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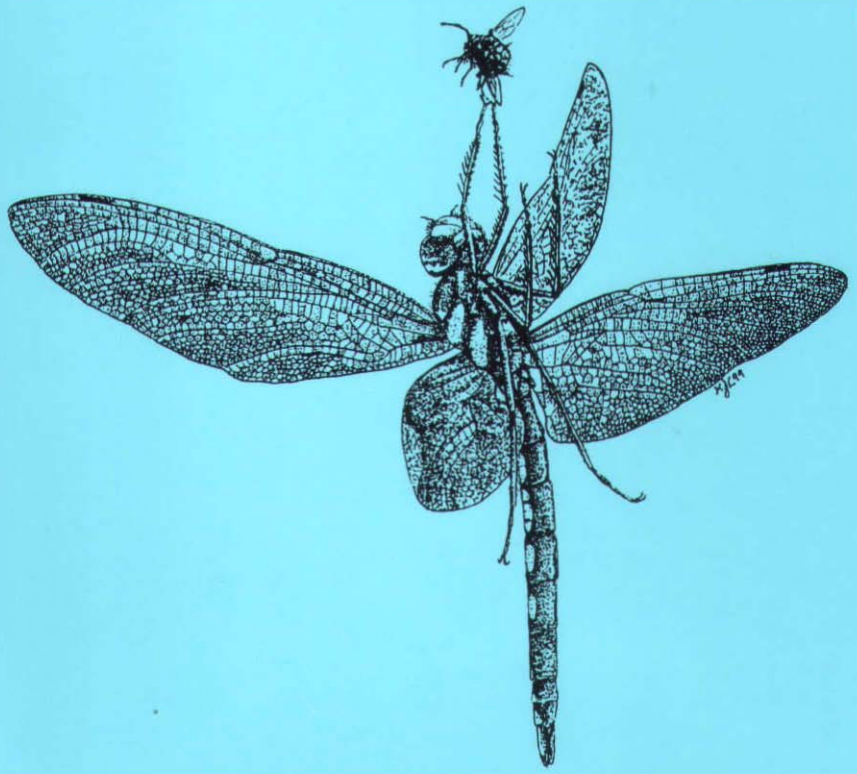

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Front cover illustration: 'The near-escape' by Dr Kevin Caley. A failed attempt by a Brown Hawker *Aeshna grandis* (L.) in the capture of a blow-fly (Diptera: Calliphoridae) at Attenborough Nature Reserve on 26 June 1999.

Damselfly exuviae found in a UV light moth trap

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At Pitsford Reservoir Nature Reserve in Northamptonshire, two ultraviolet (UV) light moth traps are operated throughout the year and checked each day as part of a wildlife-recording scheme. During the late winter and spring of 2000, the level of the reservoir rose to surround one of the traps by water, to a depth of approximately 0.15m. This moth trap consists of a square box approximately 0.58m wide and 0.37m deep, raised on four wooden legs (70 x 60mm in section) so that the upper edge of the trap is 0.9m above ground level. This meant that the rim of the trap was *c.* 0.75m above water level during the 2000 emergence period. The UV light is set in the centre of the trap, with a square Perspex screen supported above the trap to prevent rain entering. Inside the trap, two Perspex screens set at 45° to the horizontal direct entering creatures to a central slot, through which they fall. Egg boxes placed under the screens provide shelter. The moth trap is sited in an exposed position at the mouth of one of the bays in the reservoir (Holcot Bay), with the main body of the water located to the north and west of the trap.

Damselflies were first noted in the trap on 31 May 2000, and were then found on each day until 12 June 2000. A total of 187 exuviae were collected during this period, with a maximum total of 56 collected on 1 June. After 12 June, only occasional exuviae were found and these were not identified. In addition to the exuviae found inside the light trap, many exuviae were present on the supports, but these were not collected. The emerged damselflies either found their own way out of the trap or were released when the trap was checked for moths. Using the key in Miller (1995), a total of 105 exuviae of *Enallagma cyathigerum* (Charpentier) and three *Erythromma najas* (Hansemann) exuviae were identified. It was not possible to identify all specimens, as many were badly damaged.

It appears that the damselfly larvae may be attracted to the light during emergence. However, no attempt was made to compare emergence numbers with the surrounding vegetation (primarily Reed Sweet-grass *Glyceria maxima*). The trap was set higher than the surrounding vegetation, which was cleared for approximately 0.5m around the trap. Assuming the nearest support was used for emergence, the damselfly larvae that climbed the four legs supporting the trap would have had to come from an area of approximately 0.83m square. On that basis, the peak emergence on 1 June 2000 represented 81 emerging larvae per square metre, if no light attraction was involved. This is likely to be an underestimate since damselflies emerging on the supports of the light trap have been excluded from the count.

During the emergence period, adults of *Coenagrion puella* (L.), *Ischnura elegans* (Vander Linden), *Pyrrhosoma nymphula* (Sulzer) and *Brachytron pratense* (Müller) were all observed in Holcot Bay, near to the site of the moth trap. No exuviae from any of these species were found in the trap. This may be a function of the location of the trap and the variation in the distribution of the species of Odonata. For example, *C. puella* appears to be confined to an area around a small pond near the far end of Holcot Bay.

The discovery of large numbers of damselfly exuviae in the moth trap suggests that damselfly larvae may be attracted to UV light at emergence. This observation supports previous work indicating a response to UV light by emerging larvae of the family Coenagrionidae (Lavoie-Dornik & Pilon, 1987). It also poses several areas for further investigations, including the variation in response between species, the most effective wavelengths for eliciting a response, and the relationship between the intensity of the light source and the distances over which damselfly larvae will be attracted.

Acknowledgements

We would like to thank Cliff Christie, warden of Pitsford Water Nature Reserve for the Wildlife Trust for Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough at the time of this study; and Andy Brown of Anglian Water for their encouragement and support of the wildlife-recording schemes at Pitsford.

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Some observations on the identification of the exuviae of the final-instar larvae of the Common Blue Damselfly *Enallagma cyathigerum* (Charpentier)

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Introduction

Collecting exuviae of final-instar larvae throughout the emergence season can give useful information about the sex ratio at emergence as well as the species present within a habitat and their relative abundance. While the exuviae of most European Odonata can be identified to genus, their identification to species is more difficult. A number of keys, largely based on the use of microscopic characters, have been published over the years but they are intended primarily for generic identification (for example: Rousseau, 1909; Lucas, 1930; Gardner, 1954; Franke, 1979; Gardner in Hammond, 1983; Carchini, 1983 and, more recently, those in Miller, 1987; in Askew, 1988; and in Brooks, 1997). As such, the specific characters of many larvae, particularly those in the larger genera, have not been satisfactorily established. Furthermore, significant intraspecific variation of some of these characters can also occur. For example, although the Common Blue Damselfly *Enallagma cyathigerum* is the only species of this genus that is found in the UK, accurate identification of the exuviae of this species can still be difficult. Some problems associated with the reliability of using available keys in the identification of the larvae of some species of the family Coenagrionidae have been highlighted (see, for example, Cham, 1992; Seidenbusch, 1996, who published notes on the identification of the exuviae of species of *Ischnura* and *Coenagrion*, respectively) and further investigation is required. Accordingly, observations were made over a three-year period (1993–1995) to assess the degree of intraspecific variation within a number microscopic characters used to identify the exuviae of *E. cyathigerum*.

Methods

The study area

The Wraysbury and Hythe End Gravel Pits are located at Wraysbury, Middlesex, UK, and comprise an area of open water, islands, grassland, scrub and woodland within an area of former gravel extraction. The site incorporates four flooded gravel pits lying within the floodplains of the River Thames and the Colne Brook. The unworked areas of the site comprise floodplain gravels and alluvium of the Quaternary period (English Nature, pers. comm.).

The flooded pits are structurally diverse and the one chosen for this study, Wraysbury North, is the largest and has the most complex shoreline and a number of islands. This particular pit was worked for gravel during the 1960s, although more recent workings (1990s) have been undertaken in the north-eastern corner. The average depth of water is between 3 and 4 metres (Sir William Halcrow and Partners Ltd. pers. comm.).

Collection of exuviae of final-instar larvae

During the summer months of each year, a number of exuviae of *E. cyathigerum* were collected from off vegetation growing at the margins of Wraysbury North Pit. A total of 553 exuviae were collected: 103 during 1993; 237 during 1994; and 213 during 1995. None of these exuviae had remained *in situ* from the previous emergence season.

Visits to the gravel pit were made approximately weekly from mid-May and mid-August during each year. Each visit was of about one hour duration and took place between 1000h and 1800h GMT. Exuviae were collected mainly from Common Reed (*Phragmites australis*) and placed individually into uniquely numbered small plastic tubes. Each tube was then filled with 70 per cent methanol, which acted both as a preservative and a relaxing agent. Badly damaged exuviae were generally discarded, although the sex of all specimens was recorded.

Microscopic examination

Although a number of published keys (see introduction) were consulted, two features in particular were heavily relied on for the initial identification of exuviae of *E. cyathigerum*, namely:

1. a spine on the outer margin adjacent to distal seta on the labial palp; and
2. subnodate caudal lamellae (nodal line crossing the median tracheae diagonally near the middle of the lamellae), usually with one to three narrow, transverse, dark bands.

After preliminary examination of many exuviae, a number of morphological characters were selected for further data collection. Preference was given to features that could be examined accurately with the minimum use of detailed microscopy.

General description

The general appearance of each exuvia in the field was noted, in particular its colour and that its gross structure was typical of the family Coenagrionidae. Individual exuviae were placed on their dorsal side in a small drop of 70 per cent methanol on a glass microscope slide and examined under a dissecting microscope using a magnification of between 15 times and 20 times. The exuviae were flaccid and easily straightened. The body length of each exuvia was measured from the front of the head (antennae excluded and labium retracted) to the apices of the caudal lamellae. All measurements were made to the nearest 0.5mm using a ruler. The sex of each specimen was determined by examining the larval integument for signs of the gonapophyses and also the developing secondary genitalia of males.

Head

As the structure of the head is damaged during adult emergence (a T-shaped slit appears in the back of the head and leads posterially in the back of the larval integument) the general characteristics of the head were not studied. Some authors have given importance to whether antennae have six or seven segments. However, it was not easy to determine the number of antennal segments on the exuviae and even with fresh specimens the division between the two apical segments was difficult to see. Accordingly, this feature was not studied in any further detail.

Labium

Labia were carefully dissected from the head of each exuvia and temporarily placed in a weak solution of lactophenol cotton blue on a glass microscope slide and flattened by a coverslip. They were examined under a compound microscope using a magnification of between 100 times and 400 times. The number and arrangement of setae both on the labial palps and the prementum were observed and recorded. This task was hindered by the partial masking of the smaller setae by debris within the labium. Because of this, neither the premental or palpal seta formulae described by Corbet (1953) were routinely used. The terminology used for the larval labium does however follow that as defined by Corbet (1953), *i.e.* palpal setae are denoted using '&' and premental setae using '+' in Table 2.

Abdomen

The presence of a mid-dorsal longitudinal pale line on all the visible segments except S10 was recorded.

Caudal lamellae

To examine some of the morphological features of the caudal lamellae, each individual lamella was carefully dissected and separated from the abdominal segment S10 and placed in a drop of lactophenol cotton blue on a glass microscope slide to which was added a coverslip. Great care was taken to ensure that individual lamellae from each specimen were positioned in precisely the same orientation on the slide. Using a magnification of between 100 times and 400 times, the length and shape of each lamella (53 males, 50 females), the number of stout marginal setae (53 males, 50 females) and the number of transversely arranged darkly pigmented bands (148 males, 152 females) were recorded. The length of the row of stout setae on both the ventral and dorsal margins of the lateral and median lamellae was measured from the base of each lamella to the nodal line.

Results

Some of the exuviae were damaged, therefore not all of the key features described above were recorded from all specimens.

Table 1. The number of exuviae of *E. cyathigerum* collected at Wraysbury North Gravel Pit, Middlesex during 1993, 1994 and 1995, on which a small spine on the outer margin of the labial palps, adjacent to the distal seta, was observed.

Character	1993		1994		1995		1993–1995	
	M	F	M	F	M	F	M	F
Spine on left margin only	0	3	4	3	3	5	7	11
Spine on right margin only	2	4	5	5	5	4	12	13
Spine on both margins	51	43	109	111	110	80	270	234
Spine on at least one margin	53	50	118	119	118	89	289	258
(% of total exuviae examined)							100%	100%

Colour

All exuviae, with the exception of three (0.54 per cent), were uniformly light brown. Three specimens (one male and two female) collected during 1994 were a golden brown/orange colour.

Table 2 Premental and palpal setation on exuviae of (a) male and (b) female *E. cyathigerum* collected during 1993, 1994 and 1995 at Wraysbury North Gravel Pit, Middlesex. Palpal setae are denoted using '&' and premental setae using '+'.

(a) *Male* (n = 289)

	4&6	5&5	5&6	6&5	6&6	6&7	6&10	7&5	7&6	7&7	7&8	8&6	8&7	8&8
2+4														
2+5						1								
3+3		1	1	1	5				1					
3+4					4				1	4				
3+5						1								
4+3		1			12	1				2				
4+4		4	3	1	**115**	2			7	8			1	
4+5			1	1	16				3	8				
4+6									1					
5+3						1								
5+4			1	1	19			1	3	5				
5+5		1		3	19	3			2	10				
5+6					2	1			1					
6+4					1					1				
6+5					1				1	1				
6+6					1	1								
6+7														
7+5					1									
7+6					1									
7+7														
8+6														

(b) *Female* (n = 258)

	4&6	5&5	5&6	6&5	6&6	6&7	6&10	7&5	7&6	7&7	7&8	8&6	8&7	8&8
2+4					1									
2+5														
3+3		1			2				1	1				
3+4				1	6					1				
3+5														
4+3			1		2	1						1		
4+4			4	7	**82**	7	1	1	5	10	1	1	1	
4+5			2		20	1			3	3				
4+6					1					1				
5+3		1			1									
5+4			2	2	20	2			2	6				
5+5	1	2	1	4	24	3			4	5	1			1
5+6					1					1				
6+4										1				
6+5														
6+6														
6+7			1											
7+5														
7+6														
7+7					1									
8+6										1				

Body length

The mean length of the exuviae of males (n = 281) and females (n = 256) was 20.5mm (range 17.0 to 23.5mm for males; 18.0 to 23.5mm for females).

Small spine on the outer margin of the labial palps adjacent to the distal seta

This feature was generally easy to observe using a magnification of 100 times, although for a few specimens careful examination was required using a magnification of 400 times. Generally, the spines were similar in size, although frequently a spine had broken off to leave an inconspicuous base. On a few specimens, the spine was very small although located in the same position. All exuviae examined had the small spine on at least one margin of the labial palps (Table 1).

Labia setation

Considerable variation in the setation on both the labial palps and the prementum of both males and females was observed (Table 2). From the 289 male exuviae examined, 53 different combinations of setation were recorded, with one combination (6&6, 4+4) seen in 115 (39.8 per cent) of the specimens. From the 258 female exuviae examined, 54 different combinations of setation were recorded, with one combination (6&6, 4+4) seen in 82 (31.8 per cent) of the specimens. Approximately 50 per cent of the combinations were common to both sexes.

Although the presence of small vestigial setae in the same vicinity as the premental setae could complicate the counting of the latter, this was not a common occurrence. The premental setae were arranged in two oblique series with the mesial ones more basal in position than the outer ones. Vestigial setae were rarely observed in the vicinity of the setae on the labial palps. It is noteworthy that on six specimens (1.1 per cent), apparent deformities were observed where the ends of certain premental setae were bifurcated. Similar deformities were also seen on the labial palp setae of four other specimens (0.7 per cent). The lengths of the individual setae on the labial palps and on the prementum were variable. The presence of newly-added setae increased this variation. Whilst such setae were observed at any point within the palpal series, they were usually added at the innermost end of the premental series.

Abdomen

All exuviae examined had a prominent mid-dorsal, longitudinal pale line on all the visible segments except S10.

Caudal lamellae

For both sexes, the mean length of each caudal lamella was 6mm (range 3.5 to 7mm). The general shape of the apical point was variable. The number and arrangement of transverse dark bands on the caudal lamellae are shown in Table 3. The number of bands varied from zero to four. Not all banding patterns were similar on each of the three lamellae of an individual specimen. For male exuviae, 25 per cent had single banding on each of their caudal lamellae, 48 per cent double banding, 5 per cent triple banding and 0.7 per cent quadruple banding. For female exuviae the frequencies were 19 per cent, 47 per cent, 16 per cent and 0 per cent, respectively.

The caudal lamellae were subnodate. The distributions of stout setae on both the ventral and dorsal margins of the lateral and median lamellae were recorded on male and female specimens. The stout setae reached to the midpoint on the dorsal margins and beyond the midpoint on the ventral margins of both lateral lamellae. The distribution of the stout setae was, however, different on the median lamellae, usually reaching the midpoint on the ventral margin but extending beyond the midpoint on the dorsal margin.

Discussion

Despite the publication of several keys on the identification of Zygoptera, there are still difficulties in identifying exuviae of final-instar larvae to species. Due to considerable variation, identifications based on the arrangement and number of setae on the prementum and labial palps or, on the form of the caudal lamellae, are not always reliable. Of the characters investigated in this study, the only two features specific to all exuviae of *E. cyathigerum* were: (1) the presence of a small spine on the outer margin of the labial palps adjacent to the distal seta and (2) the presence of a prominent mid-dorsal, longitudinal pale line on all visible segments except S10.

Table 3. The number and arrangement of transverse dark bands on the caudal lamellae of exuviae of *E. cyathigerum* collected during 1993 and 1994 at Wraysbury North Gravel Pit, Middlesex. A total of 148 male and 152 females were examined.

Number of bands on each lamellae			1993		1994		1993–1994	
Right	Median	Left	M	F	M	F	M	F
0	0	0	5	4	13	8	18	12
0	0	1	0	0	1	0	1	0
0	1	0	1	0	0	0	1	0
0	1	1	1	0	0	0	1	0
0	2	2	0	1	0	0	0	1
1	0	1	0	0	0	1	0	1
1	1	1	9	7	28	22	37	29
1	2	1	0	0	1	1	1	1
1	2	2	1	1	1	0	2	1
2	1	1	0	1	0	0	0	1
2	1	2	0	2	0	2	0	4
2	2	1	2	1	0	0	2	1
2	2	2	25	24	46	48	71	72
2	3	2	1	0	2	2	3	2
2	3	3	1	0	1	0	2	0
3	2	2	0	1	0	1	0	2
3	3	3	1	1	6	24	7	25
4	3	4	0	0	1	0	1	0
4	4	4	0	0	1	0	1	0

The mean body length of the exuviae collected in this study, 20.5mm (range 17 to 23.5mm), was the same for both sexes and is generally similar to that published in the keys used in this study with the exception of: (1) MacNeill (1950), who stated that the average length of twelve specimens (six of each sex) was 24.25mm, although he did note that this figure 'may err on the high side', and (2) Gardner (1954), whilst not giving a figure for mean body length, gave a range of between 20 and 26.5mm. It is uncertain what affect storage in 70 per cent methanol has on shrinkage of exuviae, although Lucas (1930) noted that specimens kept in spirit may contract a little in length and Gardner (1954) also noted that shrinkage of 10 per cent might be expected when stored in spirit. It is also known that the length of exuviae of zygopteran larvae may be significantly reduced on account of the telescoping of the abdominal segments (Gardner, 1954).

The presence of a small spine on the outer margin of the labial palps adjacent to the distal seta was noted on all specimens examined, although on 43 specimens (7.9 per cent of total number examined) the spine could only be seen on one of the margins of the palps.

Considerable variation in labial setation was seen. Earlier workers such as Lucas (1930), MacNeill (1950) and Gardner (1954) appreciated that such variation could occur. However, in this study approximately fifty different combinations of premental and palpal setation were noted, with one combination (6+6, 4&4) being the most common. Between 4 and 10 setae were seen on the labial palps, considerably more than seen by the three aforementioned workers, who quoted 6, 6 or 7, and, 6 or 7, respectively. Similarly for the premental setae, between 2 and 8 setae were seen on the prementum of specimens in this study, significantly more than stated by Lucas (4+4 or 4+5), MacNeill (4+4, 5+5, 4+5) and Gardner (3+3 to 5+5). None of these earlier workers recorded how many specimens they examined, but it is likely that the greater number of combinations recorded in this study is a consequence of more specimens being examined.

Interestingly, although not included in recent keys (Miller, 1987; Askew, 1988; Brooks, 1997), all exuviae examined had a prominent mid-dorsal, longitudinal pale line on all visible segments except for S10, as described for this species by Lucas (1930). Further work is required to determine if this is a feature specific to *E. cyathigerum*.

Although a number of authors have placed a high degree of reliance on the form of the caudal lamellae as an aid to identification (*e.g.* Gardner, 1954; Vick, in Miller, 1987; Askew, 1988), considerable variation in many of the key features was seen. The general shape of each lamella, in particular the apical point, was variable. The apex of the lamellae was often not acute and abruptly tapered (Fraser, 1949), and a short apical point (Askew, 1988) was not always observed. Convex margins of each lamella (Vick, in Miller, 1987) were another inconsistent feature. Another character showing significant variation was the presence of narrow transverse dark bands across the caudal lamellae. Of the specimens collected during 1993 and 1994, 300 (88.2 per cent) had all three lamellae fully intact. All lamellae examined were subnodate, and the inner most pigmented band (that nearest to the base of the lamella) appeared to follow the nodal-line. In many specimens the pigmented bands were not always narrow but in the form of small, often diffuse, areas of pigmentation the intensity of which varied considerably. Furthermore, as observed by MacNeill (1950), the spacing between the bands was variable. Thirty specimens (10 per cent) had a full complement of lamellae on which there were no visible pigmented areas and 269 (89.7 per cent) had at least one lamella with one to three pigmented bands. As reported by MacNeill (1950) the double-banded arrangement was most common (48 per cent of specimens).

The median and lateral lamellae had different arrangements of marginal setae (with the exception of a single left lamella from a male specimen which had no visible stout setae on its dorsal margin). All median lamellae had a longer and often more closely spaced row of stout setae on their dorsal margin, whereas the lateral lamellae had more stout setae on their ventral margin. The thicker setae generally reached to, or beyond, the midpoint on both margins of both the lateral and median lamellae.

Further work is required to evaluate the reliability of using these characters for the identification of *E. cyathigerum*. It should be noted that only on rare occasions was the identification of an individual exuvia confirmed by subsequent identification of the newly emerged adult. Therefore, further work should include laboratory studies in which all larvae can be reared to the adult stage, as well as field studies to examine variation between different populations of *E. cyathigerum*.

Conclusions

Significant intraspecific variation in labial setation was noted and, as such, it is not considered a sufficiently consistent character to use for larval identification. It is suggested that the following amendments should be made to the commonly used specific characters to identify the exuviae of *E. cyathigerum*:

1. Mean body length (including lamellae) about 20.5mm (range 17 to 23.5mm).
2. Labial palp with a very small spine on at least one of the outer margins adjacent to the distal seta.
3. Prominent mid-dorsal, longitudinal pale line on all visible segments except S10.
4. Caudal lamella subnodate and about 6mm long (range 3.5 to 7mm), usually with one to three (rarely zero or four) narrow, transverse, dark bands; thicker setae generally reaching to (or beyond) the midpoint on both margins of the caudal lamellae.

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Habitat management for the Southern Damselfly *Coenagrion mercuriale* (Charpentier) on Aylesbeare Common, Devon

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Introduction

The colony of *Coenagrion mercuriale* (Charpentier) on Aylesbeare Common is located in an area of shallow runnels and pools flowing over a substrate of shallow mud with small pebbles. This discrete area covers approximately 2ha within the main body of a lowland acid heath that extends over 197ha. The area supports a mire dominated by Black Bog-rush (*Schoenus nigricans*) and Bog Asphodel (*Narthecium ossifragum*), the distinctive National Vegetation Classification (NVC) Community M14 (*Schoenus nigricans – Narthecium ossifragum* mire (Rodwell, 1991; Evans & Kerry, 1989)). A basic flush system with a pH in the range of 6.5 to 7.5 flows through this area throughout the year and does not freeze in winter.

A colony of *C. mercuriale* has been recorded intermittently at this site in low numbers since 1956. With the exception of 1986, when twelve individuals were recorded, the maximum count was four individuals for each year from 1977 to 1990. Two other colonies are present within 5km of this site, on the East Devon pebble-bed heaths that extend over 1100ha. One of these colonies, on Colaton Raleigh Common, has been recorded since 1963, with a maximum count of over 100 in 1986. The other colony, on Venn Ottery Common, has been recorded since 1979, but only low numbers were recorded prior to the last sighting of a lone male in 1990.

In 1977, the Royal Society for the Protection of Birds (RSPB) leased Aylesbeare Common from the owners, Clinton Devon Estates, since when the colony of *C. mercuriale* has been counted annually (various authors, 1977–1998; Kerry, 1991). A standardized transect walk was established in 1994 (Kerry, 1994). This transect is carried out on days when optimum weather conditions for damselfly observation prevail, *i.e.* warm, relatively calm days with sunshine recorded for at least 60 per cent of the time between 1200h and 1400h. In practise, other counts are also recorded as time allows. The data collected before 1994, are not directly comparable with those collected after that date, because previous records are not based on intensive standardized transect counts and, in some years, only one count was made.

Habitat Management

Physical habitat management began in 1981 with some limited hand clearance of runnels and the creation of a small pond. A digger crossed the site in 1978, and its tracks created several shallow depressions, which are still used by *C. mercuriale*. Pony or cattle grazing has been recommended for managing *C. mercuriale*, with controlled winter burning, hand digging of runnels and removal of shading scrub (Evans, 1989). Following consultations with English Nature and the British Dragonfly Society, similar prescriptions were undertaken and the response of the *C. mercuriale* population was monitored.

Grazing began with seventeen Devon cows fenced into an area of approximately 4ha, including the 2ha *C. mercuriale* site, between 17 December 1990 and 6 January 1991. The cattle were also fed a high protein block daily to supplement their diet of sedges and rushes. At this time, the standing leaves of the Purple Moor-grass (*Molinia caerulea*) were dead so the cows did not graze them, but the high-density stocking rate opened up the tussocks by trampling. The cows grazed the Black Bog-rush by following the shoots into the tussocks. The grazing area included some dry heath for the cows to lie on, and approximately 0.5ha of the mire served as a control area and was not grazed. An NVC vegetation survey (Evans & Kerry, 1989) was undertaken in 1989 prior to the grazing, to provide baseline vegetation data. Ten 2m by 2m permanent quadrats were established to monitor the changes in vegetation caused by cattle grazing, five in the grazed area and five controls in the ungrazed area. These were repeated in 1991 and again in 1995.

Unfortunately no summer grazing took place in 1991 due to a lack of available cattle. However, the intense winter grazing meant that the vegetation remained relatively short and less tussocky than previously. Since 1992, light summer grazing has taken place, with yearling cattle used until 1995 and with a suckler herd used since 1996. Until recently this grazing maintained an open vegetation structure. However, since 1998, the Black Bog-rush has once more become dense and tussocky. This species is not palatable to cattle and they will not eat it unless they have no alternative food. The cattle prefer Purple Moor-grass, especially the fresh shoots. An area of Black Bog-rush was brushcut during the winter 1999–2000 to mimic the effects of winter grazing and to remove the dead standing vegetation, with a single-strand electric fence erected along a brush-cut swathe. Since 1992, the area grazed by cattle has increased from approximately 20ha to 35ha in 1998. Separate fences divide two outlying areas. This has meant that the cattle are free to roam a relatively large area and are not now concentrated on the *C. mercuriale* site, which is lightly grazed as the cattle move around the site.

The heath as a whole has benefited from the grazing with a less overgrown, more open structure and an increase in several plant species, especially Meadow Thistle (*Cirsium dissectum*). The opening up of dense Purple Moor-grass tussocks has resulted in an increase in the small plants which thrive in runnels between the tussocks, *e.g.* Bog Pimpernel (*Anagallis tenella*), Round-leaved Sundew (*Drosera rotundifolia*), Pale

Butterwort (*Pinguicula lusitanica*) and, more importantly, Bog Pondweed (*Potamogeton polygonifolius*), which is a species favoured by *C. mercuriale* for egg laying.

Shady wet woodland, with Purple Moor-grass tussocks, is present along the stream to the south of the *C. mercuriale* site. An area of this woodland was cleared in 1997 to further increase the available area of suitable habitat. This cleared area has been used by *C. mercuriale* since 1998. *C. mercuriale* has a two-year life cycle and in relatively small populations such as this one, a 'good year'/'bad year' pattern can be seen (Figure 1). The counts of individuals are not absolute figures and can only give an indication of the relative abundance of the population. Beth Purse, a PhD student, carried out mark/recapture experiments during 1998, at the start of her three-year study into this species. She marked over 300 individuals but the maximum count on the standard transect was 27. 1998 was a 'bad year', but numbers were certainly further depressed by the effects of the poor summer weather. However, 2001 was the best year yet and, hopefully, the colony will continue to expand. Several individuals were seen away from the main site, in areas of apparently suitable habitat, providing the possibility of further expansion.

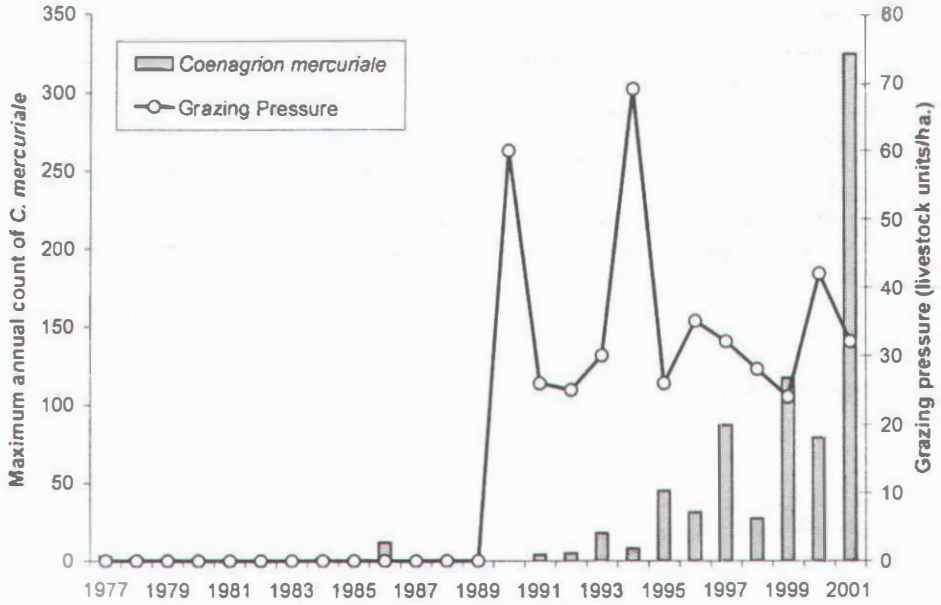

Figure 1. Variation in maximum annual counts of *Coenagrion mercuriale* and grazing pressure between 1977 and 2001. Grazing pressure is measured in 'livestock units' per hectare, where 1 cow = 1 livestock unit and 1 yearling = 0.6 livestock units.

Conclusion

The population of *C. mercuriale* at Aylesbeare Common has certainly increased since the advent of cattle grazing (Figure 1). It is probable that the grazing is responsible for the increase in damselflies. Various factors may be important, for example the cattle poach the substrate and create a mosaic of shallow pools; their droppings enrich the water; and their grazing alters the vegetation structure. The crucial parameter is unknown. Hopefully, Beth Purse's PhD study will bring together the management regimes on other sites and establish the specific habitat requirements for *C. mercuriale*.

The future management at Aylesbeare will continue with light summer grazing, followed by brush cutting of small areas of Black Bog-rush during the winter. The *C. mercuriale* population will continue to be monitored on a standard transect and the vegetation quadrats will be surveyed on a long-term basis.

Acknowledgements

I acknowledge the help and support given by Pete, Jessica and Katie Gotham and other volunteers including Sarah Hawkes and Jason Mitchell who assisted with the transect counts.

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Migrant and dispersive dragonflies in Britain during 2000

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Summary

The year 2000 was perhaps not as dramatic for migrant Odonata in Britain as, for example, 1995 or 1998, but there were a number of highlights. Most notably, high numbers of *Sympetrum fonscolombei* arrived for the third time in the last five years and several other unusual migrant species were recorded. Two main periods of immigration took place. A brief hot spell in mid-June saw a significant arrival of migrant insects, including dragonflies such as *S. fonscolombei*, *Anax parthenope* and a single *Crocothemis erythraea*. During late-July, further arrivals of *A. parthenope* and *S. fonscolombei* were observed. The first wave of immigration pushed quite far north; the record of *A. parthenope* from Orkney represents the most northerly record for this species in Europe. Complementing the events in Britain, three species new to Ireland were recorded during the year.

Account of Species

Significant records reported to the BDS Migrant Dragonfly Project during 2000 are outlined below. During the course of the year a major new recording scheme for Ireland was established ('DragonflyIreland'), so Irish records are not covered in full detail, but referred to when they complement British records. For a report on events in Britain during 1999, see Parr (2000).

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

2000 – One was seen flying along the tide line at Eccles-on-Sea, Norfolk, on 1 August (NB). A record at Aldbrough, East Yorkshire, on 24 August was from an area where the species is very uncommon.

***Ceriagrion tenellum* (Villers) – Small Red Damselfly**

2000 – A male was seen at close range at Lower Barden Reservoir, near Bolton Abbey, North Yorkshire on 7 June (JFT), well away from the normal range of this species. This sighting followed a period of strong south-westerly winds, so it is possible that the origin of this individual could have been one of the established colonies in north Wales.

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

2000 – Several small colonies discovered on the Isle of Wight (DD) represent a new stronghold for this species. At the time of writing, all other records for this damselfly,

first seen in Britain as recently as 1999, are from Essex (Cham, 2001). As the superficially similar *E. najas* (Hansemann) is absent from the Isle of Wight (Cham, 2001) it is unlikely that *E. viridulum* had previously been overlooked there, suggesting that colonization of the island by migrants from the Continent has been in very recent times. However, some of these colonies appear to be established, suggesting that colonization occurred prior to 2000.

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

2000 – Little in the way of large-scale movement was noted from Britain during the year, but several were reported from County Wexford and County Wicklow in south-east Ireland during August/September (KM, Nelson *et al.*, 2000). These represent the first-ever confirmed records for Ireland.

***Aeshna grandis* (L.) – Brown Hawker**

2000 – One was caught in a moth trap at Winterton Dunes, Norfolk, on the night of 13 August (MTu). Another was observed flying away from the coast while already two miles out to sea off Benacre, Suffolk, around 12 August (TA). These unexpected observations may suggest that some sort of dispersal took place in East Anglia during mid-August.

***Anax imperator* Leach – Emperor Dragonfly**

2000 – One was caught in a moth trap at Bradwell-on-Sea, Essex, on the night of 23 July (SD). More significantly, several were observed in County Wexford, south-east Ireland, during late-July and August (KM, Nelson *et al.*, 2000). These represent the first ever records from Ireland. The timing of the sightings, and also the presence of species such as *Sympetrum fonscolombei* in the same general area, suggests a migratory event. However, the number of records raises the possibility that a recently established population may already exist in the area, and has only now been discovered (Nelson *et al.*, 2000).

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

2000 – First observed in Britain as recently as 1996, this species now occurs regularly in small numbers. The year was notable for some very northerly records, including one from Orkney, the most northerly European record for the species. Following observations of oviposition at Bake Farm in Cornwall during 1999 (Pellow, 2000), it was disappointing that no individuals were observed emerging at this site during 2000. It is possible that any larvae may have required more than one year to complete development and so may emerge in 2001.

The following records were made during the course of the year. Busuttil (2001) gives further information on the sightings from Dungeness.

19 June	Male on Sanday, Orkney (RT)
19 June–19 July	Male seen intermittently at Kemerton NR, Worcestershire (SW)
27 June	Male at Boldon Flats, County Durham (DF)
15 July–11 August	Male at Bake Farm, Cornwall (KP, LT)
20 July–23 August	Singles recorded regularly at Dungeness, Kent, throughout the period (SB, DW). It is likely that several different individuals were involved.
21 July–8 August	Up to two males at Rainton Meadows, County Durham (IW)
30 July	One at Spurn NNR, East Yorkshire (GG)
30 July	One at Bradwell-on-Sea, Essex (MTe)
13 August	One at Colwick Country Park, Nottingham (MD)

In addition to these British records, there are two reports from the south coast of Ireland during late-July/early-August (Nelson *et al.*, 2000; Parr, 2001). If confirmed, these would be the first records of this species in Ireland. All of these records support the observation that this species is continuing to expand its range.

***Cordulia aenea* (L.) – Downy Emerald**

2000 – There was an unexpected sighting of a male at Chartley Moss NR, Staffordshire on 17 June (TB). The nearest known breeding site is some 65km away, although apparently suitable habitat exists closer to the site.

***Libellula quadrimaculata* L. – Four-spotted Chaser**

2000 – High numbers were reported from Angler's Country Park, near Wakefield, West Yorkshire, on 19 June, when three species of migrant butterfly were also present. The first record for the East Lothian region was made at Aberlady Bay NR on 21 June (IT), when various migrant butterflies and moths were again present. Several records from new sites in County Durham, where the species had until recently been markedly uncommon, were also made during late-June, with records showing a strong bias favouring localities near the coast (IW). These observations imply that a few *L. quadrimaculata* were included in the substantial insect migration that took place in mid-June.

***Libellula depressa* L. – Broad-bodied Chaser**

1999 – The record from near Darlington mentioned in Parr (2000) as occurring on 26 September should in fact refer to 5 September.

2000 – The first record for Spurn NNR, East Yorkshire, was made on 17 June (BS) and five individuals were reported from a site just north of Scarborough, North Yorkshire, on 19 June (JH). Both records are unusually far to the north in eastern Britain. In Kent, several records were made from unexpected localities during 17 and 18 June. These reports suggest that the major insect immigration of mid-June may possibly have contained small numbers of *L. depressa*.

***Orthetrum cancellatum* (L.) – Black-tailed Skimmer**

2000 – Some interesting records were received from near the north-eastern limit of the

species' range during mid-June. On 19 June, two males visited the Filey Dams reserve in North Yorkshire, though only one lingered (JH). This species was not recorded from this site during 1999. At Spurn NNR, East Yorkshire, three individuals seen on 18 June were the first for the year. Four were present the following day, but numbers dwindled rapidly thereafter and this mid-June peak was not exceeded until six weeks later (BS).

***Crocothemis erythraea* (Brullé) – Scarlet Darter**

2000 – A male was seen at Drakelands, near Plympton in Devon on 17 June (RB). This represents the fourth record for Britain, all of which have occurred since 1995. Three of these records have now been from the far south-west; the other is from the Isle of Wight.

***Sympetrum striolatum* (Charpentier) – Common Darter**

2000 – Relatively few records of note were reported during the year. On the night of 25 August, one individual was caught at a UV light at Portland Bill in Dorset, along with numerous migrant moths and a Red Admiral butterfly, *Vanesssa atalanta* (MC). In the early morning of 20 September, one was found at rest on a wall near a moth-trap on The Lizard, Cornwall, at a time when good numbers of migrant moths were also present (MTu). At Bradwell-on-Sea, Essex, some 18 darters, *Sympetrum* sp., were attracted to light between 21 August and 23 September, with another solitary individual on the earlier date of 24 July (SD).

***Sympetrum sanguineum* (Muller) – Ruddy Darter**

1999 – Records from UV light at Bradwell-on-Sea, Essex, mentioned in Parr (2000) are now believed to include some misidentified individuals. However, there is still evidence of a minor immigration during the year.

***Sympetrum fonscolombei* (Sélys) – Red-veined Darter**

2000 – The species now appears to be a regular immigrant with major arrivals reported for the third time in the last five years. The previous large influx was recorded in 1998 (Parr, 1999). Mature adults were noted between 18 June and 27 August, and records were received from some 35 sites in England (Cornwall, Devon, Somerset, Dorset, Isle of Wight, Sussex, Kent, Hertfordshire, Norfolk, Lincolnshire, Worcestershire, Staffordshire, Lancashire, Durham and South, East, West & North Yorkshire) and Wales (Glamorgan). There were also several records from Ireland (notably County Cork and County Wexford).

A substantial influx of migrant *S. fonscolombei* took place on 18 and 19 June, although interestingly many of these individuals did not remain at the site at which they were observed for very long. A few further records were reported through late-June and into early-July. In the second half of July there was another upsurge of records, with 20 and 21 July being particularly productive. It was at this time that the most northerly sightings of the year occurred, in County Durham (IW). This wave of new records continued into the first third of August, with a male in Staffordshire on 23 August (TB) coming from a possible third wave of migration.

Despite the many records of migrants, there were surprisingly few records of British-bred individuals. No spring emergence was noted from any sites in 2000, although it is possible that this may have been overlooked. Autumn emergence was only recorded in Cornwall, where over 300 exuviae were found during September and October, principally at the now traditional site of Bake Farm. Given the poor weather during the summer, and the relatively late dates on which many migrants were recorded, it is probable that many eggs laid in 2000 would not have had the opportunity to develop into fully mature larvae before the autumn. It will be of interest to see whether any emergence takes place during spring and summer of 2001.

***Sympetrum flaveolum* (L.) – Yellow-winged Darter**

2000 – In contrast to the influx of *S. fonscolombei*, it was a poor year for this species. A male was seen at Kenfig Burrows, Glamorgan, on 18 June (GJ), and there is an unconfirmed report of one from Icklesham, Sussex, on 14 July.

Discussion

Although the total number of migrants observed in 2000 was not as high as in the best of recent years, it is clear that the trend towards the increased occurrence in Britain of what were previously thought of as 'southern' species still continues. There was a major invasion of *Sympetrum fonscolombei* for the third time in five years. Significant numbers of *Anax parthenope* were again recorded, with one migrant setting a new record for the most northerly observation of this species in Europe. In addition, Britain's fourth-ever *Crocothemis erythraea* was observed in June, and there was further evidence for the colonization of our region by *Erythromma viridulum*. When all this is coupled to the observations of no less than three species new to Ireland during 2000, it is apparent that major changes in the distribution of several species of Odonata are currently taking place. It seems highly plausible that this is linked to regional, if not global, climate change, and it will be of interest to see whether further species start to appear in Britain in the near future.

Acknowledgements

I would like to sincerely thank all those individuals who submitted records. The following have been identified in the text by their initials: T. Abrehart (TA); N. Bowman (NB); T. Beynon (TB); R. Burn (RB); S. Busuttil (SB); M. Cade (MC); D. Dana (DD); M. Dennis (MD); S. Dewick (SD); D. Foster (DF); G. Jones (GJ); G. Gamage (GG); J. Harwood (JH); K. Mullarney (KM); K. Pellow (KP); B. Spence (BS); I. Thomson (IT); R. Thorne (RT); L. Truscott (LT); M. Telfer (MTe); J. & F. Topham (JFT); M. Tunmore (MTu); D. Walker (DW); I. Waller (IW); S. Whitehouse (SW). The help of members of the Odonata Records Committee in assessing and verifying records of national rarities is also much appreciated.

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The Northumbrian frontier of the Banded Demoiselle *Calopteryx splendens* (Harris)

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Introduction

The Banded Demoiselle, *Calopteryx splendens* (Harris), is one of Britain's most striking insects, tropical in appearance with its colours of iridescent blues and greens. The maps in Hammond (1983) present *C. splendens* as a species with a southern and midland distribution in England and Wales, declining in Yorkshire, and with an isolated northern outpost on the Solway Firth. However, more recent studies on the distribution of this species (Merritt *et al.*, 1996; Gibbins & Moxon, 1998) show a stronger presence up through County Durham and one record north of the River Tyne in southern Northumberland. This paper describes the recent distribution of *C. splendens* within Northumberland (north of the River Tyne), from the time of its discovery in 1988. The extent of available habitat appearing suitable for further colonization is also considered.

History

The modern records of *C. splendens* in Northumberland began in 1988 with a letter from Lesley Silcock to the Hancock Museum, Newcastle, published in Recording News (No 12, November, 1988). This letter reported several sightings of male *C. splendens* on the River Wansbeck at Marlish Farm (O.S. Grid Reference NZ0784), a mixed livestock/educational farm open to the public. The sighting does not appear to have resulted in any follow up.

In July 1991, I found three males along a 50m stretch of the River Blyth at Bellasis Bridge (O.S. Grid Reference NZ190777). Some additional lengths of the River Blyth were checked, although no more *C. splendens* were found. After forwarding this record to the Hancock Museum, I was alerted to Lesley Silcock's letter. Since 1991, I have checked stretches of the Rivers Blyth, Wansbeck, Lyne and Aln. The Bellasis Bridge population has persisted (in 1994, Ian Cameron counted eight to ten males, two females and one teneral; in 1995, I found two males; in August 2000, Duncan Hutt found two males; and in June 2001 I found one male and one female. All other records from the River Blyth consist of between one and three males and females). The Marlish Farm population has also persisted to 1999, with numbers ranging between one and thirty, predominantly males, although this site has not been revisited recently. Stretches of the Rivers Blyth (1995) and Wansbeck (1996) adjacent to the respective Bellasis and

Marlish sites have yielded small numbers (between one and ten males) and one male has been found on a pond adjacent to Seaton Burn (1996). The known distribution of *C. splendens* in the Northumberland coastal plain up to the end of August 2001 is summarized in Figure 1, plotted as 2km tetrads.

Habitat

All of the sites at which *C. splendens* has been found share three characteristics:

(1) Extensive stretches of shallow (depth <0.5m), smooth flowing water supporting submerged vegetation (*e.g. Ranunculus* spp., *Potamogeton* spp.) and emergent

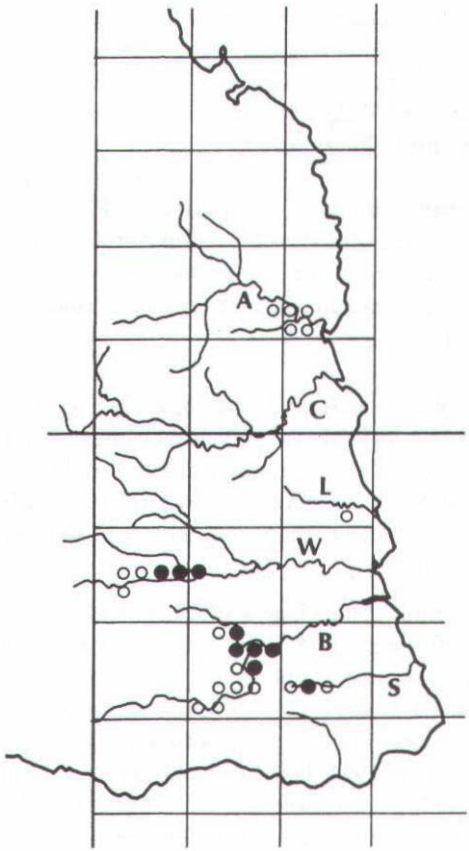

Figure 1. Distribution of *Calopteryx splendens* in Northumberland (to the north of the River Tyne). Records are plotted as 2km tetrads and all date from 1988 onwards. ● Positive records, ○ stretches of river with suitable habitat for *C. splendens* but lacking any positive records. Rivers: A = Aln, C = Coquet, L = Lyne, W = Wansbeck, B = Blyth, S = Seaton Burn

vegetation (*e.g.* Branched Bur-reed, *Sparganium erectum*; Reed Canary-grass, *Phalaris arundinacea*).

(2) High banks (>1 m), providing shelter from wind and supporting a diverse riparian vegetation of rank grasses and herbs.

(3) Limited tree cover.

This combination of plant rich, sheltered but not shady habitat concurs with the results of previous studies of habitats preferred by *C. splendens* in southern England (Prendergast, 1988; Goodyear, 2000).

This combination of riverine characteristics is unusual in Northumberland. Most rivers and streams in the county are fast and turbulent, lacking extensive emergent vegetation and many are heavily shaded. Where *C. splendens* occurs on the Wansbeck, the river flows through a low gradient flood plain, allowing extensive meanders. On the Blyth, sections of the river skirt the edge of a drained wetland, Prestwick Carr, again resulting in a low gradient. Seaton Burn arises from the Prestwick Carr area, flowing through a low gradient landscape over old coal works, which is therefore prone to subsidence. Upstream and downstream of the *C. splendens* sites on the Blyth and Wansbeck, both rivers revert to a faster, shadier character.

Given the distinct habitat type associated with *C. splendens* colonization in Northumberland, I have identified stretches of river that might be able to support this damselfly. These are also shown on Figure 1 (again as 2km tetrads). Stretches of river were only recorded as suitable if they met all three habitat characteristics.

Discussion

Small populations of *C. splendens* have persisted on the Rivers Wansbeck and Blyth in southern Northumberland for at least ten years, since first recorded in 1988. The populations appear to be small. Detailed surveys of abundance have not been made but all records report no more than 15 individuals, usually only ones or twos. During this period there have been some unusually dry years (early 1990s) and several serious floods, including at least one during the summer, on the River Wansbeck (July 1997). Small populations, particularly those lacking any adjacent source of new colonists, are vulnerable to such disturbances but *C. splendens* appears to have survived. The records are not sufficiently systematic to show any definite range expansion. However the Seaton Burn record in 1996, and the two tetrads on the northern River Blyth providing positive records in 2001, suggest some further colonization. The Northumberland populations are nonetheless isolated. The nearest populations, on the Rivers Derwent and Wear in County Durham, are 20 to 30 kilometres distant. Figure 1 also shows the Northumberland records, when plotted as 2km tetrads, appear fragmented. Note that the large grid squares in Fig. 1 are 10km squares, equivalent to a record at the national scale (*e.g.* Merritt *et al.*, 1996). Plotted at the 10km scale the Northumbrian distribution would warrant four contiguous records, deceptively extensive and unified.

The precise origins and timing of the establishment of *C. splendens* in Northumberland remain a mystery. Males of *C. splendens* are conspicuous. Whilst Northumberland has only a limited history of Odonata recording, local naturalists are unlikely to have overlooked this species whilst studying other flora and fauna. Conversely, it is possible that small populations confined to short, isolated stretches of river may have gone unnoticed.

Populations of a species at the edge of its range have a special interest, not least in relation to range expansion and contraction as a response to climate change. County Durham and Northumberland are comparatively poor in Odonata species, but in 1999 and 2000, locally unusual species were recorded in County Durham (Parr, 2000 & 2001). If southerly distributed Odonata are moving northward, *C. splendens* may also be able to expand its range. However, the availability of suitable rivers may be a barrier. The north Northumberland coastal plain, squeezed between the foothills of Cheviot and the North Sea lacks low gradient, macrophyte-rich rivers such as the Blyth and Wansbeck. The River Till, draining northwards inland and eventually joining the Tweed, does have some extensive low gradient sections, *e.g.* Milfield Plain, a potential corridor to the Tweed catchment. However, the Till is isolated from the southern Northumberland rivers by hills and moorland.

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Repeated interception of wind blown flowers of Common Cottongrass by the Emperor Dragonfly *Anax imperator* Leach

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At approximately 1300h GMT on 28 June 2001, at the Waldegrave Pool, near Priddy, Somerset, a mature male Emperor Dragonfly *Anax imperator* Leach was observed repeatedly flying towards and intercepting the wind blown white flowers of Common Cottongrass *Eriophorum angustifolium*. The weather was cloudy at the time of the observation and the flowers of the Cottongrass, which grows abundantly on the nearby marshy ground, were conspicuous against a grey sky. A strong, gusting, south-west wind carried the flowers towards the pool where a male *A. imperator* was routinely patrolling over the water. As the flowers approached, the dragonfly flew towards them, into the wind. The dragonfly usually made contact with the flowers that were intercepted, although no attempt was made to seize any flowers, either by using the legs or the mouthparts. This behaviour continued, intermittently, for about five minutes, during which five or six flowers were intercepted. The individual dragonfly then resumed normal patrol activity, quite ignoring any further flowers that drifted over. There were other individuals of *A. imperator* patrolling over the pond, but none of these flew towards the airborne flowers. It was clear that only one individual was involved.

Corbet (1999) mentions that Anisoptera may make investigatory flights towards large objects and then reject them when a few feet away. He states that in Florida, *Anax junius* (Drury) and *Coryphaeschna ingens* (Rambur) have been observed chasing badminton shuttlecocks. It is not clear whether these activities represent territorial defence or mistaken prey identification.

Reference

Corbet, P. S. 1999. *Dragonflies – behaviour and ecology of Odonata*. Harley Books, Colchester. xxxiv, 829pp.

Book Review

Dragonflies of North America
Scientific Publishers, Gainesville, FL, USA. xv + 938pp., 24 colour plates, 561 text figures. 7 x 10ins, cloth. ISBN 0-945417-94-2 Approx. US $115:00. **James G. Needham, Minter J. Westfall Jr., & Michael L. May.**

Needham & Westfall's classic handbook (Needham & Westfall, 1955) was written 'to provide for all who are interested in the animal life of North America a means of cultivating acquaintance with the order of insects called Odonata, or dragonflies'. For the past 47 years it has achieved that aim with great success, encouraging two generations to make an acquaintance with these fascinating insects. With the resulting advances in knowledge during that period, however, the need for an update has become increasingly apparent. Following the publication of the long-awaited companion volume, *Damselflies of North America*, Doctors Westfall and May set about the massive task of producing this revised edition.

The geographic area covered remains unchanged, being the United States and Canada, the Greater Antilles, and the northern tier of states of Mexico. The last two regions are important, as a number of extralimital species occur in the North American mainland from time to time. It allows the authors to deal with, for instance, the complex of species of *Orthemis*: *O. ferruginea* (Fabricius) occurs commonly in mainland North America, *O. discolor* (Burmeister) in Central and South America, and an undescribed Antillean form occurs in the islands. Both *O. discolor* and the Antillean form occur from time to time on the northern continent, but the taxonomic differences and their respective distributions are not entirely clear, as is pointed out in the text.

The book is divided into two parts. Part 1, 'Dragonflies in General' gives an account of adult and larval morphology. The morphological terminology is clearly explained and well illustrated, mainly with the help of excellent black and white photographs. The terminology used to describe wing venation is that of the Comstock–Needham system (Comstock & Needham, 1898), and this aspect of morphology is particularly well covered and especially useful as wing venations are illustrated for each genus in the systematic section. There is then a section on collecting, in which the use of cyanide as a killing agent is covered ('Note: cyanide is extremely dangerous and should be used with great care, if at all')! The modern method of killing and preserving, using acetone, has been added, and there is a section on techniques for preservation and curation. A further addition to the 1955 handbook is the inclusion of 25 colour plates. Fourteen plates are devoted to lateral view paintings by Lawrence Zettler, which cover most Aeshnidae, Gomphidae, Cordulegastridae and the subfamily Corduliinae of the Libellulidae. A further nine plates present 73 colour photographs of a wide selection of species. These illustrations are mainly good, but the photographs, in particular, are reproduced rather too small. This part of the book is completed by a map of the biotic provinces of North

America, which is of limited use, as it is not referred to elsewhere in the book, and a complete checklist of species with common names.

Part 2 comprises the 'Systematic List', in which 350 species are listed and described. There are 54 species that have been added to the fauna since the publication of the 1955 handbook. Some are newly described species and the others are species whose known range has extended into the geographic limits of North America. Thirty-four names used previously have been relegated to synonymy or sub-specific status. The character tables for families and genera, so much a part of the 1955 handbook, have been removed, and now dichotomous keys to larvae and adults introduce each family, sub-family and genus. I found these much easier to use than the tables. The original black and white photographs, expertly taken by Minter Westfall, illustrating larvae and many anal appendages, are still presented. These are supplemented by drawings both from the 1955 handbook and by newly commissioned drawings, especially those of Elyse O'Grady, covering many morphological features. Virtually all of these illustrations are of the highest order, and serve to clarify the written descriptions. The physical descriptions are followed by accounts of habitat preferences, distribution by state or province, and flight periods. The latter two have been much updated since 1955. Finally, a very useful regional species list and an extensive glossary and bibliography are included.

This is an excellent book, a weighty purchase at around £80.00 and 4.5lbs, but well worth the expense for anyone with an interest in American dragonflies in particular, or odonate taxonomy in general. The authors think it would 'be a tragedy' if this book determined North American dragonfly taxonomy for the next forty years. Undoubtedly, the science will move on, but the immense amount of information and scholarship in this work may well mean that this book will stand, deservedly, as the definitive textbook for this generation.

References

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Peter Allen

INSTRUCTIONS TO AUTHORS

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

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

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

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

Use of these terms is acceptable: 'exuvia' for cast skin (plural: 'exuviae'); 'larva' (instead of 'naiad' or 'nymph'); 'prolarva' to designate the first larval instar.

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

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

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

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

Titles of journals should be written out in full.

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

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	DAMSELFLIES
Calopteryx virgo	Beautiful Demoiselle
Calopteryx splendens	Banded Demoiselle
Lestes sponsa	Emerald Damselfly
Lestes dryas	Scarce Emerald Damselfly
Platycnemis pennipes	White-legged Damselfly
Pyrrhosoma nymphula	Large Red Damselfly
Ceriagrion tenellum	Small Red Damselfly
Coenagrion mercuriale	Southern Damselfly
Coenagrion scitulum	Dainty Damselfly
Coenagrion hastulatum	Northern Damselfly
Coenagrion lunulatum	Irish Damselfly
Coenagrion armatum	Norfolk Damselfly
Coenagrion puella	Azure Damselfly
Coenagrion pulchellum	Variable Damselfly
Enallagma cyathigerum	Common Blue Damselfly
Ischnura pumilio	Scarce Blue-tailed Damselfly
Ischnura elegans	Blue-tailed Damselfly
Erythromma najas	Red-eyed Damselfly

ANISOPTERA	DRAGONFLIES
Aeshna caerulea	Azure Hawker
Aeshna juncea	Common Hawker
Aeshna mixta	Migrant Hawker
Aeshna cyanea	Southern Hawker
Aeshna grandis	Brown Hawker
Anaciaeschna isosceles	Norfolk Hawker
Anax imperator	Emperor Dragonfly
Anax parthenope	Lesser Emperor Dragonfly
Anax junius	Green Darner
Hemianax ephippiger	Vagrant Emperor Dragonfly
Brachytron pratense	Hairy Dragonfly
Gomphus vulgatissimus	Club-tailed Dragonfly
Cordulegaster boltonii	Golden-ringed Dragonfly
Cordulia aenea	Downy Emerald
Somatochlora metallica	Brilliant Emerald
Somatochlora arctica	Northern Emerald
Oxygastra curtisii	Orange-spotted Emerald
Libellula quadrimaculata	Four-spotted Chaser
Libellula fulva	Scarce Chaser
Libellula depressa	Broad-bodied Chaser
Orthetrum cancellatum	Black-tailed Skimmer
Orthetrum coerulescens	Keeled Skimmer
Sympetrum striolatum	Common Darter
Sympetrum nigrescens	Highland Darter
Sympetrum fonscolombei	Red-veined Darter
Sympetrum flaveolum	Yellow-winged Darter
Sympetrum sanguineum	Ruddy Darter
Sympetrum danae	Black Darter
Sympetrum pedemontanum	Banded Darter
Sympetrum vulgatum	Vagrant Darter
Crocothemis erythraea	Scarlet Darter
Pantala flavescens	Globe Skimmer
Leucorrhinia dubia	White-faced Darter

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