by the author. It was found to still be alive, but with its entire abdomen bitten off by the fish attack. The remaining part of the body which included the head, thorax and wings were enough to elicit mating responses from conspecific males and males of *E. wridulum*, *E. cyathigerum* and *I. elegans*. The latter was photographed attempting tandem with the 'partial' female after it had been retrieved.

Discussion

There are few published references of *Erythromma* species completely submerging as tandem pairs (Corbet, 1999; Elvidge, 1984; Winsland, 1983). In this study, tandem pairs of *E. najas* would tend to submerge completely when male density, and hence competition, was high. At other times only the female would submerge. This behaviour is similar to that of *Enallagma cyathigerum* and presumably serves as a mechanism for avoiding the attentions of conspecific males searching for females (Cham, 2002).

Group oviposition was observed in both species with no noticeable differences. Such behaviour could result from either attraction to patchy substrates or other ovipositing tandems. Where this has been investigated, the latter has been responsible for the attraction (Corbet, 1999). Females that oviposit in tandem are apparently less susceptible to predation from above the water surface (Corbet, 1999). The sentinel position adopted by males whilst in tandem is considered to be more effective in detecting potential threats than a male adopting a horizontal posture (Corbet, 1999). This would explain why males hover in the sentinel position when the pair has just settled on a new patch of oviposition substrate. To an arriving pair an existing tandem pair may indicate that no recent attack has taken place and that the site may be regarded as 'safe'.

Group oviposition has been shown to serve as an anti-predation function with respect to frogs (Corbet, 1999). If an attack was to occur, the presence of more than one pair may confuse the predator and give a better chance of escape. The observations reported here suggest that it may also apply to predation by fish from below the water surface. The study also suggests that *E. viridulum* is less likely to be predated by fish due to its oviposition behaviour. However, there is a possibility that the lower numbers of this species may have precluded the need for underwater oviposition. Based on observations by Elvidge, as well as the 2004 observations in Wrest Park, it would appear that *E. viridulum* never submerges even when numbers are high.

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Migrant and dispersive dragonflies in Britain during 2003

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Summary

With a fine and hot summer and record high temperatures for the UK in August, it was no surprise that 2003 turned out to be an excellent year for dragonflies. As far as migrant and dispersive species were concerned there were many highlights. Several records were received of 'resident' species in very unusual locations, possibly in part due to the extreme weather providing favourable conditions for dispersal. Of the more traditional migrants, Yellow-winged Darter *Sympetrum flaveolum* reappeared in low numbers after an absence of three years, and Red-veined Darter *S. fonscolombii* and more especially Lesser Emperor *Anax parthenope* had a good year. However, the main theme was one of continuing range expansions. Following the first record for Britain during 2002, Southern Emerald Damselfly *Lestes barbarus* was again observed in eastern England, with single individuals seen at two sites. There was also a record of a possible Banded Darter *S. pedemontanum*. On a more local scale, several British residents continued their expansion northwards, and Scotland recorded at least two 'firsts' (Emperor Dragonfly *A. imperator* and Broad-bodied Chaser *Libellula depressa*) during the course of the year.

Account of Species

Important records received by the Migrant Dragonfly Project during 2003 are summarized below. For details of events in Ireland, readers should consult the DragonflyIreland website (Nelson *et al.*, 2004). For a summary of events in Britain during 2002 see Parr (2003).

Calopteryx virgo (L.) - Beautiful Demoiselle

There was some indication that the extreme summer weather resulted in greater dispersal of this species than normal, perhaps due to drying out or overheating of some of its breeding streams. In north-west England, a male was seen briefly in a garden at St Annes, Blackpool, Lancashire, in mid July (via PM) and another was observed flying along the shoreline near Heysham, Lancashire, on 5 August (PM). Further south, an individual reported from Gugh, Isles of Scilly, on 16 August (via KP) was some 45km from known colonies on the mainland.

Calopteryx splendens (Harris) - Banded Demoiselle

During summer 2003 there were a number of unusual records of C. splendens at coastal

localities in eastern England away from its typical riverine breeding habitats, although there appeared no single underlying cause. Individuals were observed at Spurn, East Yorkshire, on 15 June (TM) and 20 July (LD), at Landguard, Suffolk, on 25 June (NO), at Bradwell-on-Sea, Essex on 11 and 20 July (SDe) and on the beach at Gibraltar Point, Lincolnshire, on 7 and 18 August (via TS). Interestingly, the first record of this species from the German North Sea coastal region of Ostfriesland also occurred during June 2003 (Rettig, 2003).

Lestes barbarus (Fabricius) - Southern Emerald Damselfly

Following the first sightings from Britain during 2002 (Nobes, 2003), more records were forthcoming during 2003:

20 July

21 August Male photographed at Sandwich Bay, Kent (P. Forrest)

The Norfolk individual was found close to where the species was first observed during 2002, although it is unclear as to whether

individual seen during a period of known immigration may be another primary immigrant. However, this species remains a potential colonist.

Erythromma viridulum (Charpentier) - Small Red-eyed Damselfly

This species now appears to be well established as a British resident. At single sites in Suffolk and Essex, maximum counts of over 1000 were recorded in 2003, with 2500 reported from near Lowestoft

apace. The first records for Surrey were made during the year at Mitcham Common and Blindley Heath. In Sussex, the only previously documented record (during 2002) was from Icklesham in the far south-east of the county but, during 2003, *E. viridulum* was recorded at five sites scattered throughout the eastern half of the county. Elsewhere the species appeared for the first time in north-west Suffolk with records from Lackford Lakes Suffolk Wildlife Trust Reserve, and further inland the species also continued to consolidate, with several reports from eastern Hertfordshire close to the known Bedfordshire sites.

Now there is a substantial resident population, the degree of continuing immigration from the Continent is difficult to assess. A record of twelve from Winterton Dunes, Norfolk, on 20 July may refer to migrants as the habitat here appears sub-optimal for the species and previous breeding attempts at the site have most likely failed (Nobes, 2003). Low numbers at Eccles-on-Sea, Norfolk, on 22–23 August and 21 September were also considered to be migrants as the flight period of the resident population at this site was seemingly finished by 2 August (NB). In addition to these records, an individual was also recorded at a UV light at Icklesham, Sussex, on the night of 29 July (Jones, 2004). These unexpected sightings from coastal regions could well represent fresh immigrants from the Continent, especially as the Winterton record coincided with records of other more obvious immigrants in eastern England. It should, however, be noted that what appeared to be a mass dispersal of locally-bred individuals was observed at Bradwell-on-Sea, Fssex, during early July (Dewick, 2004).

Elsewhere, the first records of *E. viridulum* for the Channel Islands were received from Guernsey during summer 2003 (Medland, 2004). Since there are currently relatively few observers of dragonflies on these islands, it is possible that the species may have been overlooked for a few years.

Brachytron pratense (Müller) - Hairy Dragonfly

This species has been expanding its range in Britain during the last decade or so, although this is apparently more of an 'infilling' than a directional spread. The most interesting record during 2003 was of a male seen at Meathop Moss, Cumbria, on 7 June (GJ). This is about 100km from the nearest known breeding sites.

Aeshna grandis (L.) – Brown Hawker

One was observed on Lunga, Treshnish Isles, Inner Hebrides, on 25 June (JH *et al.*), following a period of south-westerly winds. Merritt *et al.* (1996) mention a record from Dumfriesshire in the mid 19th century and a further old Dumfries record from the same area is on the national database, but the Hebridean sighting represents the first modern Scottish record. Unconfirmed reports of singles at the Calf of Man on 27 August and 2 October (via TBa) would also seem to indicate significant movement at the northern limit of the species' range during the course of the year. Elsewhere, one was seen arriving off the sea at Gibraltar Point, Lincolnshire, on 24 July (via TS).

Aeshna mixta Latreille – Migrant Hawker

An obvious influx was reported from Spurn, East Yorkshire, on 31 July (BS) and an individual was caught in a UV moth trap near Manningtree, Essex, on the night of 28 August (RF) with the species being unusually common in this general area for several weeks afterwards. The most dramatic events of 2003 however took place further north. An individual claimed from the Calf of Man on 30 August (via TBa) was noteworthy, and significant range expansion was noted in Cumbria, when on 3 September low numbers were observed in the very north of the county at North Plain Farm Reserve. Later that month, the species was discovered at two other sites in the Solway Plain area (Clarke, 2004). These sightings represent the most north-westerly confirmed records for Britain, although it is worth noting that a 'possible' was seen at Brow Well, Dumfriesshire, at the end of August 2003 (GS).

Aeshna isosceles (Müller) - Norfolk Hawker

During 2003, a number of individuals were reported away from traditional breeding sites. The most spectacular record was of a male caught and photographed at Spurn, East Yorkshire, on 20 July (BS). Several individuals were also observed at Minsmere, Suffolk, during mid June (via RSPB, RH) with a single observed on the Dingle Marshes, Suffolk, on 16 June (via RSPB). A 'possible' had also been seen there on 21 May (LH).

The Spurn individual would seem likely to be an immigrant from the Continent, coinciding with the timing of sightings of *L. barbarus* and *S. flaveolum*. There have been occasional records of other probable immigrants in the past, e.g. one

caught at Landguard, Suffolk, on 1 August

Minsmere (and from nearby Walberswick)

other possibilities exist. There have been occasional records from this area since the early 1990s (Mendel, 1992; P. Taylor, pers. comm.), with several individuals observed at Minsmere in 2001. As the normal generation time is probably 2 years (Brooks, 1999), this raises the possibility that individuals seen there in 2003 may be locally-bred. Although Water-soldier (*Stratiotes aloides*) is not present at Minsmere, continental *A. isosceles* are known to show a much weaker association with this plant than is the case for our own Broadlands population.

Anax imperator Leach – Emperor Dragonfly

The northerly range expansion of this species within Britain continued apace. In Scotland, a male was observed at Clatteringshaws Loch, Galloway, on 15 July (TR, ES, IS) and another was seen nearby between Loch Stroan and Loch Skerrow on 5 September (KMN). A further male was also seen at the Caerlaverock W Dumfries, on 27 August (GS). These are the first confirmed records of adults from Scotland, although a larva of uncertain origin was once discovered in Perthshire (B. Smith, pers. comm.). Slightly further south, there were also a number of records from northern Cumbria during the course of the year (Clarke, 2004) and one was recorded on the Calf of Man on 5 September (via TBa).

Anax parthenope Sélys - Lesser Emperor

After relatively few sightings in 2002, 2003 turned out to be a record year for this species. The following records have been accepted onto the **BDS** database, and there are rumours of additional sightings:

11 June	One at Eccles-on-Sea, Norfolk (N. Bowman)
15 June	One at Glovers Wood, Charlwood, Surrey (D. Healey)
16 June	One near Brierley Hill, West Midlands (B. Marsh)
28 June–15 September	Several (males and females) at Bake Lakes, Cornwall (K. Pellow,
5–9 July, 1 & 10 August	Single males at Dungeness RSPB Reserve, Kent (P. Akers et al.)
7 July	Male at Windmill Farm, Lizard, Cornwall (A
7–8 & 15 July	Single males at the Long Pits, Dungeness, Kent (D. Walker)
12 July	One at Reading, Berkshire (C. Webster)
13–19 July	Male photographed at Lound, Suffolk (A. Easton)
15–26 July	One at Priory Water
19 July	One at Portland, Dorset (P. Durnell)

24 July	One near Devoran, Cornwall (R. Parslow)
8 August	One at Bedfords Park Lake, Essex (C. Jupp, A. Middleton)
9–14 August	One or more males (one photographed) at Marazion Marsh, Cornwall (S. Jones, P. Wragg, M. Reeder <i>et al.</i>)
9–16 August	Male photographed at Wintersett Reservoir, West Yorkshire (S. Denny, M. Thompson)
10 August	Two males at Smallhanger, Devon (V. Tucker)
30 August	One at Kittythirst Pond, Kielder, Northumberland (H. Eales)
12 September	Male photographed at Hope Point, Kent (P. Chantler)

In addition, on 12 July a male was photographed near Castel on the western coast of Guernsey, Channel Islands, by B. Wells and J. Medland.

These records appear to show

June, July (more protracted and maybe representing more than one event) and August. In addition, a small resident population may now be becoming established in southern Cornwall. At Bake Lakes observations were made throughout the summer and early autumn, with a number of different individuals (both male and female) involved. Although some sightings occurred during times of immigration, the overall pattern suggests a local emergence, possibly related to arrivals seen in 2001. Oviposition was observed on 6 August, providing the opportunity for further generations. Successful breeding at this site in 1999 (as well as at another site in southern Cornwall) has already been documented (Pellow, 2000).

Cordulia aenea (L.) - Downy Emerald

One was observed at close range at Spurn, East Yorkshire, on 22 July (JT, BS, AH). This is well over 100km from the nearest known current breeding site in the UK, although there are historic records from less distant sites (Merritt *et al.*, 1996).

Libellula depressa L. - Broad-bodied Chaser

A series of exceptional northerly observations were made during the year, indicative of either a continued range expansion or some more specific migratory event(s). The first ever record for Scotland was reported on 25 June, when one was photographed at Craiglockhart Pond, Edinburgh (SDa). Slightly further south, a female at Lanercost, Cumbria, on 15 June (MMG) was a first for the north of the county, and records were also received during the course of the year from Stockton-on-Tees and Eaglescliffe in County Durham and from southern Northumberland (via MHu). Three to four males and a female observed at Heysham NR, Lancashire, on 15 July were also unexpected, and represent the first multiple record of this species from the site (PM).

Libellula fulva Müller - Scarce Chaser

This species has been recorded from a number of new localities during recent years, suggesting that it may be starting to expand its range (Cham, 2004). The most notable

record during 2003 was of a mature but apparently unmated male photographed near Exeter, Devon, on 21 June (HB, DS). This is the first record for Devon, and some 75km from the nearest known breeding sites.

Orthetrum cancellatum (L.) - Black-tailed Skimmer

Reports of *c*.20 basking on the beach at Strete Gate, Devon on 25 June, followed by a sighting of a male on a coastal path at Start Point, Devon, well away from fresh water on 28 June (MC), are highly suggestive of migration. Later in the season one was reported on 2–3 August from St Mary's, Isles of Scilly, apparently the first observation from these Isles.

Orthetrum coerulescens (Fabricius) - Keeled Skimmer

A number of observations of this species were made well away from breeding sites during 2003. One near Bishops Stortford, Hertfordshire, on 10 July (AB) was the first recent record for the county. In Norfolk, a well-known colony exists at Holt Lowes but records up to 45km away at Dersingham, Winterton Dunes and Crostwick on 10, 15 and 18 August respectively (via PT) were exceptional. These sightings may perhaps reflect dispersal away from the Holt colony brought about by the extreme weather experienced during early August, although a more distant origin is possible.

Sympetrum striolatum (Charpentier) - Common Darter

Somewhat surprisingly, given the extent of migration/dispersal seen with many other mobile species, the year appeared a relatively quiet one for movements of *S. striolatum*. It is possible that some movements may have been overlooked. Sixteen were caught at a UV light at Bradwell-on-Sea, Essex, between 20 July and 20 September, with a peak catch of three on the night of 3 August (SDe). One was similarly caught at a UV light on Portland Bill, Dorset, on the night of 5 August (MC).

Sympetrum fonscolombii (Sélys) - Red-veined Darter

This species continued its recent run of good years, with both locally-bred and high numbers of migrant individuals reported. In all, records were received from over 15 counties in the UK (Cornwall plus the Isles of Scilly, Devon, Dorset, Hampshire plus the Isle of Wight, Sussex, Kent, Essex, Suffolk, Norfolk, Gloucestershire, Worcestershire, Lincolnshire, Derbyshire, Lancashire, Fast Yorkshire and County Durham), with an additional sighting from Guernsey,

Small-scale spring emergences were recorded from Sheviock, Cornwall (KP), and from Spurn, East Yorkshire (BS). At both sites the first teneral individuals were seen on 30 May, with further emergence taking place over the next 2–3 weeks. Although these were the only definite records of locally-bred individuals during the early part of the season, it is possible that further unrecorded emergence may have also taken place elsewhere. For instance, at Heysham, Lancashire, a gradual build up of adults seen during June/early July (PM) does hint at a local emergence, especially since some individuals did not appear fully mature on first appearance.

In addition to the local individuals, many obvious migrants were also recorded during spring and summer. A mature adult was seen at Dungeness, Kent, as early as 6 May, and some substantial arrivals occurred in later months. There seemed to be a distinct influx around 14–16 June, when individuals were seen in Hampshire, the Isle of Wight, Norfolk and two sites in Cornwall. Another surge of records took place in the first half of July, with new sightings from further sites in Cornwall, and from Dorset, Kent, Gloucestershire, Worcestershire and County Durham. Both these influxes coincided with arrivals of *A. parthenope*. Late July and early August saw a scattering of records from the south coast and East Anglia, but things then went relatively quiet for a while. A count of 60 males at a site on the Lizard, Cornwall, on 19 August (SJ) is however noteworthy; especially coming at a time when most adults at other sites had apparently died off.

The first record of an autumn immature was from Breage, Cornwall, on 17 August (closely followed by a teneral from Worcestershire on 19 August (SW). In the following months, local emergence was noted at other sites in these two counties, but numbers were surprisingly low given the excellent weather enjoyed during most of the summer. In keeping with these low numbers, autumn records away from known breeding sites were also rather scarce. A record from Derbyshire on 19 September (CB) was of considerable local interest, but most late season migrants were reported from south-west England. These included records from the Isles of Scilly, most notably one caught at light on St Agnes on 12 October (TD), as well as from the headlands of Rame Head and Prawle Point on the south Cornwall/Devon coasts. One was also reported from on board a ship in the western approaches to the English Channel on 3 October (TBr). Presumably at least some of these records refer to individuals dispersing from breeding sites in southwest England.

Sympetrum flaveolum (L.) - Yellow-winged Darter

Five singletons were reported during the year, representing the first Britain records since 2000. A male was observed at Gunton, Suffolk, on 20 July and one was reported from Great Yarmouth, Norfolk, on 27 July (SS). Single individuals were also recorded from north-east Hampshire at Hawley Woods on 25–26 August, 26 August

Sympetrum sanguineum (Müller) – Ruddy Darter

In contrast to *S. striolatum*, significant migration of *S. sanguineum* was evident during the year. At Bradwell-on-Sea, Essex, 11 were caught at UV lights between 4 and 19 August (SDe). There was

the species is normally very local. A male was seen at Devoran, Cornwall, on 1 August (RP) and another was observed at Slapton Ley, Devon, on 25 August (DS). One on St Martin's on 28 August was apparently the first record for the Isles of Scilly.

Sympetrum danae (Sulzer) - Black Darter

2003 produced several records from areas well

populations. On the east coast, one seen at Bradwell, near Great Yarmouth, Norfolk, over the period 14–17 July (KK) coincided with the presence of *A. parthenope* at nearby Lound (see above). Other isolated east coast individuals were seen later in the season: in Suffolk at Minsmere on 23 September (RH) and in East Yorkshire at Tophill Low on 20 September (MHo) and Kilnsea on 6 October (BS). Elsewhere a male was observed at Devoran, western Cornwall on 22 August (RP) and one was present at Afton Down, Isle of Wight on 20 October (SKJ).

Sympetrum pedemontanum (Allioni) - Banded Darter

This species is known to be expanding its range in Europe (Wasscher, 1994), although in Britain the only confirmed record is of a male seen and photographed on the southern flanks of the Brecon Beacons north of Ebbw Vale on 16–17 August 1995 (Parr, 1996). A dragonfly with banded wings seen by an inexperienced observer amongst a group of darters at Hickling Broad, Norfolk, on 29 July seems quite likely to have referred to this species. Unfortunately, the full significance of the sighting was not appreciated until it was too late to obtain confirmation. 2003 turned out to be a good year for the species in the Netherlands (R. Hofland, pers. comm.).

Conclusions

The year 2003 was an extremely eventful one as far as migrant and dispersive dragonflies were concerned. One of the reasons for this must surely have been the prolonged periods of fine, often very hot, weather experienced during the summer. Some resident species seemed to show enhanced dispersal, perhaps triggered by the exceptional weather. There were also a number of obvious influxes of 'southern' migrant species such as *Sympetrum fonscolombii* and *Anax parthenope* observed during the year. Immigration was not, however, restricted to these species, and influxes apparently from the east were also observed. Most are likely to have originated from the near Continent, but more distant sources can not alwave be excluded.

Although some of the migrants observed during the course of the year have a long history of appearing in Britain, others such as *A. parthenope* are of more recent appearance and yet others such as *Lestes barbarus* have only been seen in the last few years. Thus, it is clear that the shifts in distribution of many European species of Odonata that have been observed over the last two decades are continuing to progress. New species, such as *Erythronna viridulum*, have successfully colonized Britain, and 2003 saw further evidence for range expansions of resident species, with Scotland recording two notable 'firsts' for the country. Although the importance of climate change as a driver of range changes in all of these species is not yet understood, it is clear that studies of the British dragonfly fauna are now of more than local relevance. It will be very significant to observe the unfolding pattern during years to come.

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Population expansion of the Hairy Dragonfly Brachytron pratense (Müller) and other breeding dragonflies of the Nene Valley in Northamptonshire

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Summary

The River Nene valley is the primary habitat for Odonata in Northamptonshire, hosting breeding populations of 18 of the 19 resident species. A series of gravel pits, many of which are managed nature reserves, have created excellent habitats for these typical lowland species. The data from the survey reported on in this paper has been included in a report to English Nature to support the case for expansion of the Nene Valley SSSI suite with the recommendation that some pits are designated as SSSI based purely on their assemblages of dragonflies.

Following an apparent decline since the 1950s, the Hairy Dragonfly Brachytron pratense is now firmly established as a breeding species in the Nene Valley gravel pits, and breeds in fishing pits, country parks, dykes and managed nature reserves. The main dispersal route into the valley appears to have been along the River Nene corridor from the Cambridgeshire gravel pits located to the north-east. The expansion during the early 1990s coincided with a general range expansion in southern England. The Hairy Dragonfly appears absent from the newer heavily commercial pits, such as Billing Aquadrome south of Northampton, where the leisure uses of the pits may be incompatible with wildlife management, and from those pits with an open aspect such as those found in the Northampton, Hardingstone and Clifford Hill areas. Confirmed breeding is concentrated to the east of Northampton, with only occasional sightings to the west. Breeding sites in Northamptonshire are associated with moderately dense emergent vegetation, floating decaying plant debris, shallow water margins and the presence of Common Club-rush, Bulrush, sedges, Reed Canary-grass and Reed Sweetgrass. Ditchford Lakes and Meadows Nature Reserve is the primary breeding site, based on the number of exuviae collected. Breeding has been proven at one site away from the Nene Valley gravel pits and with regular sightings at others, the indications are that the Hairy Dragonfly continues to expand its range in the county, and may soon be recorded at other suitable habitats.

Introduction

The Nene Valley in Northamptonshire is an internationally important area for wintering waterbirds. The Royal Society for the Protection of Birds (RSPB) is promoting an increase in the area covered by Sites of Special Scientific Interest (SSSI) within the valley and for the valley to be designated as a Special Protection Area (SPA) under the EC Directive on the Conservation of Wild Birds and as a Ramsar Site under the Ramsar Convention on Wetlands. The collection of biological survey data is essential to support proposals to enhance the conservation status of such sites. Whilst extensive data are available covering the wintering waterbirds, information on other taxa was relatively scarce, so in 2003 a project was initiated to determine the wider conservation value of the Upper Nene Valley gravel pits.

This paper reports on our work to establish the number and distribution of breeding Odonata in the Nene Valley, part of the larger overall project. Although not the primary driver for the RSPB work, the breeding dragonfly data will be used to support the case for expansion of the Nene Valley SSSI suite.

The Nene Valley in Northamptonshire

The River Nene is the major waterway running through Northamptonshire, rising near Badby to the west of Northampton, connecting to the Grand Union Canal at Northampton, and leaving the county at Wansford. It is a slow-flowing lowland river with a wide, navigable channel and numerous, narrow, meandering backwaters. Treated sewage effluent makes up the bulk of the summer flows. Consequently the river is classified as eutrophic, with high plant productivity and organically rich mud (Northamptonshire County Council, 2003).

Over the last 40 years, the Nene Valley has been exploited for its mineral deposits, in the form of sand and gravel extraction. This extraction industry has created a substantial gravel pit complex, with many of the lakes being transformed through specific restoration projects and by natural processes into valuable wetland habitats. The valley includes some of the best wetland habitats in the region and is internationally important for wintering Golden Plover (*Pluvialis apricaria*) and Gadwall (*Anas strepera*). The Wildlife Trust for Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough manages several nature reserves within the complex.

Fishing is a popular recreational pursuit both on the river and in the lakes. The wild fish population in the river has expanded into the lakes either due to direct connections or through regular winter floods. The Environment Agency and local angling clubs have augmented the fish population through stocking with native fish, such as the Barbel (*Barbus barbus*), and non-native fish, in particular Carp (*Cyprinus carpio*). A few lakes have been stocked with Rainbow Trout (*Salmo gairdneri*) and one with Salmon (*Salmo salar*). Boating on the Nene and water sports on a few of the larger lakes (e.g. the Town

Lake at Thrapston and Grendon Lakes) form the other main commercial and leisure uses of the valley.

Survey Methodology

A number of surveyors were recruited from the pool of contributors to the newly formed Northants Darter recording scheme, and each was allocated a pit complex. As the Nene Valley comprises over 100 lakes, ponds and other wetlands, it was decided that, rather than undertake a comprehensive survey of all sites, a representative sample, including examples of all the major wetland habitats within each area, should be surveyed. The sites surveyed were Kislingbury Gravel Pits, Stortons Gravel Pits Nature Reserve, Summer Leys Local Nature Reserve, Ditchford Lakes and Meadows Nature Reserve, Wilson's Pits Nature Reserve, Stanwick Lakes, Ringstead Gravel Pits and Thrapston Gravel Pits (including Titchmarsh Local Nature Reserve).

A detailed survey methodology, including advice on health and safety, was developed which required records to be collected on a minimum of four visits during the flying season. Surveys were scheduled for mid-May, mid-June, mid-July and mid-August. Surveyors were free to record outside of these dates, and indeed many did so. Surveyors were encouraged to focus on confirmation of breeding by collecting exuviae and recording other signs of breeding, such as teneral and emergent adults.

For recording purposes, Northamptonshire is classified as Vice County 32, which includes the Soke of Peterborough, an area which is now part of the administrative county of Cambridgeshire. For the purposes of this paper, VC32 will be used when referring to the status for the 'recording county' and Northamptonshire for status within the 'current administrative county'. Figure 1 shows a map, plotted using DMAP software (Morton, 1999), illustrating the location of all major sites referred to in this paper. The criteria of Taylor (2003) were used to establish the breeding status of each species.

Breeding Dragonflies of the Nene Valley

Analysis of the survey data showed that 18 species are confirmed as breeding in the Nene Valley. The Atlas of Dragonflies of Britain and Ireland (Merritt *et al.*, 1996) lists a total of 24 recorded species for VC32. The following species are considered vagrants as no proof of breeding has been established and only single adults appear to have been recorded at any one time: Yellow-winged Darter *Sympetrum flaveolum* (L.), Common Hawker *Aeshna juncea* (L.), Club-tailed Dragonfly *Gomphus vulgatissimus* (L.) and Variable Damselfly *Coenagrion pulchellium* (Vander Linden). In the summary tables, the Atlas also lists the Scarce Blue-tailed Damselfly *Ischnura pumilio* (Charpentier), an entry which is in doubt as the Biological Records Centre (BRC) Odonata database for VC32 contains no records of this species and the species map in the Atlas shows no records. Eden (1989) reports a sighting of a female Scarce Chaser *Libellula fulva* Müller in the



Figure 1. Geographical distribution of the recording sites in VC32 referred in the text

valley, which was also reported by Cham (2000). However, in Colston *et al.* (1996) it was stated that there have never been any reliable records of this species in the county. In July 2003, two male *L. fulva* were recorded in the Soke of Peterborough on two occasions, one week apart (D. Sutcliffe, pers. comm.). Including a record of the Downy Emerald *Cordulia aenea* (1...) from Yardley Chase (Cham, 2004), the recognized total of species recorded in VC32 is 25. The total for Northamptonshire remains at 24. The number of species confirmed as breeding in VC32 is 19 (Tyrrell, 2004).

The status within the Nene Valley of each species breeding in the county is summarized in Table 1. From a county total of 19 confirmed breeding species, the Nene Valley total of 18 illustrates that it is probably the key dragonfly habitat in Northamptonshire, comprising the majority of wetland habitats represented in the county.

Table	1:	Breeding Status for Odonata in the Nene Valley, Northamptonshire.
Key: 1	=	Northants Red Data Book Species (Colston et al., 1996)

Northamptonshire Breeding Species	Distribution Status in the Nene Valley
Calopteryx virgo (Linnaeus) (1)	Not Breeding. Habitat not suitable.
Calopteryx splendens (Harris)	Confirmed Breeding. Widespread.
Lestes sponsa (Hansemann)	Confirmed Breeding. Probably under-recorded.
Platvenemis pennipes (Pallas) (1)	Confirmed Breeding. Restricted.
Parenosoma nymphula (Sulzer)	Confirmed Breeding. Widespread.
lectimura elegans (Vander Linden)	Confirmed Breeding. Widespread.
Enallagma cyathigerum (Charpentier)	Confirmed Breeding. Widespread.
Connagrion puella (L.)	Confirmed Breeding. Widespread.
Aeshna mixta (L.)	Confirmed Breeding. Widespread.
Erythromma najas (Hansemann)	Confirmed Breeding. Widespread.
Brachytron pratense (Müller) (1)	Confirmed Breeding. Widespread.
Aeshna grandis (L.)	Confirmed Breeding. Widespread.
Aeshna cyanea (Müller)	Confirmed Breeding. Limited distribution.
Aeshna mixta (L.)	Confirmed Breeding. Widespread.
Anax imperator Leach	Confirmed Breeding. Widespread.
Libellula depressa (L.)	Confirmed Breeding. Limited distribution.
Libellula quadrimaculata (L.)	Confirmed Breeding. Widespread.
Orthetrum cancellatum (L.)	Confirmed Breeding. Widespread.
Sympetrum striolatum (Charpentier)	Confirmed Breeding. Widespread.
Sympetrum sanguineum (Müller) (1)	Confirmed Breeding. Widespread.

Several species have a limited distribution in the valley, for example the Broad-bodied Chaser *Libellula depressa* (L.) was 'confirmed breeding' at Stortons Gravel Pits (R. Eden, pers. comm.) and Stanwick Lakes with adults only recorded at Wilson's Pits and 'probable breeding' at Titchmarsh. *L. depressa* larvae burrow into mud at the bottom of shallow warm ponds, and so avoid coarse gravel-bottomed deep gravel pits, which may limit distribution in the valley. However, although many of the older pits have muddy bottoms (due to silting), this species appears not to have dispersed well in the valley. The Emerald Damselfly *Lestes sponsa* (Hansemann) and Southern Hawker *Aeshna cyanea* (Müller) also exhibit limited distribution, and are possibly declining in the valley, although it is likely that the behavioural characteristics of *L. sponsa* mean it is underrecorded. The Nene Valley is totally unsuitable for the Beautiful Demoiselle *Calopteryx virgo* (L.), which is restricted to the River Cherwell and the River Tove, where it often exists side-by-side in equal numbers with the Banded Demoiselle *Calopteryx splendens* (Harris).

The formation of a new 'Darter' recording scheme in the county and work for this survey uncovered previously unknown breeding populations of the Hairy Dragonfly *Brachytron pratense* (Müller) in Northamptonshire. This prompted further research into the status and history of this species, the results of which are detailed in the next sections.

Expansion of the Hairy Dragonfly

The distribution map for *B. pratense* in Merritt *et al.* (1996) shows only a limited recorded presence in VC32, with records in the west of the county from 1923 and 1951. The species was recorded at Castor Hanglands in the east (O.S. Grid Reference TF 119016) in 1971 and was still present in 1990. There is a record of an adult at Kingswood SSSI, Corby in 1985, which is the first recent record for Northamptonshire. Populations appear to have been lost from west Northamptonshire, despite extensive recording during the period covered by Merritt *et al.* This suggests the species was lost from the areas originally recorded. The reasons for this apparent decline are not known or documented, but may be due to post-war changes in agricultural land use.

By the early 1990s, records were appearing from within the Nene Valley, the first of which was near Yarwell in 1993 (Colston *et al.*, 1996) followed by a single adult at Short Wood SSSI on 17 May 1998 (A. Colston, pers. comm.), with undated records at Summer Leys Nature Reserve in the same year. The first recorded sighting at Titchmarsh Nature Reserve was on 29 May 1999 (J. Showers, pers. comm.). These sightings correspond with a recorded range expansion in southern England at about this time (S. Cham, pers. comm.).

The 2003–2004 survey and additional recording has established 'confirmed breeding' status for *B. pratense* along the Nene Valley, from Earls Barton pits, Summer Leys Local Nature Reserve, Ditchford Lakes and Meadows Local Nature Reserve, Wilson's Pits, Stanwick Lakes, Ringstead Pits, Thrapston Pits and Barnwell Country Park. Oviposting females were recorded at Billing gravel pits in 2002 and 2004 (J. Dunkley, pers. comm.) and the current limit of the known distribution to the west is at Kislingbury Pits (R. Eden, pers. comm.), however exuviae have not been found at either site.

Milne (1984) reviewed the dragonfly fauna of the nearby Ouse Valley gravel pits in Huntingdonshire, and found that the older pits were more suited to a wider species assemblage and that the newer pits were in greater use for more ecologically disruptive leisure activities. Interestingly, *B. pratense* was absent form the list of species recorded by Milne, although it is has since colonized the valley (V. Perrin, pers. comm.).

As *B. pratense* favours mature gravel pits (Perrin, 1997), the expansion and flooding of the Nene Valley pits in the late 1980s and the restoration of several of these sites as managed nature reserves in this same time period may have lead to their selection as breeding sites. The well-established populations in the Cambridgeshire gravel pits to the north-east are probably the source of this expansion, using the River Nene as the main dispersal route. *B. pratense* has been present at Felmersham Gravel Pits on the River Ouse in Bedfordshire since at least 1994 (Cham, 2004). Felmersham is *c*.10km to the south of the Nene Valley, with no direct or easily obvious dispersal route to the River Nene.

A series of sightings of adults at the Holcot Arm, Pitsford Nature Reserve, starting on 22 May 1998, coincide with the first recorded sightings in the Nene Valley, and suggest that dispersal away from the valley may have occurred, perhaps using the Brampton Arm of the River Nene to reach Pitsford. Oviposition was observed in the Holcot Pond on 19 June 2000 (J. Showers, pers. comm.). Despite regular Odonata recording at this Wildlife Trust Reserve, no adults were observed in 2001 or 2002 and there is no evidence that oviposition in 2000 lead to successful breeding. Regular recording in 2004 has failed to find any larvae or exuviae.

Contirmed breeding away from the Nene Valley gravel pits was established for the first time in May 2004 with the discovery by the author (MT) of exuviae at Twywell Gullet SSSI, part of the Twywell Hills and Dales Nature Reserve. This follows observations of copulation (D. Goddard) and oviposition (MT) at this site. The dispersal route here may have been the Alledge Brook, a tributary of the Nene.

Other records have been received away from the gravel pits that suggest continued expansion. Males holding territory at Yardley Chase Sane Copse have been recorded over a number of years (D. Goddard), as well as several records from the River Nene, an unsuitable habitat for this species. Two males were clashing over territory on the River Nene at Northampton (M. Piper), and a female was recorded ovipositing into floating debris on a flowing backwater of the Nene at Hardwater Mill (MT). These records on the Nene are indicative of the species' attempts to breed away from its usual gravel pits and are an excellent indication of the success of this species in the County.

The distribution map for *B. pratense*, plotted from data held in the VC.32 'Darter' database using DMAP software (Morton, 1999) is presented in Figure 2. Cham (2004) recommends a 1km resolution for distribution maps; however Figure 2 is plotted at 2km resolution for clarity in publication and to illustrate the individual gravel pit sites rather than individual records. The dashed line indicates the boundary separating the current county of Northamptonshire from the Soke of Peterborough.

Ecology of the Hairy Dragonfly in Northamptonshire

The Nene Valley gravel pits exhibit a range of habitats, from exposed pits with very low levels of emergent and marginal vegetation (examples at Ditchford and Clifford Hill Pits), to those with high levels of shielding from trees, hedges and emergent and marginal vegetation (examples at Wilson's Pits and Stanwick Lakes). These extremes can often be found within the same pit complex, for example at Stanwick Lakes.

Perrin (1999) reviewed the collective knowledge on the habitat requirements of *B. pratense* and concluded that a rich assemblage of emergent and marginal vegetation was important, as well as the shelter provided by surrounding trees. However, in more linear sites, such as drains and dykes in the Norfolk Fens, a more open aspect is acceptable, suggesting that shelter is by no means obligatory. Perrin also reviewed other



Figure 2. Distribution map for Brachytron pratense in VC32 showing recorded breeding status to 2004

aspects such as pH and variety of vegetation, but found no clear common factor linking them with chosen breeding sites.

What appears to link all *B. pratense* breeding sites in Northamptonshire is a sufficient density of emergent vegetation extending from the bank into shallow water margins, and the presence of surrounding trees or woodland. These provide a trap for dead and decaying plant material such as, but not exclusively, broken stems of Common Club-rush (*Schoenoplectus lacustris*) and Bulrush (*Typha latifolia*). The vegetation should not be too dense so as to prevent complete submersion of the material, nor too thin that the material may be removed easily. Similarly, pits with irregular perimeters readily form such traps in

the absence of a sufficient density of emergent vegetation providing there is a sufficient density of decaying material. There is an association with Bulrush, sedges (*Carex* spp.), rushes (*Juncus* spp), Common Club-rush, Reed Sweet-grass (*Glyceria maxima*), Reed Canary-grass (*Phalaris arundinacea*) and Water and Marsh Horsetails (*Equisetum fluviatile* and *E. palustre*), although not all sites have all species. These characteristics are in broad agreement with Perrin (1999) and Cham (2004) for Bedfordshire sites. Sedges provide the main emergence supports. Perrin (1999) reviewed the variety of species at *B. pratense* breeding sites and established no clear pattern. This study has shown that the presence of any individual species is not a requirement, but that there should be a variety of species. A variety of emergent vegetation is more likely to provide the high densities of dead and decaying material necessary for the larval habitat.

During the 2004 season, 51 *Brachytron* exuviae were found at Ditchford Lakes and Meadows Local Nature Reserve, suggesting that this site is the primary breeding site in the county. Large areas of the margins of this old irregular shaped gravel pit are covered in floating decaying Common Club-rush, sedge and horsetail stems.

During pond dipping, larvae have been found clinging to rotting submerged stems of Bulrush at Summer Leys, Ringstead Pits and Ditchford Pits, and females have been observed oviposting into floating decaying leaves and stems of Bulrush, sedges and Common Club-rush.

The apparent lack of proof of breeding at the Holcot Arm, Pitsford Nature Reserve, despite a record of oviposition, may be explained by a consideration of the above characteristics. At first glance, this site appears to be a suitable breeding habitat with surrounding woodlands and dense emergent vegetation. The main marginal and emergent plants are reed (*Phragmites* spp.), sedges and Reed Sweet-grass, with minimal Bulrush and no Common Club-rush. During visits to pond dip for larvae it was noted that the margins shelve away sharply from the very dense bank-side vegetation. The characteristic dead material traps are not present as the vegetation is too dense and very few submerged stems or leaves were extracted during the dipping. This site may be sub-optimal as a larval habitat. The Holcot pond has also been the subject of an infestation of New Zealand Pigmyweed (*Crassula helmsii*) which, despite treatment, has effectively limited emergent plant growth in the main pond.

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Postscript

Mark Piper and Nick Roberts recorded the first sightings of the Small Red-eyed Damselfly *Erythromma viridulum* in Northampstonshire, in August 2004. It was subsequently recorded in the Nene Valley (MT). Confirmation of breeding has not yet been obtained.

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Distribution of the Banded Demoiselle *Calopteryx splendens* (Harris) in northern England: an example of range expansion?

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Introduction

In the British Isles the distribution of the Banded Demoiselle *Calopteryx splendens* (Harris) is considered to be predominantly southern, barely reaching 55°N. In contrast, its range in continental Europe extends into southern Scandinavia, reaching as far as 65°N.

Merritt et al. (1996) stated that it ... is widely distributed in lowland areas of both southern Britain and Ireland', but is absent from Scotland and most of northern England. In addition, Brooks (1997) described it as '... largely restricted to the south of a line drawn between Blackpool and Middlesbrough, with isolated populations in the north of the Lake District'. These isolated populations are from the Solway Plain in Cumbria, where it has been present since at least 1936 (Clarke, 1999). Clarke (1999) suggested that the possibility of natural colonization of this area seems remote and attributed these records to accidental, or even deliberate, release of the species in the early 20th century. On the north-eastern side of the country, there are a number of records from Yorkshire (e.g. on the River Derwent (Sunter, 2002)). However, further north there have been relatively few records prior to 1988. Thus, in County Durham there are a few pre-1961 records from the south of the county just to the north of the River Tees, and C. splendens was recorded during the summers of 1994-1996 at several sites on the River Wear (Gibbins & Moxon, 1998). Further north still, in Northumberland, the earliest record seems to have been in 1988 by L. Silcock (in Jeffries, 2001) on the River Wansbeck. Its presence on this river was confirmed by Jeffries in 1999, who also found it on the River Blyth during visits between 1991 and 2001 (Jeffries, 2001). These Northumberland populations are generally small but appear to be established (Jeffries, 2001).

Many authors have commented on the habitat favoured by the adults of the species as slow-flowing, silty-bottomed rivers and streams (and sometimes canals) with open banksides lined with dense riparian vegetation and often adjoining meadowland (Prendergast, 1988; Siva-Jothy, 1997; Askew, 1988; Goodyear, 2000). Although these conditions are particularly common in southern Britain, where lowland rivers meander slowly, many northern rivers do have stretches of apparently suitable habitat. *C. splendens*



Figure 1. The distribution of *Calopteryx splendens* in the former West Riding of Yorkshire and adjacent areas. Records from: The Biological Records Centre database (courtesy Steve Cham), Sunter (2002), the Wintersett Area Annual Report (1966) and the Wharfedale Naturalists Society Annual Reviews (1997 & 2002). Individual records supplied by David Blakeley, Brian & Jill Lucas, Steve Warrilow. Larval records from the Environment Agency. Dotted lines represent Watsonian Vice-County boundaries. Note that the former West Riding consisted of two vice-counties. Its North-east border follows the R. Ouse and the lower reaches of the R. Nidd.

is a species that is also thought to be very sensitive to pollution (Siva-Jothy, 1997).

This paper explores the possibility that *C. splendens* may currently be undergoing range expansion in the north of England.

Methods

The study area was in the former West Riding of Yorkshire, an area of some 2,275 square miles (about 5,870 square kilometres). To the north and west of this area is the Yorkshire Dales National Park, encompassing the east side of the Pennines; to the south and east the ground is more low-lying. The rivers in the region flow generally eastwards, entering into the Ouse/Humber before flowing into the North Sea.

During the flight periods of 1999–2003 (between late May and mid August), the rivers in the West Riding were searched for adult *C. splendens*; this survey was somewhat Jurtailed in 2002 due to the outbreak of Foot and Mouth Disease. Both presence and desence records were noted.

Records were also obtained from the Dragonfly Conservation Group of the British Dragonfly Society (which holds the odonate database for Great Britain on behalf of the Biological Records Centre), local natural history groups and individual recorders (see legend to Figure 1); larval records were obtained from the Environment Agency. Distribution data are presented using DMap software (Morton, 1999). Only '6-figure' records have been used, although in a few cases, particularly with older records, where accurate site information is available, such records have been inferred for completeness.

Results

The distribution of *Calopteryx splendens* in the West Riding follows that of a typical lowland riverine species and shows a clear affinity with such habitats (Figure 1). The species occurs where the altitude is below about 200m and the rivers flow over a bed composed predominantly of silt, with dense stands of riparian vegetation such as Reed Canary-grass (*Phalaris arundinacea*). These habitat characteristics predominate in the lower reaches of the rivers Ure, Nidd, Wharfe and Torne. The corresponding reaches of the rivers Aire, Calder and Don are more industrialized and/or urban.

In the Yorkshire Dales in the north-west and the Pennines in the west (on the River Washburn and the head waters and tributaries of the rivers Ure, Nidd and Wharfe), *C. splendens* was not recorded. The physical characteristics of the upper reaches of these rivers is an increased flow rate and a predominantly pebble and boulder substrate. The bankside vegetation is dominated by shrubs and trees, giving way at higher altitudes to grass-lined banks again.

In the northern area of the West Riding, on the lower reaches of the rivers Ure, Nidd and Wharfe, *C. splendens* is abundant and widespread. Flowing from high ground in the



Figure 2. The distribution, based on 10km squares, of *Calopteryx splendens* in the north of England up to a) 1976, b) 1982, c) 1990, and d) 2003. a-c are based on previously published distribution maps -- a, Hammond, C. O. (1977) *The Dragonflies of Great Britain and Ireland*. Curwen Books, London; b, Hammond, C. O. (1983) *The Dragonflies of Great Britain and Ireland* (2nd ed.) Revised Merritt, R Harley Books, Colchester; c, Merritt, R., Moore, N. W. & Eversham, B. C. (1996) *Atlas of the dragonflies of Britain and Ireland*. HMSO, London.

Pennines and Yorkshire Dales, these rivers flow through small farming villages and towns. To the mid and south of the region, on the rivers Aire (which flows through Bradford and Leeds), the Calder (which flows through Halifax) and the rivers Don and Dearne (which flow through the heavily populated and industrial areas surrounding Doncaster and Sheffield), populations of *C. splendens* are more patchily distributed, and indeed are absent from long stretches. Furthermore, only very low numbers have been recorded on the rivers Aire and Calder. As these rivers flow through industrial and residential areas the vegetated banks give way to the concrete supports of road bridges and there are long stretches devoid of appropriate vegetation, although there are regions where the species is absent in spite of apparently appropriate bankside vegetation.

In the north-east of England, comparison of the current distribution of *C. splendens* (Figure 2d) with earlier distribution maps (Figures 2a–c) shows that its area of occurrence appears to have increased considerably since 1961. However, when recorder effort is taken into account, most or all of the increase up to 1990 can be accounted for by the increase in the number of 10km squares for which odonate records in general have been received. By then, 21 per cent of the 10km squares in the 100km squares with the O.S. grid letters SE and NZ (which cover most of Yorkshire, Durham and Northumberland) had *C. splendens* to 34 per cent of these squares since 1990 appears to reflect a real increase in the area of occupancy by this species in the north-east of England.

Discussion

On the Solway Plain in Cumbria, *C. splendens* occurs in high numbers on stretches of bank that combine good marginal vegetation with deep slow-flowing water close to the bank. There are also small isolated populations found on the rivers Wampool and Waver (Clarke, 1999). The lower Waver has been reported to have relatively high numbers of breeding *C. splendens* in contrast to the adjacent Wampool, where it has been recorded since 1995 but has apparently not yet established a firm breeding population (Clarke, 1999). It may range considerable distances upstream in search of suitable areas and, in recent years, the species has been recorded from sites not previously known, or in numbers exceeding previous records. Thus, Clarke (1999) concluded that there seems little doubt that *C. splendens* is expanding its range northwards in the north-west of England.

In Great Britain, the most northerly records of *C. splendens*, to date, occur on the rivers Wansbeck and Blyth in southern Northumberland. However, the populations appear to be small and to be somewhat isolated from the nearest populations on the rivers Derwent and Wear in County Durham, 20km to 30km to the south (Jeffries, 2001), which in turn are some 20km north of the most northerly known Yorkshire sites. Habitat characteristics consistent with the presence of *C. splendens* at the Northumberland sites are limited tree

cover and high banks with a diverse riparian vegetation (Jeffries, 2001). However, these characteristics are unusual in Northumberland, where most rivers are fast and turbulent with heavily shaded banks and lacking extensive emergent vegetation (Jeffries, 2001). Thus, a potential barrier to further northward expansion of *C. splendens* may be the lack of availability of suitable habitat. Whilst records on the River Wear in County Durham date back to the late 1980s, it appears that the species is now more widespread and abundant in the area. Gibbins & Moxon (1998) suggested that this expansion may be due to an improvement in water quality following the decline in heavy industry in the region. They also suggested that climatic changes may allow *C. splendens* to establish viable colonies in previously unoccupied northerly latitudes.

In Britain and Ireland the most northerly latitude, to date, for viable breeding populations of the species is 55°N, whereas in Finland it extends to 65°N (Merritt *et al.*, 1996), where winters are colder and summers much shorter than in Britain. However, north of Yorkshire, most British rivers provide little of the characteristic habitat favoured by *C. splendens*, i.e. relatively open habitats with few trees and a flow regime providing well-oxygenated water, sufficient for the establishment of aquatic and riparian vegetation (Goodyear, 2000). However, some such sites do exist and it may well be that the northward movement of the species in England has been impeded hitherto by the pollution of many northern rivers, particularly in central and southern Yorkshire and in Durham and southern Northumberland.

Some Odonata that breed in still waters have also recently expanded their northern range. Thus the Hairy Dragonfly *Brachytron pratense* (Müller) has been recorded in many new areas to the north of its previous range in recent years, prompting the suggestion of range expansion occurring in coincidence with a series of warm summers since 1991 (Perrin, 1999).

The Emperor Dragonfly Anax imperator Leach has also increased in number in the northern part of its range in recent years (Merritt et al., 1996). Possibly as a result of recreation and amenity schemes and the subsequent cleaning-up of former colliery sites, it has been found at several new sites in Derbyshire. Recently, a breeding population has been established in the region of Huddersfield (B. Lucas & J. Lucas, pers. comm.) and the species has been recorded at a number of sites in Yorkshire, including Skipwith Common Nature Reserve, just south of York (J. Lindley, pers. comm.), Fairburn Ings Nature Reserve (B. Copley, pers. comm.) and Spurn (pers. obs.).

Banks (1984) documented the apparent expansion of the Broad-bodied Chaser *Libellula depressa* L. to Ravenglass, Cumbria. Found widely in southern Britain, the species thins out in the north Midlands. It has declined in eastern England from the Fens to Yorkshire probably due to agricultural pressures, especially the loss of farm ponds (Merritt *et al.*, 1996). However, in the early 1980s larvae were found in a garden pond in Ravenglass. No deliberate introduction was made and, although fieldwork had been

carried out in both Hampshire and Ravenglass, there was no apparent source of translocation, although it is not impossible that eggs were transferred from one pool to another by sticking to the mesh of the pond net (Banks, 1984).

Having never previously been recorded in Scotland, the six *Anax imperator* exuviae collected from a garden pond in Edinburgh were undoubtedly introduced as eggs in aquatic plants sent from Hampshire (Smith, 1995). Similarly the Scottish records of the *Azure Damselfly Coenagrion puella* (L.) found near the River South Esk, north of Forfar, Angus (the most northerly for Britain by about 70km) were almost certainly transported to Scotland with aquatic vegetation (Prendergast, 1986). Thus it seems that, for species inhabiting lentic habitats, even with the ability to disperse long distances, the appearance of individuals in previously unoccupied areas may sometimes have dubious origins. The popularity of garden ponds, often stocked with plants of unknown origin, undoubtedly increases the chance of accidental introduction of odonates outside their normal range (Smith, 1995). For riverine species this risk is less great, since they tend not to occur too far away from the lotic habitat and accidental introduction as a result of translocation is unlikely.

In recent years, range expansions have occurred for many taxa, resulting in the colonization of previously unoccupied areas (Alexandrino *et al.*, 2000; Hansson *et al.*, 2000; Husak & Maxwell, 2000). Although not all range expansions can be ascribed to climate change, e.g. the Grey Squirrel (*Sciurus carolinensis*) (Teangana *et al.*, 2000), nevertheless there is increasing evidence that this is the primary cause in many instances (Peterson *et al.*, 2002; Vogel *et al.*, 2002). Geertsema (2000) suggested that the availability of suitable food is the critical factor enabling migrant insects to settle. However, for insectivorous insects, such as Odonata, food availability is less restrictive to range expansion. Furthermore, odonates are not limited to specific prey items.

Many authors have suggested that the quality of the aquatic habitat is critical in determining species richness and abundance of Odonata (e.g. Brooks, 1997; Gibbins & Moxon, 1998) and the distribution of *Calopteryx splendens* in Yorkshire lends credence to the view, reported by several authors (Gabb & Kitching, 1992; Siva-Jothy, 1997), of its intolerance to pollution and associated habitat degradation. For species such as *C. splendens*, which require particular habitat characteristics for successful reproduction and therefore continuation of a viable population, the barrier to range expansion may be a lack of suitable habitat for them to move into, possibly due to pollution, rather than to any temperature effect. This may explain the limited northward extent of the species compared to that in continental Europe.

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Wing clapping in the Blue-tailed Damselfly Ischnura elegans (Vander Linden)

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Summary

Wing clapping by the male during copulation has been described in two species of Anisoptera, the Migrant Hawker *Aeshna mixta* Latreille and the Common Hawker *Aeshna juncea* (L.) (Gibson, 2003). This behaviour is now reported from a species of Zygoptera, the Blue-tailed Damselfly *Ischnura elegans* (Vander Linden). The manner of wing clapping differs between this damselfly and the two species of dragonflies.

Wing clapping behaviour in Ischnura elegans

The camcorder and associated equipment, and video processing, were the same as used when wing clapping in Anisoptera was described (Gibson, 2003). As is usual with standard camcorders, recording was at a fixed 24 frames per second, so setting the resolution with which the timing of the behaviour was recorded.

On 19 August 2003, a pair of Blue-tailed Damselflies *Ischnura elegans* in the wheel position, were observed to alight on and perch upright on a rush stem at Old Moor Wetland Centre, Brierlew, South Yorkshire. Copulation had been in progress for an unknown length of time when video recording began. Recording continued for 5min 20s, at which time a battery change was required. The pair flew off during the battery change, still in the wheel. Although the perch position was moderately well sheltered, the windy conditions were not ideal for recording.

The sequence of wing clapping activity, the only significant activity observed except for some slow genital thrusting by the male, occurred approximately halfway through the recording. The male used only his forewings for wing clapping. In total, seven full wing that source given during the 13 second period of the activity.

Let *a* 1 shows the sequence of behaviours, with the timing (in seconds) given from the start of the wing clapping activity.

Discussion

At all special attention was paid during the 2003 season to the recording of whole species of Odonata in copulation, the sequence on which this paper is based was the species show wing clapping in Zygoptera. Table 1. Sequence of events in wing clapping behaviour of Ischnura elegans

Time (s)

Behaviour

- 0.0 pair in the wheel, nearly vertical, wings folded back, female touching the stalk (Figure 1a)
- 0.4 male begins to open wings, as does female fractionally later
- 0.9 male increases bend in abdomen, thus lifting female higher
- 1.7 male flicks wings twice and lifts female away from stem
- 2.6 male and female spread wings, male hindwings fully open, forewings semi open (Figure 1b)
- 3.0 male wing claps female about the head, using his forewings, which return to semi open
- 3.7 repeat with female lifted higher: line through male-female thoraxes about 45° to vertical
- 4.6 several minor claps, male forewings only opened a little between each clap
- 6.0 brisk, full clap, female then lowered
- 6.4 female lifted back to 45° angle, then clapped, 45° angle retained (Figure 1c)
- 8.1 another clap retaining 45°
- 9.9 another clap retaining 45°
- 11.0 female held just below 45° while male flutters his forewings close to her head
- 13.0 fluttering ends in full clap, male then returns forewings to open position
- 13.2 female lowered towards but not touching stem

A comparison of the wing clapping behaviour reported here for *I. elegans* with that for the two species of Anisoptera, previously described (Gibson, 2003), shows a number of contrasts. In the wheel, the Zygoptera normally have wings folded back, so both pairs must be extended to the open position before clapping. As Anisoptera wings are normally in the open position, they are ready to clap. The Zygoptera male used only its forewings to clap whereas the Anisoptera males mantled the female head and thorax with their hindwings before clapping with their forewings. (Incidentally this shows that once Anisoptera have extended their wings they can be folded back.) The use of only the forewings for clapping by the Zygoptera may represent a major difference from the Anisoptera, providing the observations reported are typical of the two suborders. It is possible that the Zygoptera wing clap is less strong or that no contact is involved, and that there is no need to protect the female's head with hindwings. Another difference observed was that the Zygoptera female was not lifted so high before clapping. This may be simply a matter of Odonata geometry. Not enough of the whole mating sequence of the pair of *I. elegans* was recorded to make any observation as to the stage in the sequence at which the male wing claps.

It was pleasing to observe that at least one species of Zygoptera wing claps, a behaviour which does not appear to have been reported previously. It would be interesting to obtain recordings of similar behaviour from a wider range of species of Odonata to establish whether my observations can be generalized as 'the difference in wing clapping behaviour between the sub-orders is: Zygoptera use their forewings, Anisoptera use their four wings'.



(a) Pair in wheel position

(b) Male and female spread wings, male hindwings fully open, prior to wing-clapping, female lifted away from the stem

(c) Female lifted back to 45° angle (thorax to thorax), then clapped

Figure 1. Stages in wing clapping of Ischnura elegans (see Table 1 for further details).

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Vernacular names for the dragonflies of north-western Europe

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Introduction

The study of British Odonata has a long and rich history, going back at least to the end of the 18th century. For much of this time it was a relatively specialist affair, and species tended to be known simply by their Latin names, there being little drive to develop English language 'common' or vernacular names for use by a wide audience. In this matter the situation differed from more popular areas of Natural History, such as birds, flowers and butterflies. The first serious attempt to develop a systematic naming system suitable for use by a wider audience came in the 1930s from Cynthia Longfield in her book 'The Dragonflies of the British Isles' (Longfield, 1937). Here Latin genus names were typically retained, but each species within a genus was characterised by a suitable English language qualifier. For instance *Calopterys splendens*, then known as Agrion splendens, was referred to as the Banded Agrion, while Sympetrum striolatum was known as the Common Sympetrum. Although perhaps slightly unadventurous, this approach represented the first-ever attempt to develop English language common names for dragonflies anywhere in the world, and did serve to help popularize the study of Odonata. However, there was clearly room for improvement, and by the early 1.8% states system had evolved further, with the publication of the second edition of Hammond (revised by Merritt) (1983) introducing names with the Latinized general being replaced by the now familiar terms demoiselle, hawken chaser skinnen for an

Recent Developments

Although there has been occasional minor debate on one or two issues, e.g. whether *Brachytron pratense* should be called Hairy Dragonfly or Hairy Hawker, the 'Hammond' vernacular names for the British Odonata have stood the test of time – indicative of their sensible and consistent nature. Some further development of English vernacular names has, however, occurred in recent years. Range expansions taking place in northern Europe have brought a number of additional species to our shores, and English names for these have had to be developed. This has been achieved by basing them on pre-existing European names for the species, suitably modified to reflect established British stylistic precedents. Such an approach was first pioneered in the English edition of d'Aguilar *et al.* (1986), whose translation from the French had been overseen by Steve Brooks

Table 1. Vernacular names for the species of ●donata of north-western Europe

ZYGOPTERA

Calopterygidae Calopteryx splendens Banded Demoiselle Calopteryx virgo Beautiful Demoiselle Calopteryx xanthostoma Yellow-tailed

Demoiselle

Lestidae

Chalcolestes viridis Willow Emerald Damselfly Lestes barbarus Southern Emerald Damselfly Lestes dryas Scarce Emerald Damselfly Lestes sponsa Emerald Damselfly Lestes virens Small Emerald Damselfly Sympecma fusca Winter Damselfly Sympecma paedisca Siberian Winter Damselfly

Coenagrionidae

Cercion lindenii Goblet-marked 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 puella Azure Damselfly Coenagrion puella Mariable Damselfly Chenagrion scitulum Dainty Damselfly Enallagma cyathigerum Common Blue Damselfly

Ersthromma najas Red-eyed Damselfly Ersthronma viridulum Small Red-eyed

Damselfly

Innura elegans Blue-tailed Damselfly Infinitia pumilio Scarce Blue-tailed Damselfly Nehalennia speciosa Pygmy Damselfly Porthosoma nymphula Large Red Damselfly

Platycnemididae Matyonemis acutipennis Orange White-legged Damselfly Matyonemis pennipes White-legged Damselfly

ANISOPTERA

Agsinidae Lobina affinis Southern Migrant Hawker Lobina caerudea Azure Hawker Lobina caeruea Southern Hawker Aeshna grandis Brown Hawker Aeshna isosceles Norfolk Hawker Aeshna juncea Common Hawker Aeshna mixta Migrant Hawker Aeshna subarctica Subarctic Hawker Aeshna viridis Green Hawker Anax imperator Emperor Dragonfly Anax junius Green Darner Anax parthenope Lesser Emperor Brachytron pratense Hairy Dragonfly Boyeria irene Dusk Hawker Ilemianax ephippiger Vagrant Emperor

Gomphidae

Gomphus flavi pes Yellow-legged Club-tail Gomphus pulchellus Western Club-tail Gomphus simillimus Yellow Club-tail Gomphus vulgatissinnus Common Club-tail Onychogomphus forcipatus Green-eyed Hook-tail Onychogomphus uncatus Blue-eyed Hook-tail Ophiogomphus cecilia Green Club-tail

Cordulegastridae

Cordulegaster bidentata Two-toothed Goldenring

Cordulegaster boltonii Golden-ringed Dragonfly

Corduliidae

Cordulia aenea Downy Emerald Epitheca bimaculata Two-spotted Dragonfly Oxygastra curtisii Orange-spotted Emerald Somatochlora arctica Northern Emerald Somatochlora flavomaculata Yellow-spotted Emerald Somatochlora metallica Brilliant Emerald

Libellulidae Crocothemis erythraea Scarlet Darter

Leucorrhinia albifrons Eastern White-faced Darter Leucorrhinia caudalis Dainty White-faced

Darter Leucorrhinia dubia White-faced Darter

Leucorrhinia pectoralis Large White-faced

Darter

Leucorrhinia rubicunda Northern White-faced Darter

Libellula depressa Broad-bodied Chaser Libellula fulva Scarce Chaser Libellula quadrimaculata Four-spotted Chaser Orthetrum albistylum White-tailed Skimmer Orthetrum tonneum Southern Skimmer Orthetrum concellatum Black-tailed Skimmer Orthetrum coerulescens Keeled Skimmer Pachydiplax longipennis Blue Dasher Pantala flavescens Wandering Glider Sympetrum danae Black Darter Sympetrum depressiusculum Marshland Darter Sympetrum flaveolum Yellow-winged Darter Sympetrum fonscolombii Red-veined Darter Sympetrum meridionale Southern Darter Sympetrum pedemontanum Banded Darter Sympetrum sanguineum Ruddy Darter Sympetrum nigrescens Highland Darter Sympetrum striolatum Common Darter Sympetrum vulgatum Vagrant Darter Trithemis annulata Violet-marked Darter

The future

Given ongoing trends in the changing distributions of many European Odonata, it has become clear that further English names for new migrants and colonists will likely be needed in the not too distant future. The rapid growth of interest in dragonflies that has taken place in the last decade or so has also led to an interest in developing English names for European species beyond those found in Britain. Although some suggestions are available from d'Aguilar et al. (1986), this is by no means the case for all species. Discussions have therefore recently taken place within the BDS, and with other interested parties, that have been aimed at formalizing a list of English names for all the species found in north-western Europe. In this way, established names will already be available should further species appear in the UK in the near future. People travelling within Europe should also find this list of benefit. Table 1 presents the list of vernacular names for the dragonflies of north-western Europe as agreed for use by the BDS. Already established names have almost without exception been kept, since they are so widely accepted and used, both within Britain and far beyond. Major changes would therefore serve no useful purpose, and could be deleterious. Literally one or two minor changes from past usage have, however, been introduced in order to deal with the large number of species in some genera, or to tidy up anomalies. Perhaps the most immediately relevant is the suggestion that Gomphus vulgatissimus be referred to as the Common Club-tail ('vulgatissimus' meaning common) in order to fit it more appropriately within the wider group of club-tailed dragonflies.

At this point it is worth reminding readers that some other English speaking countries use a slightly different approach to naming their species. In America, for example, the Demoiselles are known as Jewelwings, and the Darters are Meadowhawks. The use of alternative styles in a European context has recently been put forward in the new Irish publication 'The Natural History of Ireland's Dragonflies' (Nelson & Thompson, 2004). The BDS has discussed the merits of these alternatives, and has concluded that in a British context they offer few advantages and considerable disadvantages. The Society therefore reaffirms its commitment to the use of traditional British vernacular names, though would be interested to hear from people on this or related issues (via the authors).

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Notes on the oviposition and flight attitude of the Brilliant Emerald *Somatochlora metallica* (Vander Linden) in Scotland

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On 19 and 23 July 2004 we visited Loch Bran, near Foyers, Inverness-shire, where the Brilliant Emerald *Somatochlora metallica* (Vander Linden) is the only species of Emerald present. In warm, humid and mostly overcast weather on 19 July at least 15 males were observed patrolling the margins of the south side of the Loch, usually between 15 and 50cm above the water, and from 10 to 200cm from the bank. Two males were observed to catch females near the water's edge and complete the wheel in the air as they flew up into the top of the surrounding Birches (*Betula pubescens* Males were also observed to catch two ovipositing females.

In flight the males predominantly flew with a characteristic head-down attitude, at a somewhat steeper angle than we have observed in the Downy Emerald, *Cordulia aenea* (L.). Miller (1995) and Follett (1996) both state that the abdomen of *S. metallica* is held horizontal in flight, unlike that of *C. aenea*.

All the ovipositing females that we observed were hovering just above the marginal *Sphagnum* and facing the bank. The abdomen was held horizontally, including the tip, in accord with the observations of Smith (1984). At very close range, the vulvar scale (or subgental plate) was obvious when viewed through binoculars. One female, caught for closer examination, had eggs adhering to the rear of the vulvar scale and the underside of the abdomen.

Searching the literature we found four references to the body attitude of ovipositing *S. metallica* (Askew, 1988; Richards, 1996; Powell, 1999 and Smallshire & Swash, 2004). All comment that the last two abdominal segments and the anal appendages are held up at 90° to the rest of the abdomen during oviposition. This is illustrated by Powell, where the whole body of the female is shown at 45° to the water surface. None of the females we observed showed this behaviour. It would seem counterproductive to raise these segments through 90° when dipping low with the abdomen held horizontally. It would seem that raising the tip would result in the eggs being more difficult to deposit. Whether eggs are actually released whenever the vulvar scale touches a surface is not always certain (Corbet, 1999).

Fox (1989) suggested that differences may exist in the oviposition behaviour of *S. metallica* in the two areas of Britain in which it occurs. Fox observed oviposition into *Sphagnum* lawns and damp peat in Scotland, whereas females were observed dropping eggs onto the water surface in southern England. Thus *S. metallica* may adopt one of two different oviposition behaviours. These may be determined by differences in the substrate into which the eggs are being released. Alternatively, these differences may be a function of two disjunct British populations, each of which may be the result of separate post-glacial colonizations (Corbet *et al.*, 1960; Corbet, 1999; Smallshire & Swash. 2004).

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Group oviposition behaviour in the Brown Hawker *Aeshna grandis* (L.)

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While conducting routine dragonfly recording at two gravel pit sites in the Nene Valley, Northamptonshire, I observed the following behaviour. During the afternoon on 27 July 2003, in warm (22°C), humid and overcast conditions at Stanwick Lakes, a group of six to eight female Brown Hawkers *Aeshna grandis* (L.) were observed swarming around a partially submerged wooden pallet. The pallet had been present at this site for at least six months and was used as a stand by fishermen. It became clear that the females were ovipositing as a group into the submerged sections of the pallet. Despite the weather, which would not generally have allowed much activity, the hawkers were highly active, competing for space to oviposit on the pallet.

A similar observation was made on 18 July 2004 at Ditchford Lakes and Meadows. Again this was during a warm (21°C), humid, but overcast afternoon. This time, activity was centred on a partially submerged broken tree trunk. It appeared that at all points where the trunk entered the water, a female *A. grandis* was ovipositing just above the water level. There were many other females swarming around and perching on nearby branches, as if waiting their turn. When one female flew away, her oviposition site was immediately taken up by one of the waiting females. This carried on for several minutes until the group broke up and dispersed.

Group oviposition in the White-legged Damselfly *Platycnemis pennipes* (Pallas), the Common Blue Damselfly *Enallagma cyathigerum* (Charpentier) and the Small Red-eyed Damselfly *Erythromma viridulum* (Charpentier) is reported (e.g. see Cham, 2004). While Cham does refer to this behaviour in *A. grandis*, it appears not to be widely reported in the literature.

Reference

Cham, S. A. 2004. Dragonflies of Bedfordshire. Bedfordshire Natural History Society. 145pp.

Book Review

The Natural History of Ireland's Dragonflies

The National Museums and Galleries of Northern Ireland, Ulster Museum, Botanic Gardens, Belfast BT4 5AB (2004) 28 x 23cm., 454pp. plus over 300 colour plates. £20:00 (hardback), postage £12. ISBN 0 900761 45 8 Brian Nelson and Robert Thompson

This book was made possible by the all-Ireland project Dragonflylreland, which was supported by the National Parks and Wildlife Service, the Environment and Heritage Service the Ulster Museum and The Heritage Council. Using computerized data collection the authors, with the help of Damian McFerran (Project Manager for DragonflyIreland) and Bernard Picton (Website Manager), recorded the distribution of dragonflies throughout Ireland over the four years, 2000–2003. Many more records are available now than at the time of the preparation of the Atlas of the Dragonflies of Britain and Ireland in 1995. On the basis of what is now known the authors present a comprehensive review of the distribution and population trends of Irish dragonflies in relation to their habitats in Ireland. The result is a marvellous book which is very informative, well written and thorough. It is beautifully illustrated, almost entirely by Robert Thompson. The quality of the photographs is outstanding: for example, those of the Emerald Damselfly *Lestes sponsa* (Hansemann) and the Scarce Emerald Damselfly *Lestes dryas* Kirby clearly show the subtle difference of the green colour in the two species.

About 60 per cent of the book consists of accounts of individual species. Each species, its behaviour, life cycle, habitat, history in Ireland and distribution is described, with an indication of population trends. For each species there are photographs of male and female adults and of a larva together with a photograph of its typical habitat. Maps show the known distribution pre-1980, 1980–1995 and 2000–2003, with an indication of abundance in each square. They include histograms which show when adults are on the wing in Ireland and the altitudes of the sites at which they occur. As one who has observed dragonflies in Ireland for many years, I can confirm the accuracy of the text. I found only one omission: no mention is made of the occurrence of *Lestes dryas* in ponds in woodland, which has been observed in County Clare as well as in three counties in England.

Perusal of the maps is fascinating. The increased number of entries extends the recorded range of several species, notably the Irish Damselfly *Coenagrion lumulatum* (Charpentier) to the north-west and central-west. The commonest species of Odonata have now been recorded in most squares. The maps indicate a considerable expansion in range of the Brown Hawker *Aeshna grandis* L. to the north and west in recent years, and also of the Azure Damselfly *Coenagrion puella* (L.) to the west. Both expansions are probably due to

increased eutrophication of many Irish habitats. In the course of the Dragonflylreland project the Migrant Hawker *Aeshna mixta* Latreille and Emperor Dragonfly *Anax imperator* Leach were added to the Irish list, having been found in 33 and 20 squares respectively along the south and south-east coasts. The Lesser Emperor Dragonfly *Anax parthenope* (Sélys) was also added to the Irish list in this period. Sadly the new studies have not resulted in the discovery of new populations of the Downy Emerald *Cordulia aenea* (L.) and the Northern Emerald *Somatochlora arctica* (Zetterstedt) in County Kerry.

The species accounts are preceded by chapters on the 'Biology and Ecology of Irish Odonates', 'The History of the Study of Irish Odonates' and 'Results – Summary and Interpretation'. I found the historical review particularly interesting. It emphasizes the unsung pioneer efforts of Mary Ball, who in 1838 discovered the Broad-bodied Chaser *Libellula depressa* L. – the only record of the species in Ireland so far – fortunately supported by a voucher specimen! After the 1840s and 1850s the studies of Niall MacNeill and Cynthia Longfield laid the foundation of the present era.

The species accounts are followed by chapters on the 'Habitats of Irish Odonates', 'Habitat Gallery', 'Conservation', 'Studying Odonates in the Field', 'Where to see Irish Odonates' and 'Photography'. The main threats to dragonflies in Ireland today appear to be due to the further reduction of bogs for fuel – the authors emphasize the importance of the habitats left in cut over bogs – and to the intensification of agriculture and to global warming. *C. aenea* and *S. arctica* are particularly threatened by climate change.

The publication of this book should be of great value to those seeking the conservation of particular sites. In the chapter on studying dragonflies in the field the authors point out that if used responsibly and with care the insect net is arguably the most useful item of equipment. It is refreshing that they state the need to take voucher specimens on occasion. A good feature of the chapter on where to see Irish Odonates in the field is that all the sites mentioned have public access.

The only controversial aspect of this splendid book is the use of new English names for most Irish Odonata. The authors' argument is effective: the new names are more logical and consistent than those introduced by Cyril Hammond 27 years ago. If we were starting from scratch today I would favour the use of Nelson's and Thompson's names. However, we do not start from scratch: thousands of people now use Hammond's names. If we changed to new ones it would confuse many people, especially beginners using modern field guides which employ Hammond's names. As the authors state, 'only time will tell' whether their ideas on English names are accepted. Fortunately scientific names are, and always will be, the common property of all people who study Odonata throughout the world.

The contentious issue of names should not detract from the value of this outstanding book. It is full of valuable information. It is a pleasure to read and to relate the facts with the superb photographs of dragonflies and the beautiful habitats which they inhabit in Ireland. The book is outstandingly good value for its price. While reading it I kept thinking how much it would have delighted my old friend and mentor Cynthia Longfield, who inspired so many of us in Ireland and Britain.

Norman W. Moore

Book Review

Dragonflies of Bedfordshire The Bedfordshire Natural History Society (2004); 145pp.; colour photographs throughout £24.95 (hard cover). ISBN 0 9506521 7 2 by **Steve Cham**

For some time Steve Cham has been the national co-ordinator of the *Dragonfly Recording Network* for the British Dragonfly Society. He is also currently involved in the *Dragonflies in Focus* project which, in association with the Biological Records Centre and the National Biodiversity Network, aims to develop a sustainable system for gathering, managing and using information about the status of dragonflies in the U.K. Impeccable credentials and an excellent photographer as well.

In the Preface, the quote from the New Naturalist *Dragonflies* (P. S. Corbet, C. Longfield & N. W. Moore, 1962) when Norman Moore spent the night beside a roosting Fourspotted Chaser *Libellula quadrimaculata* L. to see what it did over 24 hours is also one of my enduring seminal memories. This is the first many delights of this book: apposite extracts from historic records, field notes, and other books, appearing contiguously with the topic under discussion.

The easy-to-read design is to be applauded. Brief initial sections cover general biology and identification, providing just enough detail, with suitable references for those who want to pursue further. In further sections 'how to record it' is enlivened by contemporary records of real events. I wish I might have seen hornet attacks. Sections on the history of recording in Bedfordshire, comprehensive site descriptions, conservation, mapping and species accounts flow seamlessly into each other. Six appendices include the BDS Code of Practice on Collecting; sites with over fifteen species; and some maps of breeding distributions – possibly the first ever for the county.

The Conservation section includes 'before' and 'after' photographs showing seral succession and the consequences of man's misguided or blatantly uncaring intervention. How many of us have had the foresight to take pictures years apart of the same site?

The species accounts are hugely comprehensive. County distribution is mapped on a 1 km square resolution and compared with the 10km square national maps. How refreshing to find all maps and photographs together with the text – no riffling back and forth to collate. Apart from descriptions, historic records, several photos of each species (including larvae), many accounts also contain identification tips and field records. The latter cannot but enthuse those of us who like sitting by water – watching and *recording*! Together with species currently occurring in Bedfordshire, we are also treated to species no longer present, other species present in nearby counties and those vagrants that might appear in the near future.

As might be expected of the current doyen of U.K. dragonfly recording, Steve Cham's description of the historic and current status of dragonflies in Bedfordshire sets a standard which future books might strive to emulate. This is the culmination of a five-year labour of love by a man who cares for his dragonflies and his adopted county. In his Foreword, Ruary Mackenzie Dodds says this is a must-have book. It is, buy it and read it.

Tim Beynon

INSTRUCTIONS TO AUTHORS

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

Word-processed manuscripts may be submitted in electronic 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 2004.

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 on separate, unnumbered pages.

DAMSELFLIES

Legends for figures should be presented together in sequence on a single, unnumbered page.

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

Caloptersy splendens Calopteryx virgo Chalcolestes sividis Lestes dryas Lestes spinsa Ceriagrion tenellion Coenagrion armatum Coenagrion hastulation Coenagrion Lunulation Coenagrion mercuriale Coenagrion puella Coenagrion pulchellum Coenastion scitulium Enallagma cyathugerum Ersthromma naias Frythromma viridulum Ischnura degans Ischnura pumilio Pyrrhosoma nymphula Plat venemis pennipes

ANISOPTERA

Aeshna caevulea Aeshna cyanta Aeshna grandis Aeshna isosceles Aeshna juncea Banded Demoiselle Beautiful Demoiselle Willow Emerald Damselfly Scarce Emerald Damselfly Emerald Damselfly Small Red Damselfly Norfolk Damselfly Northern Damselfly Irish Damselfly Southern Damselfly Azure Damselfly Variable Damselth Dainty Damselfly Common Blue Damselfly Red-eved Damselfly Small Red-eved Damselfly Blue-tailed Damselfly Scarce Blue-tailed Damselfly Large Red Damselfly White-legged Damselfly

DRAGONFLIES

Azure Hawker Southern Hawker Brown Hawker Norfolk Hawker Common Hawker Aeshna mixta Anax imperator Anax juning Anax parthenope Brachytron pratense Hemianax ephippiger Gomphus vulgatissimus Cordulegaster boltonii Condulta aenea Oxygastra curtisii Somatochlora arctica Somatochlora metallica Crocothemis erythraea Leucorrhinia dubia Libellula depressa Libellula fulva Libellula quadrimaculata Orthetrum cancellation Orthetrum coerulescens Pantala flavescens Sympetrum danae Sympetrum flavenlum Sympetrum fonscolombii Sympetrum nigrescens Sympetrum pedemontanian Sympetrian sangiuneion Sympetrum striolation Sympetrum vulgation

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

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

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