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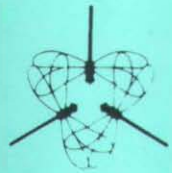

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member of the Societas Internationalis Odonatologica

The *Journal of the British Dragonfly Society*, published twice a year, contains articles on Odonata that have been recorded from the United Kingdom. The aims of the British Dragonfly Society (B.D.S.) are to promote and encourage the study and conservation of Odonata and their natural habitats, especially in the United Kingdom.

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Front cover illustration of male *Aeshna juncea* by Roderick Dunn

Obituary

Peter Miller
(1931-1996)

Peter Lamont Miller, Vice-President of the British Dragonfly Society since 1989, died on 24 March 1996. He was born in Edinburgh on 20 May 1931. His unusually strong interest in zoology, evident from an early age, gave continuing pleasure, both to him and to those associated with him, as students and colleagues, throughout his highly productive life.

After completing his National Service, which offered opportunities for observing insects in Wales and Germany, Peter went up to Downing College, Cambridge, in 1951, initially to study Veterinary Science (his father's profession), but he soon transferred to the Natural Sciences Tripos, obtaining First Class Honours in Part One and Part Two of the Tripos and being awarded the Frank Smart Prize for Zoology. He then spent four more years at Cambridge, studying respiration of locusts and dragonflies for the Ph.D degree, supervised by Professor V. B. (later Sir Vincent) Wigglesworth, F.R.S., and holding a Junior Research Fellowship at Downing College. He and his wife Kate (née Palmer), also a Cambridge biologist, were married in the college chapel at Downing College in the spring of 1959.

From 1959 until 1962 Peter was a lecturer in the Zoology Department of Makerere College, Kampala, Uganda (now Makerere University), a position that firmly established his abiding affection for the tropics in general and Uganda in particular. From 1962 until his retirement in 1994, Peter was Lecturer in Zoology at Oxford University where he was Fellow and Tutor at the Queen's College, earning distinction as a research scientist and as a teacher. A dedicated, skilful and original investigator, he soon acquired an international reputation for his entomological research, primarily in the laboratory, involving exploration of physiological and neural control of several vital processes, including respiration, rhythmic and motor behaviour, ventilation and learning. His international standing at that time is reflected in his receipt of the prestigious Medal of the Zoological Society of London in 1972.

Odonatology, internationally as well as in Britain, has been enriched by Peter's decision, in the early 1980s, to concentrate his research on dragonflies. He possessed a remarkable variety of highly developed skills: the ability to observe, record and interpret behaviour in the field, sometimes on a miniature scale; formidable competence for microdissection; talent for identifying neural and muscular mechanisms underlying behaviour; and an ability to perceive functional connections between physiology, behaviour and ecology. Thus his many publications on Odonata reveal an unusually high number of insights which have helped greatly to reveal broad patterns throughout the order, as well as providing a very detailed picture of behaviour at the level of the species and individual. His first paper to describe field observations, on an East African lindeniine gomphid (Miller, 1964), is an example, containing as it does a wealth of suggestions for interpreting behaviour, especially during emergence and subsequent adult life.

Among Peter's one hundred or so scientific publications, about half deal with Odonata, almost all of the latter being published after 1980. Peter was one of the first odonatologists to pursue the monumental discovery by Waage (1979) that during copulation the dragonfly penis serves not only to inseminate the female but also to displace rivals' sperm already within her storage organs. More than 20 of Peter's post-1980 publications deal directly or indirectly with the implications of this phenomenon and many of these treat British species. All Peter's papers on this topic are important, stimulating contributions, but several merit especial mention because they illustrate particularly well the way Peter advanced frontiers in this field.

With his daughter Clare (Miller and Miller, 1981) Peter elucidated the sequence of stages in copulation of *Enallagma cyathigerum*, using electromyograms to verify the contributions of three sets of muscles to the movements observed. In two other papers (Miller, 1987a, b) he explored the anomalous copulation of *Ischnura elegans* which in southern France typically lasts for more than five hours: by dissecting and then examining living copulating pairs *in situ* in the field (an extraordinary feat) Peter showed how stimulation of certain parts of the female genitalia brings about reflex responses of muscles that prolong copulation; and, by measuring sperm volumes in copulating females, he was able to infer that copulating males remove all the sperm of rivals from the bursa but none from the spermatheca. And Peter's masterly review of the structure and function of genitalia in the Libellulidae (Miller, 1991), based almost entirely on his own anatomical research, will serve as a foundation paper for the foreseeable future.

Odonatologists in Britain are much in Peter's debt on account of his splendid book *Dragonflies* in the Naturalists' Handbooks series (Miller, 1987c). The second, completely rewritten edition (Miller, 1995) constitutes a remarkable achievement in which Peter used his unrivalled personal experience to place the British species in a broader context. This book is a model of its genre, providing a sound and attractive manual for identification, an authoritative, up-to-date account of dragonfly biology against which observations can be interpreted, and an array of stimulating suggestions for investigators.

The British Dragonfly Society benefited greatly from Peter's contributions. As Vice-President he was a valued member of the Board, making constructive proposals and, by precept and example, encouraging others to adopt a positive, co-operative approach to problems. From an early stage in the Society's development he was a strong advocate of the Society's active involvement in conservation of dragonfly habitats. As programme organiser for the annual Indoor Meeting since 1990, and as organiser of local arrangements in Oxford since 1986 (alternating in successive years with Peter Mill in Leeds), Peter contributed importantly to the friendly, tolerant and constructive atmosphere that prevailed at such meetings. Peter and Kate were generous with their hospitality on these occasions, adding to the success of the meetings.

A brief obituary article such as this cannot do justice to Peter Miller's rich life of service, friendliness and fun. Notices are still appearing, but all those known to me are listed at the end of this article. A list of Peter's publications on Odonata appears in the obituary notice by Moore (1997). As an outstanding biologist, and as a person who exhibited to an advanced degree strength of character, honesty, gentleness, humility and charm, Peter will be sorely

missed by friends and colleagues in many parts of the world. It is fitting that the Society has established the Peter Miller Memorial Appeal to further the aims to which he was committed – in education, research and conservation.

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Philip Corbet

Leucorrhinia dubia (Vander Linden) at Chartley Moss NNR, Staffordshire, in 1995

T. G. Beynon
Saltwells Local Nature Reserve, Pedmore Road, Brierley Hill, Dudley DY5 1TF

The Moss was described by Bailey (1992) and Beynon (1995). In the latter paper Shooters Pool, the main breeding-site on the Moss for *Leucorrhinia dubia* (Vander Linden), was described in detail, together with observations made on the species in the 1994 season.

There were no significant changes in the physical characteristics of the site during 1995, not even in water-level, despite the prolonged drought, because the pool is a hole in the floating *Sphagnum* raft. However Wavy Hair-grass (*Deschampsia flexuosa*), omitted from previous descriptions, is widespread. Also, the *Sphagnum* edges of the pool are almost imperceptibly growing inwards.

The pattern of emergence, and to a lesser extent the flight period, differed greatly from 1994, and a phenologist could not have wished for a better pair of contrasting seasons. Some of the tentative conclusions in the previous paper need qualification, and these are noted below.

Method

The experience of 1994 indicated that the third week of May, the fourth week of June and the first week of August should cover key episodes in the species' season in England. However, tenerals were seen at the pool on 3 May, and observations were all brought forward (Table 1).

Using a 7x25 SpecWell Binomic mounted on a monopod, counting emerging dragonflies was relatively easy. Ideally, the count should start before the first maiden flight of the day and continue after the last larva has left the water. This was not always possible and numbers recorded (Table 1) are minima. With the instrument it was also possible to make an accurate count of exuviae, without damaging the fragile *Sphagnum* lawn, and this was done during the first period of emergence. Accuracy was well over 95 per cent as shown by the close agreement between the numbers of emerging dragonflies seen on one day and the count of exuviae on the following day.

Larvae

On 8 April, three or four samples were taken at each of seven stations around the pool. Wearing waders, it was possible to reach with the net beyond the fringing cotton-grass (*Eriophorum* spp.) to the clear water and submerged *Sphagnum* edge. The aim was to determine only the anisopteran species present and their age-classes; no counts of larvae were made. A remarkable number of shed larval skins of several species were found caught in the *Sphagnum*, possibly preserved by the dystrophic peaty water.

L. dubia larvae were found in numbers in every sample, and were clearly of two different

age groups. The species is most probably semi-voltine, although Corbet *et al.* (1960) state that there is slight evidence for a life history of more than two years in Britain. Gibbons (pers. comm.) believes that there might be a diapause egg, as in the univoltine *Sympetrum danae* (Sulzer), but I think that this is unlikely because *L. dubia* is a spring species and Gardner (in Corbet *et al.*, 1960) gives 26 days for egg development (in captivity). No very small larvae were found in the samples.

Larger larvae, some 15mm long, were often netted several together, and seemed to have been loosely grouped in submerged (but not dense) *Sphagnum*. The posterior dorsal edges of their eyes sparkled in the sun. Smaller larvae (7–8mm), like the larger ones, were found in every sample. Only very few individuals in either of the two size groups differed greatly from the sizes quoted. All *L. dubia* larvae were easily distinguished from the many very small *S. danae* larvae by the presence of ventral stripes.

Corbet (1957) gives a period for *Anax imperator* Leach of some forty-five days between visible external signs of metamorphosis and emergence. *L. dubia* probably differs little from this as it emerges at about the same time of year. However, what appears evident from the cessation of emergence between 8 and 22 May (Table 1), is that individuals can arrest metamorphosis temporarily if adverse conditions – in this case low temperatures – occur. Metamorphosis is hormonally controlled and triggered by a change in photoperiod, but thereafter appears to be temperature dependent. It is interesting that it can be arrested for a not inconsiderable period at what must be a very late stage.

If *L. dubia* is a semi-voltine species, some precocious individuals will complete their life cycle in one year, as for example in *A. imperator* (Corbet, 1957). This prevents genetic isolation between cohorts of a species whose life cycle usually spans two years.

Other species of Odonata found in the net samples included undetermined Zygoptera, *Aeshna juncea* (L.) and *A. grandis* (L.) (mostly 20–25mm, but one less than 10mm and one over 40mm with well-developed wing-buds), *Anax imperator* (two shed skins, *c.* 20mm), *Libellula quadrimaculata* L. (at least three well-grown larvae) and *Sympetrum striolatum* (Charpentier) (several small larvae). Surprisingly, no larvae of *Aeshna cyanea* (Müller) were found even though it breeds in the pool in larger numbers than *Anax*.

Pre-emergence larvae behaved as previously noted (Beynon, 1995), but the ambient temperature and, in particular, the minimum night temperature, seem to affect their willingness to leave the water as much or as well as sunshine.

From observations of numbers emerging, it appears that larvae are reluctant to leave the water on windy days. Most of the supports they use are *Eriophorum* stems or leaves emerging from water, and a larva is probably able to sense windy conditions from the movement of submerged stems. Those that do emerge on a windy day suffer high mortality; many are blown off and drown or are unable to expand their wings properly while lying on a wet substrate.

There are no fish in the pool and the only significant predators of larvae are other invertebrates, including larger Odonata larvae (particularly aeshnids). However, the fact that similar large numbers of *Leucorrhinia* emerged in 1994 and 1995, although derived from different cohorts, probably indicates that predation of larvae does not have a large effect on the population.

Henrikson (1988) postulated that in Sweden the absence of fish, rather than acidity *per se*, probably determines the presence of *L. dubia*. At less than about pH 5.4 most fish cannot reproduce. Shooters Pool is about pH 3.4. In twenty lakes in south-west Sweden the presence of fish and *L. dubia* was mutually exclusive. A limed lake with pH 7.0 and no fish had *L. dubia*; in an acidified lake (pH 5.2) with Perch (*Perca fluviatilis*) and Roach (*Rutilus rutilus*) there were no *L. dubia*.

Exuviae

Counts of exuviae not associated with an active emerger were made during the first emergence period (Table 1). At this time nearly 90 per cent were over water, rather more than in 1994 (c. 75 per cent). It is possible that the urgency to emerge during this period caused larvae to choose one of the first supports encountered. In the second prolonged emergence period, a greater proportion came ashore, mostly to use *Eriophorum*, and few were found over water. As in previous years, some exuviae were on the *Sphagnum* mat without a discrete support. Probably most of these on land, and many on supports over land, were predated by ants (see below).

By 18 May, eleven days after the end of the first emergence period, nearly half the exuviae had disappeared. On 16 July, seven days after emergence ended, very few were visible, and on 21 August only one was found. Most which disappear are knocked down by rain, and fewer are blown off by wind. There was little clogging of emergents by blown *Eriophorum* seed in 1995.

As in previous years, exuviae were often closely grouped, sometimes in contact in twos and threes, and sometimes piggybacked. On 5 May, two emergers in stage 2 (layback) were so close on the same stem that the head and thorax of the upper overlapped the abdomen of the lower. Both were successful, but had the lower individual gone to stage 3 first, it would have grasped the still-hanging upper insect.

Emergence

In striking contrast to 1994, there were two distinct periods of emergence in 1995, separated by nearly a fortnight of bad weather.

Warm weather began on 29 April, with night minima of 6–7°C, and days averaging around 17°C with only one exception (14°C on 30 April). From 2 to 7 May, temperatures did not fall below 8.5°C at night or below 23°C in the day.

On 2 May, the EN Site Manager saw no *Leucorrhinia*, although there were many *Pyrrhosoma nymphula* (Sulzer) about. On 3 May a colleague reported at least seven *Leucorrhinia* at midday, most of which appeared teneral. It thus seems that emergence began on 3 May. This is the third time in the last nine years that emergence has begun early, at around this date (Beynon, 1995).

Emergence over the next five days was spectacular, with totals of c. 70, c. 95, 104, 169 and 176, before two only on 8 May (cripples and predated on this date were almost certainly from the previous day). Altogether, 700–720 emerged over this period, well over half the final total (Table 1).

The two mass emergences in 1991 noted by Coleshaw (Beynon, 1995) also occurred during periods of prolonged high pressure and hot weather. Observations at Chartley over the past few years show that *L. dubia* is behaving in a fashion intermediate between that of a spring and a summer species. In suitable conditions it synchronizes its emergence in the typical spring species fashion, but in an average British spring it has an extended emergence period in the pattern of a summer species. Pajunen (1962) provides data on the progress of emergence of *L. dubia* in Finland, but unfortunately without details of the weather. Totals were found by very thorough collection of exuviae. In Finland in 1959, over the first nine days of a 26-day emergence period, 83 per cent of a total 1707 at one pool, and 85 per cent of 588 at another, emerged. In 1960, figures for the first eleven days of 36 were 87 per cent of 967, and 55 per cent of 431. All these except the last are much more concentrated than the 1995 Chartley data: first six of 54 days, 56 per cent of 1254. It is possible, however, that the British and Finnish data would have shown a similar pattern had emergence at Chartley not been stopped by weather for a 13-day period.

Absence of weather details in Pajunen's data is frustrating. In 1959 on 10, 11, 12 May the totals are 291, 20, 230 at one pool, and 119, 0, 56 at the other. At the same pools, figures for *L. rubicunda* (L.) are 19, 0, 17 and 2, 0, 3. Knowledge of conditions on the night of 10 May and the day and night of 11 May would be useful.

Emergence, defined as the time from larva at rest on support to maiden flight, was taking at Chartley on average no more than two and one-quarter hours. In the second period, when similar but shorter periods of very hot weather occurred, several individuals completed in under two hours. In such weather, many also began very early, before 0730, and most emergers had gone by midday. This was most marked late in the second period.

Events in the first period could have given the impression that emergence occurs only in sunshine as claimed by Pajunen (1962), but this is not the case (Beynon, 1995). Had the weather been poorer at the beginning of May, dragonflies that emerged in the first period might well have been forced to emerge in relatively unsuitable weather later (as in 1994).

In 1995, unlike 1994, emergence was not seen in rain. However, on 18 June, two of the dead cripples counted were clearly from the previous day when there was fine drizzle from 0700 to 2130 with periods of steady rain. The cripples had probably emerged in this rain.

On 8 May, although the preceding night minimum had been 10°C, the day temperature reached only 11°C. Emergence now ceased for the next thirteen days. Day temperatures only occasionally reached double figures, while night temperatures were generally well below 5°C, with frosts on 10, 12, 14 and 18 May. Temperatures then began to rise; on 21 May the day reached 17°C followed by a night minimum of 8°C.

On 22 May the day temperature reached 22.5°C and emergence started again. It then proceeded much as in 1994 (Beynon, 1995), probably ending again about 9 July, a total period of 67 days but including 13 consecutive days without any emergence (Table 1). There was no emergence on 25 May (night minimum 8°C, day maximum 19°C, strong wind), 29 May (14.5°C, 19.5°C, very strong wind), 10 June (8.5°C, 16°C, very strong wind) and 11 June (11.5°C, 17°C, thin drizzle and strong breeze). However, there was some emergence on cool but windless days, notably 27 May (9°C, 18°C), 4 June (6°C, 16°C) and 25 June (13°C, 15°C), supporting my belief that larvae can sense windy conditions and delay emergence.

Table 1. Summary of the 1995 emergence of *Leucorrhinia dubia*, with observed numbers of individuals at different stages.

Numbered stages are explained in Beynon (1995). X, M, C, P denote exuviae, maidens, cripples and predated individuals. Time is BST at start of visit. Hours is duration of visit. p = present, not counted; e = estimate; ( ) = probably from previous day; E = emergers counted; Total = actual or estimated number of emergers.

Date	Time	Hours	X	1	2	3	4	M	C	P	E	Total
02.05	1200	0.3										0
03.05	1200	0.5	Emergence starts					7				e70
04.05												e95
05.05	0900	2.3	165	4	6	21	19	9	3	0	62	104
06.05	0830	3.2	269	5	23	84	32	4	7	1	156	169
07.05	0915	3.5	438	6	13	91	15	24	7	1	157	176
08.05	0925	1.3	614	0	0	1	1	0	(3)	(1)	2	e6
09.05			Emergence interrupted									
13.05 to 21.05			p	0	0	0	0	0	0	0	0	0
22.05	1430	0.5	Emergence restarts									e20
23.05	1015	1.5	p	1	2	6	0	4	2	0	15	e30
24.05	0915	3.1	p	0	2	4	7	4	3	(2)	20	e35
25.05	1010	1.1	p	0	0	0	0	0	0	0	0	0
26.05	1205	1.3	p	0	0	2	4	1	0	(1)	7	e10
27.05	1020	1.5	p	0	0	10	1	0	0	0	11	e15
29.05	0915	1.5	p	0	0	0	0	0	0	0	0	0
30.05	1410	1.5	p	0	1	4	1	0	0	0	6	e10
04.06	1330	1.3	p	0	0	3	0	0	0	0	3	e5
10.06	1330	1.0	p	0	0	0	0	0	0	0	0	0
11.06	1120	0.7	p	0	0	0	0	0	0	0	0	0
18.06	1030	1.0	p	2	0	3	2	1	5	0	13	e15
20.06	1330	1.0	p	0	1	5	0	0	1	0	7	e10
21.06	1330	1.7	p	1	0	3	2	4	1	0	11	e15
22.06	0930	5.0	p	0	3	22	2	9	0	0	36	36
23.06	0925	4.5	p	0	1	12	5	5	2	0	25	25
25.06	0930	1.5	p	0	1	1	5	0	1	0	8	e10
02.07	1025	1.5	p	0	0	2	5	0	2	0	9	e10
07.07	1400	0.7	p	0	0	0	0	0	1	0	1	e5
08.07	0950	1.5	p	0	0	1	0	0	1	0	2	2
09.07			Emergence ends									
								Totals			651	e873

Adding 80–100 exuviae from the mat during the initial period (Note 2), 100 from the mat during the second period (Note 4), and 195 from non-visit days (Note 7), produces:

Total for 1995 = 1244–1264 (The best estimate for the 1994 population = 1356)

Notes to Table 1

1. Total (day one) = X (day two) - X (day one), for 03.05 to 07.05 only.
2. Total emergers 03.05-08.05 estimated to be 700-720, which includes 80-100 cases on the lawn, not accurately counted.
3. No emergences 09.05-21.05 because of the weather.
4. Estimates during the second emergence period are generally larger than the observed numbers because of the prolonged period of diurnal emergence (e.g. a stage 1 at 1150 on 24.05; a stage 2 at 1445h on 30.05) which results in some emergers appearing after the end of a visit. A further 100 or so new cases were counted on the lawn during this second period giving, together with those from Note 7 (below), a total of 548 for this period.
5. 25.05: cold night (8°C), solid cloud, rising wind.
6. 29.05: cool day, very strong wind following heavy rain in afternoon of 28.05.
7. Taking into account the relevant weather conditions, the number of emergers on comparable days and the number of new cases counted on the first visit after an absence, the number of emergers on the missing dates in Table 1 are estimated to be:
   May: 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
   June: 10, 5, 0, 0, 5, 10, 5, 0, 0, 0, 0, 10, 10, 15, 15, 10, 10, 15, 15, 15, 15
   July: 10, 5, 0, 5, 10

   Total 195

Table 2. Diurnal progress of emergence of *Leucorrhinia dubia* on 6 May 1995 at Shooters Pool, Chartley Moss NNR.

Area is section of shoreline censused. Areas were chosen for convenience and are not comparable in size or in density of emergent plants. Stages 1, 2, 3, 4 are as explained in Beynon (1995). M = maidening dragonflies not previously counted as emergers. C+P = fresh cripples and predated individuals. Time is BST at start of census of relevant area.

Area	Time	1	2	3	4	M	C+P
N Edge	0830	2	3	0	0	0	0
NE Bay	0850	1	3	0	0	0	0
E Edge	0910	0	4	0	0	0	1
SE Bay	0920	0	4	2	0	0	0
S Edge	0930	0	4	20	2	0	2
SW (pines)	1000	1	1	14	5	1	1
W Edge	1026	0	1	4	2	1	2
NW (clump)	1042	1	3	16	6	2	2

A second circuit was made between 1115h and 1145h counting new stage 3 and stage 4 only, giving a further 28 + 17. 269 exuviae not associated with active emergers were also counted.

Those that do emerge and survive to stage 4 (wings open) without dislodgement often revert to stage 3 (wings closed), a strategy which reduces wind resistance.

There was a distinct morning peak during the first period of emergence, as also noted by Pajunen (1962). This is illustrated in Table 2 which gives numbers of individuals at different stages of emergence (Beynon, 1995) during a single circuit of the pool on 6 May. The same pattern was very obvious on 5 and 7 May also. During the second emergence period there was only an ill-defined concentration in the morning.

Males tended to emerge before females, but possibly because the initial emergence period was concentrated, this was not so marked as in 1994. On 5 May, the third day of emergence, 44 males and one female (plus 17 unsexed) were counted.

Predation

Henrikson (1988) states that the larva of *L. dubia* differs from that of many other Odonata in its behaviour, making it more conspicuous. It hides less in bottom debris and is more active in daylight. Also, in circumstances where many other species feign death, it attempts to escape. This is probably disadvantageous when threatened by a fish, but an advantage if the predator is another dragonfly larva of similar speed.

No predation of emergers by wolf spiders was noted in 1995, but primary predation by ants living in the wet *Sphagnum* appeared to be more frequent than in 1994. It appears that most *L. dubia* emerging ashore, either on the *Sphagnum* mat or on stems growing through it, are predated by ants.

On 24 May at 0935h an early stage 3 was struggling on the mat, about 0.7m from the water. An ant was found to be biting at a coxal joint. The ant was removed and the emerger placed further inland on *Calluna* at a height of 15cm. At 1106h it was being attacked by several ants, by 1203h its wings had been bitten off and it was being dragged down into the *Sphagnum* by the ants, and by 1220h it had totally disappeared with only its exuviae remaining. A late stage 2 emerger close by on a low *Eriophorum* leaf, 0.5m inland from the water's edge, had no ants near it at 0915h but by 1203h it too was a wingless stage 3 or 4 being dragged into the *Sphagnum*. The same day, at 1110h, a larva was found walking awkwardly over the *Sphagnum* mat about 0.5m in from the pool edge. It had a single ant attached to the ventral surface of its thorax. After the ant was removed, the larva walked 38cm in 13 minutes and then climbed an *Eriophorum* stem with difficulty. Ecdysis began at 1145h, but it was still in stage 2 at 1220h and appeared to have the ends of its hind legs stuck in the case, undoubtedly suffering from the ant-bite. Winsland (1995) found that a single bite on the prothorax from a black ant (*Lasius niger* (L.)) could cause a fully-emerged *P. nymphula* to lose its hold on its emergence support.

On 26 May at 1208h a new stage 4 was seen to revert to stage 3 and begin wing flicking. Examination revealed an ant attached to the right hindwing root. The ant was removed but the dragonfly remained in stage 3 and 70 minutes later it was clearly dying.

Ants were also frequent predators of adult *Leucorrhinia* caught by Round-leaved Sundew (*Drosera rotundifolia*). It is curious that the ants are not trapped by the sundew, even though they move all over the leaves when dealing with their victims, which they remove within a

day. In 1994 ant predation on dragonflies caught by sundew was not observed, their remains persisting for more than a week.

Many adult *L. dubia* were caught in spiders' webs, as in previous years, but no predation by birds or Anisoptera was seen in 1995.

Size of the *L. dubia* population in 1995

An explanation of the calculation of the size of the 1995 *L. dubia* population, estimated at 1244–1264, is given in Table 1. Considering also the figures for 1994, it appears that some 1200–1300 *L. dubia* emerge annually from this small pool (90m perimeter).

In 1995, for the first time, a few emergers were seen on the nearby East-West Ditch. This supports very large numbers of *S. danae* and is 400m long, about 5m wide, and cut into sections by peat dykes. Although physically different to Shooters Pool in having a peat base and sides, and being subject to fluctuating water-levels, it has a similar pH, and many of the sections have extensive *Sphagnum*. The progress of the *Leucorrhinia* population in the ditch will be followed with interest.

Breeding was recorded for the first time in 1995 on two smaller pools dug especially for *Leucorrhinia*, Cotton Pool in 1991 and Wood Pool in 1992. However, they have not yet developed much *Sphagnum* and when they completely dried out in 1995 it is likely that most Odonata larvae in them would have perished.

Adults

The first adults appeared on 3 May and the first identified female on 5 May. By 29 July numbers had decreased to around 60, with little sexual activity. The last female was seen on 8 August, a perfect clear-winged individual *in copula* with an old male. The last males at the pool were two on 11 August, although one was resting about 50m away on 14 August.

Emergence probably ended on 9 July, 36 days before the last adults were seen, a slightly longer interval than in 1994. The flight period of 103 days was nearly two weeks longer than in 1994 and started eight or nine days earlier.

A striking outcome of the early and prolonged hot weather was the rapid rate of maturation. The first mature males were seen sunning on the log path and territorially patrolling the margins of the pool on 6 May, and the same day a male grasped an individual on maiden flight and unsuccessfully attempted to complete the wheel. On 7 May two pairs were seen to form wheels in flight and one completed copulation. Thus only four days after the start of the emergence, males were mature enough to copulate. This contrasts very much with the 29–38 days taken to mature in the much cooler 1994 season, and is also less than Pajunen's (1962) figures of 8–12 days (males) and 10–15 days (females).

Sexual maturity is often taken to be indicated by the return to water of the young adult, since it is usually only at water that sexual behaviour occurs. However, Pajunen (1962) found that the testes were often fully developed at four or five days, before the insect had attained mature coloration, and the first ripe ova were found in six to twelve day old females. He concluded that the rate of gonad development is very dependent on the weather. Some authors working on other species have even found spermatozoa in larvae. It seems that

Odonata, like many other insects, may be physiologically sexually mature some time before they are behaviourally capable of successful copulation and oviposition. Some *L. dubia* at Chartley in 1995 were both physiologically and behaviourally sexually mature within three to four days of emergence, and this accelerated rate was undoubtedly due to the unusually hot weather.

No copulating pairs, indeed no Odonata, were seen during the period of bad weather between 9 and 21 May when emergence was interrupted. On 23 May there were large numbers of copulating pairs at the pool and elsewhere on the Moss. On 23 June there were a few copulating pairs at the pool at 0925h, and an hour later at least 40 were counted. Copulation lasted 20–25 minutes and over the next three hours a minimum of 150 pairs were observed.

On 4 June a triple male-male-female combination was disturbed from the mat and flew jerkily across the pool, pursued briefly by another male. This is the only example of a triple *Leucorrhinia* that I have seen, although triples of *S. danae* are not uncommon. It occurred during intense activity on the first fine day after four poor ones.

Oviposition was first seen on 26 May, when a lone female was driven off by a male *L. quadrimaculata*. This is 19 days after the first successful copulation was seen, but includes only seven days of warm weather. However, from observations in 1994, it is likely that unobserved oviposition occurred earlier.

Two instances of atypical oviposition and departure flights were seen. On 27 May a copulating pair settled on the wet mat, separated, and the female began to make single dips attended by the male hovering nearby. After two minutes, the male settled and did not follow the female as she moved away dipping. This may have been due to the stiff breeze which four minutes later blew the female upside down into the water. She managed to free herself two minutes later and flew off low to perch on a log in the increasingly strong wind.

On 29 May, another day of strong wind, a lone female made 73 dips in two minutes, a few of which were on to emergent *Sphagnum* tips (behaviour attributed to the gusty conditions, females habitually dipping only into clear water), rested for ten minutes on the mat before flying low 7m inland to perch on a fallen branch. These two low-level departures flights were clearly due to the wind. The following day was much calmer and a female, leaving after dipping with the characteristic high flight (Beynon, 1995), was intercepted by a male some 40m away from the pool and about 25m high. The wheel was successfully completed in the air and the pair dropped into the vegetation.

A proportion of ovipositing females were attended to some degree by their males. On 21 June an attending male hovered and perched close to the female as she completed 8+12+6 dips. An intruding male then chased off the female, and was chased by the guarding male, all three going off over the Moss. *Leucorrhinia* males which chase away intruders rarely return to still-ovipositing females. *L. quadrimaculata* behaves in the same fashion and the guarding behaviour of the two species is similar with some males guarding, others not guarding and others guarding only for a short time.

A different behaviour was seen on 7 July. At 1430h a copulating pair was perched low on an *Eriophorum* stem at the edge of clear water. The pair flew to another nearby stem and then separated, the female remaining on the stem while the male hovered above. He

approached the female twice, and each time she vibrated her wings and repelled him, in exactly the same way that the male of a settled copulating pair will vibrate his wings at intruding insects. She also arched her abdomen dorsally. His approaches were those of a male about to grasp a female to initiate copulation. The male eventually perched 40cms away from the female, but the latter flew away over the Moss without attempting to oviposit and the male remained on his perch. Perhaps a female has to begin dipping to evoke the guarding response in the male.

Perched males, scanning the sky, fly up to investigate passing insects. If these are other males, they appear quickly to recognize them as such after an initial chase and usually return to their former perches. If, however, the insect is a female, pursuit is continued to contact and grasping. Sometimes the female avoids the wheel position by curling her abdomen dorsally and the tandem eventually separates. The sexes have a subtly different flight style which usually inhibits males from closely approaching other males, but at close quarters more precise discrimination is made using the form and size of the abdomen, particularly the difference in thickness and shape immediately behind the thorax (Pajunen, 1964). Colour dimorphism of the sexes has little value in sex recognition.

Sunning males, particularly those on the log paths, are very tolerant of other males. The logs have lost much of their bark and the pale surfaces get quite warm in sun. In the extremely hot weather between 28 and 30 July, with day maxima of 28°C, 29°C and 31°C, no log-resting was seen. Presumably air temperatures were sufficient to maintain body temperature. At similar temperatures later in the season, both *Sympetrum flaveolum* (L.) and *S. danae* were seen in the obelisk position ('sky-pointing'), but this behaviour was not noted in *Leucorrhinia* even at a temperature of 32°C.

In the hot weather of 1995, activity was depressed around noon and increased again about 1400–1430h (BST). Similar behaviour, to avoid overheating, is well-known in tropical species.

Access to the Moss

The Moss is privately owned and leased to English Nature. It is a very hazardous site and access is strictly by permit only. Arrangements for group visits can usually be made by contacting the Site Manager, English Nature, Attingham Park, Shrewsbury, Shropshire SY4 4TW.

Unfortunately, following my paper in 1995, a number of people ignored the signs at the entrances, caused problems for the Site Manager and endangered themselves.

Acknowledgments

My thanks again to Tim Coleshaw (EN Site Manager) for much patient help, Neil Collingwood for providing a copy of Henrikson's paper, Bill Furse and David Gibbons for many records, and all four for comments and ideas.

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The influx of *Sympetrum flaveolum* (L.) during the summer of 1995

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Introduction

During the summer of 1995 there was a spectacular influx into the British Isles of the migrant species *Sympetrum flaveolum* (L.). It was soon evident that the migration was the most extensive for many years, and so a special effort was made to collect records centrally with as much detail as possible. This paper discusses the records received.

Records of *S. flaveolum* in 1995

Records for *S. flaveolum* were received centrally by JS, BDS Secretary, and passed on to JWS, coordinator for the species, for processing. The full set of records received is set out in Table 1. As the migration proceeded during the summer, information came in from a range of sources. At one extreme, there were authoritative and comprehensive record returns submitted on card RA72, the card for migrant species used within the Odonata Recording

Scheme (ORS). Other records were appended to RA70 forms submitted to ORS. On a less formal level, BDS members were telephoning JS with details of their personal observations. Information on the dragonfly migration was also appearing on telephone hotlines. Such details were diligently recorded by Alan Paine and others. Several short reports covering migration in a particular locality were received at the end of the flying season. It was decided to include in the present report all relevant data received, in spite of the inherent variability of quality. An interim report, written by Jill Silsby, was included in BDS Newsletter No 28, Autumn 1995.

As indicated above, some records were much more comprehensive than others. Grid references were not included in some records; such deficiencies were made good where possible using data obtained from Hywel-Davies & Thom (1986). When information on a single site was collected over several days, the records were inserted in Table 1 as a single entry. Where the records provided sufficient detail, Table 1 shows the maximum count at a site, the number of females, the number of copulating pairs, and the number of ovipositing females observed. Some historical records for Cheshire and Surrey were submitted and these are also included in Table 1.

Chronology of the invasion

The earliest record for 1995 was of two *S. flaveolum* at Chartley Moss, Staffordshire on 11 July. During July, Yellow-winged Darters were also recorded on 24 July at Waltham Abbey and Woodham Fen, both in Essex, and on 29 July at Saltwells LNR, Staffordshire. These records can be attributed either to a small and unnoticed early migration or, possibly, to an unnoticed emergence.

The major invasion of *S. flaveolum* started on 1 August. The main reported influxes were at Yarmouth, Norfolk, and Dungeness, Kent. At Great Yarmouth Cemetery the numbers reached a peak of approximately 180–200 on 2 August, and the last remaining insect left on 13 August. Earlier estimates of up to 600 *S. flaveolum* reported at the cemetery are now regarded as an exaggeration. At Dungeness a maximum of about 170 were reported, and the last of these was present on 12 August. There were other invasion sites besides Yarmouth and Dungeness. Substantial numbers arrived at Gibraltar Point in Lincolnshire, Caister, Sea Palling and Winterton in Norfolk, North Warren in Suffolk, and Hornsea in Yorkshire and Humberside, with smaller numbers elsewhere. Almost the entire arrival and, where it occurred, onward movement to inland sites, took place in the first week of August.

Dispersal through England and Wales during early August was widespread. Subsequently, sightings continued on a regular basis throughout August, but records dropped sharply at the start of September. Occasional records occurred during September, and two records, were submitted for early October both from Wimbledon Common.

Distribution of dispersed dragonflies

The principal points of entry were Norfolk, Kent and Suffolk, in that order, but all the coastal counties along the south and east of England, from Cornwall through to Yorkshire and Humberside, reported sightings of *S. flaveolum*.

But there remain some uncertainties about first destinations. The records for two counties in particular are of interest. Firstly, Pembrokeshire, exposed on the westernmost extremity of south-west Wales, had a very high count of over 130; did these dragonflies arrive directly from France, or did they arrive elsewhere first and then disperse into Pembroke? In the absence of recordings of large numbers of arrivals in Devon and Cornwall, direct arrival in Pembroke seems the more probable explanation. Secondly, the first sightings for the 40 *S. flaveolum* recorded at Christchurch, Hants were dated 17 August. Had these insects come into the country elsewhere, were they late arrivals, or had they arrived earlier and remained undetected? We shall probably never know the answer. As we shall see later, the answers to the above questions concerning the Pembrokeshire and Christchurch dragonflies are important in the context of estimating the size of the total influx of Yellow-winged Darters.

Some dragonflies found suitable habitat within the county in which they arrived, and so remained throughout the summer. But the majority moved on. The distribution of all records is shown in Figure 1, which has been prepared using DMAP, courtesy of Dr Alan Morton. Substantial numbers found their way as far as Merseyside, and all the following counties had counts of over 20: Avon/Somerset, Berkshire, Cheshire, Glamorgan, Hertfordshire, Lancashire, Staffordshire, Surrey, Worcestershire.

The majority of sightings were in England and Wales, but two records from Ireland were received, and a single male was seen on the Isles of Scilly.

Estimate of the number of migrating dragonflies

A rough indication of the minimum number of *S. flaveolum* that migrated into Britain can be obtained by summing the numbers recorded for the eight main arrival sites identified earlier. The total is 478, to which must be added a further 50 or so to represent the aggregate from the remaining coastal sites at which a few dragonflies arrived. This gives a total of about 530 recorded arrivals in the country; this figure is probably an underestimate.

An alternative count can be arrived at as follows: the total count at all sites within the coastal counties from Cornwall through to Yorkshire/Humberside is about 750. The total count from sites within the remaining counties is about 670. Some dragonflies never dispersed beyond the county in which they arrived, as is evidenced by, for example, the records for North Warren, Suffolk. So, very roughly, we may deduce that the minimum number of recorded *S. flaveolum* was between 670 and 750. The maximum possible number of records of distinct insects was the sum of these two figures, namely 1420. This figure is likely to be an overestimate.

Because a certain number of dragonflies will have been recorded twice, once at an arrival site and again at a dispersal site, we shall never have a precise figure for the total number of *S. flaveolum* that invaded the country in 1995. Overall, from the figures discussed above, it appears that between 700 and 1000 distinct individuals were recorded during the summer of 1995. If recording was comprehensive, these figures provide a good representation of the total entry of *S. flaveolum*, but if significant numbers arrived undetected, the recorded figures would be well below the actual number of arrivals.

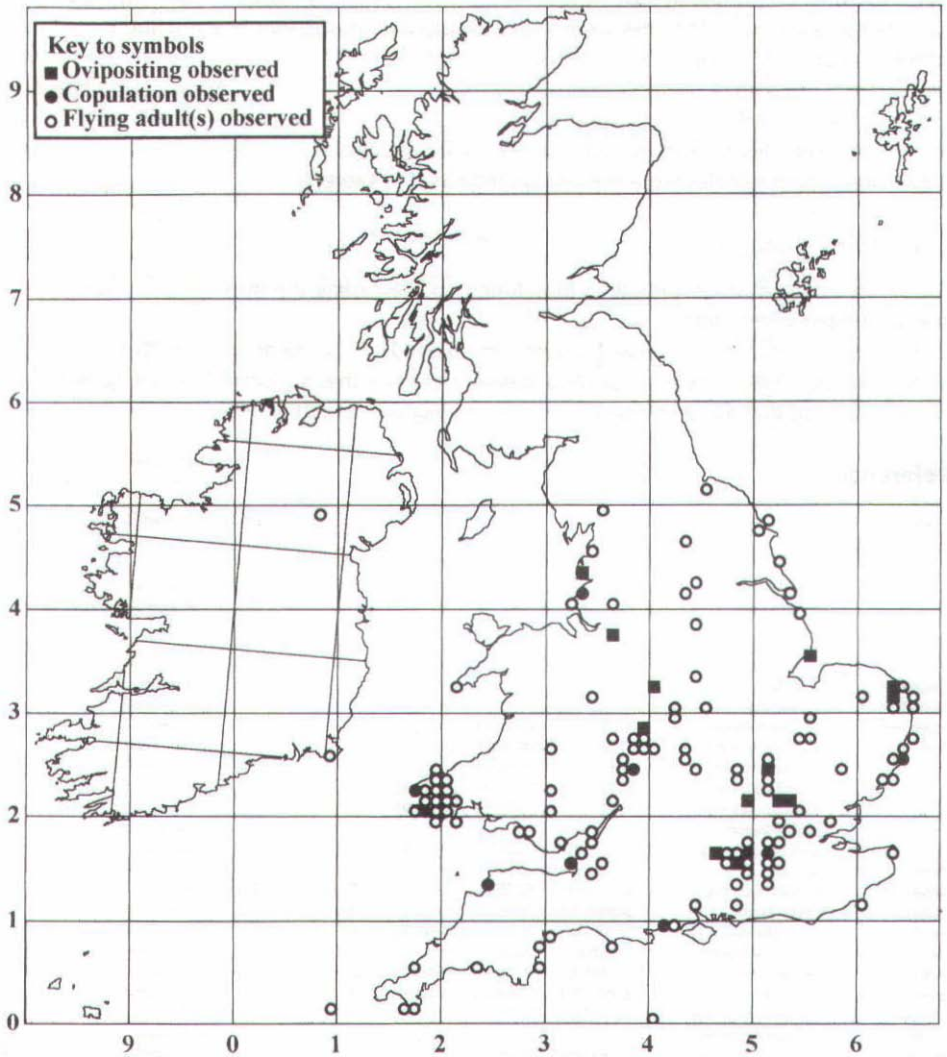

Figure 1. Distribution of records of *Sympetrum flaveolum* (L.) in 1995.

Breeding

Ovipositing was recorded at sixteen sites, and a distinct symbol has been used on Figure 1 to indicate these records. The sites were widely distributed throughout England and were in the following counties: Bedfordshire, Berkshire, Cheshire, Hampshire (x2), Hertfordshire (x4), Lancashire, Lincolnshire, Norfolk (x2), Staffordshire (x2) and Surrey. Additionally, breeding may have occurred in other counties where copulating pairs were observed, namely: Avon/Somerset, Devon, Suffolk and Worcestershire in England, and Pembrokeshire in Wales. Other sites where females were present are indicated in Table 1.

Concluding remarks

The involvement of many people in monitoring and recording the invasion of *S. flaveolum* is acknowledged with thanks.

The above records show that *S. flaveolum* enjoyed an excellent summer in England and Wales during 1995. There must be a genuine chance that successful breeding will have taken place and that flying adults will emerge at a number of distinct sites in 1996.

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Table 1. Records of *Sympetrum flaveolum* in 1995 (with some earlier Cheshire and Surrey records)

County	Site	Grid ref.	First date	Last date	Max.	Fem.	Co.	Ov.	Source	
Avon/Som	Berrow	ST25	05/08/95	06/08/95	20	3	1		Avon N/L 5	1
Avon/Som	Charterhouse	ST55	08/08/95		Some				Avon N/L 5	2
Avon/Som	Middle Hope	ST 36	08/08/95		2				BrianSlade	3
Avon/Som	Portbury Wharf	ST47	13/08/95		1				Avon N/L 5	4
Avon/Som	Priddy Mineries	ST55	06/08/95	21/08/95	7				Avon N/L 5	5
Avon/Som	Weston Moor	ST47	11/08/95	13/08/95	2				Avon N/L 5	6
Beds	Willington	TL14					2	2	BDS 28	7
Beds	Willington	TL11 2502	05/08/95	06/08/95	12				RBA	8
Beds			05/08/95						AP:BP	9
Berks	Aldermaston	41 611635	06/08/95		C		B	B	RA72	10
Berks	Bracknell	SU888653	04/09/95		1				JWard-Smith	11
Berks	Englemere, Ascot	SU907687	08/08/95	26/08/95	8				JWard-Smith	12
Berks	Moor Green Lake	SU808625	10/08/95		1				Tom Gladwin	13
Berks	Swirley, Ascot	SU904668	07/08/95	21/09/95	21	2	2		IWS DS	14
Berks	Windsor GP	SU951704	09/08/95	09/08/95	3				JWard-Smith	15
Bucks	Clattercote Res	42 449485+	11/08/95		1				RA70	16
Bucks	Milton Keynes	42 83x33x	05/08/95		2				J Phillips	17
Bucks	Milton Keynes	42 85x42x	06/08/95		2				J Phillips	18
Bucks	Milton Keynes	42 89x34x	09/08/95		2				J Phillips	19
Bucks	Milton Keynes	42 89x40x	10/08/95	26/08/95	2				J Phillips	20
Bucks	Milton Keynes	42 83x42x	11/08/95	17/08/95	1				J Phillips	21
Camb	Wicken Fen	TL57	12/08/95	19/08/95	3				PFollet	22
Camb	Haddenham	TL467751	26/08/95		1				Barbara York	23
Cheshire	Marbury CP	SJ661755	Aug-95	01/09/95	20	1		1	MDensley	24
Cheshire			Aug-07		1				MDensley	25
Cheshire			02/08/45		1				MDensley	26
Cheshire			04/08/45		1				MDensley	27

County	Site	Grid ref.	First date	Last date	Max.	Fem.	Co.	Ov.	Source	
Cheshire			18/08/45		1				MDensley	28
Cleveland	Lovell Hill Ponds	NZ51	27/08/95		1				N W Harwood	29
Cornwall	Goonhilly	10731198	06/08/95	19/08/95	1				RA72	30
Cornwall	Lizard	10694169	06/08/95	23/09/95	4				RA72	31
Cornwall	Penhale	10781567	20/08/95		1				RA72	32
Cornwall	Seaton Valley	SX35	11/08/95	28/08/95	3				AP-LACT	33
Derbyshire	Long Eaton	SK43	06/08/95	28/08/95	5				PC/MC/RF	34
Devon	Berry Head	SX95			1				PC/DS	35
Devon	Budleigh Salterton		19/08/95		1				RBA	36
Devon	Colaton Raleigh	SY08							BDS 28	37
Devon	Croyde	SS43					1		BDS 28	38
Devon	Dawlish Warren	SX97			3				BDS 28	39
Devon	Teignmouth	SX97							BDS 28	40
Dorset	Bourne Bottom	SZ05943	03/08/95	04/08/95	2	1			APhilpott	41
Dorset	Holt Heath	SZ057047	21/08/95	30/08/95	4				AP/CW/AS	42
Dorset	Portland	SY67	26/08/95		1				AP-BP	43
Dyfed	Pembroke	SM90							BDS28	44
Essex	Epping	TL40	28/08/95		1				AMcGeeney	45
Essex	Ratnham	TQ58	22/08/95		1				I Phillips	46
Essex	Waltham Abbey	TL30	24/07/95		1				AMcGeeney	47
Essex	Walthamstow	TQ38	10/08/95	06/09/95	1				AP-BP	48
Essex	Woodham Fen	TQ79	24/07/95		1				AMcGeeney	49
Glam	Kenfig	SS78	03/08/95	14/08/95	12				Avon N/L 5	50
Glam/Gwent	Cardiff	ST17	13/08/95		2				Avon N/L 5	51
Glam/Gwent	Magor NR	ST48			13				BDS 28	52
Glam/Gwent	Merthyr	SO00	11/08/95		4				Avon N/L 5	53
Glam/Gwent	Tondu	SS88			1				Avon N/L 5	54
Gloucestershire	Forest of Dean	SO61							BDS 28	55
Gwynedd	Bardsey	SH12	01/08/95		1				AP-BTO	56
Hants	Ancells Farm	SU824557	12/08/95	06/09/95	4	1		1	D&I Dell	57
Hants	Bramshill	SU753623	27/08/95		1				D&I Dell	58
Hants	Christchurch	SZ19	17/08/95	03/09/95	40	1			KGGoodyear	59
Hants	Hengistbury Head	SZ19	24/08/95		2				KGGoodyear	60
Hants	Holmsley Gravel Pit				1				KGGoodyear	61
Hants	Holmsley Passage		24/08/95		2	1	1		KGGoodyear	62
Hants	Itchen Valley	SYU45x16x	06/08/95		8				RA70	63
Hants	Mortimer West End	41 637652	12/08/95		C		B	B	RA72	64
Hants	Sopley Common	SZ132982	26/08/95		D		Y		RA70	65
Hants	Warren Heath	SU777587	21/08/95		B				RA70	66
Hants	Woolmer	SU83							AP-WHW	67
Hants	Wootton Pond	SZ29	13/08/95		2	2			KGGoodyear	68
Herts	Broxbourne	TL3707	03/08/95	16/08/95	1				Tom Gladwin	69
Herts	Cheshunt Gravel Pit	TL375030	06/08/95		4				Tom Gladwin	70
Herts	Colney Heath	TL201059	13/08/95		2				Tom Gladwin	71
Herts	Digswell	TL246148	12/08/95		3	1			Tom Gladwin	72
Herts	Hertford Heath	TL349105	05/08/95	20/08/95	25+	2	2	2	TomGladwin	73
Herts	Hilfield Park Res	TQ158960	12/08/95	19/08/95	12	3			S Murray/TG	74
Herts	Hitchin	TL12	06/08/95		1				AP-BP	75
Herts	Hitchin	TL187313	06/08/95		1				RBA	76
Herts	Hoddesdon	TL387100	11/08/95		1				Tom Gladwin	77
Herts	Ickleford	TL185317	06/08/95		1				Tom Gladwin	78
Herts	Panshanger	TL292126	12/08/95		10	2	Y	Y	Tom Gladwin	79
Herts	Rickmansworth	TQ051936	19/08/95		2				Tom Gladwin	80
Herts	Stansted Abbots	TL377130	12/08/95	25/08/95	13	2			Tom Gladwin	81
Herts	Tring Reservoir	SP91	03/08/95		1				Tom Gladwin	82
Herts	Tyttenhanger	TL190050	13/08/95		6	1			Tom Gladwin	83
Herts	Watford	TQ086987	12/08/95		1				Tom Gladwin	84
Herts	Watton-at-Stone	TL285205	06/08/95	21/08/95	7				Tom Gladwin	85
Herts	Wilstone	SP908128	02/08/95	28/08/95	10	5	1	1	PColston/T G	86
Kent	Hothfield Common	TG9645	07/10/95		1				I & G Brook	87
Kent	Sandwich Bay	TR36	02/08/95	09/09/95	5	2			A Johnson	88
Kent	Dungeness	TR01	01/08/95	12/08/95	170				DW&WA	89
Lancs	Amberswood	SD60	06/08/95	17/08/95	5				SFair	90

County	Site	Grid ref.	First date	Last date	Max.	Fem.	Co.	Ov.	Source	
Lancs	Birkdale Hills	SD31	03/08/95	15/08/95	11	1	1		PHS/MJ	91
Lancs	Formby	SD20	08/08/95		1				PHSmith	92
Lancs	Heysham	SD45	04/08/95	19/08/95	4				DJClarke	93
Lancs	Lytham St Annes	SD33	05/08/95	07/09/95	7	1	1	1	PHS/JP/MJ	94
Leics	Aylestone	SK50	03/08/95		Many				AP-BP	95
Lincs	Donna Nook	TF49	06/08/95	12/08/95	5+				P Troake	96
Lincs	Gibraltar Point	TF5558	03/08/95	15/08/95	20	1		Y	BDS 28	97
Merseyside	Birkdale LNR	SD31	03/08/95		100				BDS 28	98
Merseyside	Seaforth		05/08/95		1				RBA	99
Middx	Hounslow	TQ17	09/08/95	24/08/95	3				BDS 28	100
Middx	Hadley Green		01/08/95	28/08/95	7				S Murray	101
Middx	Mill Hill	TQ29	02/08/95		1				S Murray	102
Middx	Monken Hadley		09/09/95		1				S Murray	103
Norfolk	Berry Hall	TG358237	20/08/95		1				PJH	104
Norfolk	Bramble Hill	TG483222	02/08/95		3				PJH	105
Norfolk	Braydon, Horsey	TG444224	16/08/95		5				PJH++	106
Norfolk	Brundall		02/08/95	06/08/95	3	2			PJH/RBA	107
Norfolk	Bure Pk, Yarmouth	TG522102	05/08/95		1				PJH	108
Norfolk	Burgh Common		06/08/95		4				PJH/Ken Saul	109
Norfolk	Caister	TG518127	01/08/95	06/08/95	30	5			BDS 28	110
Norfolk	Catfield Dyke, Hickling	TG406219	09/08/95	22/08/95	8	1			PJH	111
Norfolk	Catfield, Hickling	TG404217	03/08/95	08/08/95	1				PJH	112
Norfolk	Dilham	TG343252	03/09/95		9	3	2	1	PJH/BCrook	113
Norfolk	Hickling	TG42	03/08/95		2				AP-BP	114
Norfolk	Holkham NNR		05/08/95		1				RBA	115
Norfolk	Hopton	TG50	12/08/95	13/08/95	2				AP-EJ	116
Norfolk	Horsey	TG465240	03/08/95		1				PJH/TJ	117
Norfolk	Ludham Marshes	TG3917	20/08/95	09/09/95				6	PTaylor D Hewit	118
Norfolk	Lyng, Easthaugh	TG079179	06/08/95		2				PJH++	119
Norfolk	Sea Palling	TG432278	03/08/95		12				AP-BP	120
Norfolk	Strumpshaw	TG30	03/08/95	16/08/95	2				AP-BP/J&DG+I	121
Norfolk	Upton Fen	TG380138	03/08/95		2				RBA	122
Norfolk	Wayford Bridge	TG352245	20/08/95		10				PJH	123
Norfolk	Welney	TL59	27/08/95		1					124
Norfolk	Winterton	TG488215	02/08/95		26	1			PJHeath	125
Norfolk	Yarmouth	TG526084	01/08/95	13/08/95	200	20			PJHeath	126
Pembroke	Bathesland Pond	12 864205	14/08/95						SACoker	127
Pembroke	Bosheston	11 976943	06/08/95		1				SACoker	128
Pembroke	Broomhill Burrows	12 889001	06/08/95		20	1	1		SACoker	129
Pembroke	Clarey Dale	22039177	09/08/95	13/08/95	20				SAC/JWD	130
Pembroke	Dowrog	12 771266	08/08/95		8	2			JWD	131
Pembroke	Llandruidion E Pond	12 913379	05/08/95		3				SACoker	132
Pembroke	Llandruidion W Pond	12 911377	05/08/95		20				SACoker	133
Pembroke	Marloes Mere	12 775082	22/08/95		2				JWD	134
Pembroke	Penally Marsh	21 120995	08/08/95		1				SACoker	135
Pembroke	Porthsychan	12 905407	09/08/95		2				GHR	136
Pembroke	Roch Valley Pond	12 888213	14/08/95		3				SACoker	137
Pembroke	Romans Castle	12 891100	08/08/95						SACoker	138
Pembroke	Skokholm	12 7305	27/08/95		1				MB	139
Pembroke	Skomer	12 7209	03/08/95		1				GT	140
Pembroke	Stradland Moor	12 994262	11/08/95						SACoker	141
Pembroke	Summerton	22 064023	23/08/95		2				SACoker	142
Pembroke	Sunnyhill L Pond	12 920102	21/08/95		3				SACoker	143
Pembroke	Treferddan	12 734251	07/08/95	08/08/95	20	1	1		SACoker	144
Pembroke	Valley Farm	22011172	13/08/95		1	1			SAC/JWD	145
Pembroke	Valley Lake	22015173	10/08/95	13/08/95	15				SAC/JWD	146
Pembroke	Valley Pool	22015173	04/09/95	11/09/95	2	1			SACoker	147
Pembroke	Wallis Pond	22011268	13/08/95		1				SACoker	148
Pembroke	Waterston Pool	12 936060	21/08/95		5				SACoker	149
Pembroke	Waun Fawr	22 016301	22/08/95		1	1			SACoker	150
Pembroke	Whitehouse Mill Pds	22 164149	24/08/95		1				SACoker	151
Powys	Brecon Beacons	SO02							BDS 28	152
Slrops	Catherton Marshes	32 648794	09/08/95		1				RA72	153

County	Site	Grid ref.	First date	Last date	Max.	Fem.	Co.	Ov.	Source	
Shrops	Shrewsbury	SJ41							BDS 28	154
Som	Som Levels	31 452440	10/08/95		1				RA72	155
Som	Waldegrove		10/08/95	17/08/95	5				AP-APR	156
Staffs	Chartley Moss	43 02328-1	06/08/95	28/08/95	7	1	1	1	RA72	157
Staffs	Chartley Moss	43 026282	11/07/95	19/08/95	2				RA72	158
Staffs	Fenspool LNR	32 920890	03/08/95	14/08/95	4				RA72	159
Staffs	Saltwells LNR	32 939888	29/07/95	30/08/95	30	1	2	1	RA72	160
Suffolk	Felixstowe	TM33	02/08/95	06/08/95	8				AP-LBO	161
Suffolk	Landguard B O	TM23	01/08/95	11/08/95	5				AP-LBO	162
Suffolk	North Warren	TM45	09/08/95	09/09/95	90	Y	1		BDS 28	163
Suffolk	Sizewell	TM46	02/08/95		4				AP-BP	164
Suffolk	Snape	TM35	12/08/95		1	1			AP-BP	165
Suffolk	Southwold	TM57	12/08/95		5	1			Tom Gladwin	166
Suffolk	Sudbury	TL868418	27/08/95		1				Alan Paine	167
Suffolk	Sudbury	TL868418	05/08/95		2				RBA	168
Suffolk	Thorpeness	TM45	01/08/95		2				AP-LBO	169
Surrey	Ash Vale	SU888516	01/09/95						PFollett	170
Surrey	Brook Pond	SU983539	08/08/95		2				D&J Dell	171
Surrey	Capel	TQ176404	02/08/95	05/08/95					PFollett	172
Surrey	Chobham Common	SU964646	08/08/95	20/08/95	1				PFollett/FRC+H	173
Surrey	Esher Common	TQ128623	15/08/95	21/09/95					PFollett	174
Surrey	Esher Common	TQ129622	15/08/95	21/09/95	6	1	1		BDS 28	175
Surrey	Frensham Little Pnd	SU860413	13/08/47						PFollett	176
Surrey	Kiln Pond	SU964646	08/08/95		1				D&J Dell	177
Surrey	Lakeside	SU886517	20/08/95	30/08/95	5	2		1	D&J Dell	178
Surrey	Normandy Pond	SU928517	22/08/95		2				D&J Dell	179
Surrey	Ockham/Wisley	TQ077584	20/08/75						PFollett	180
Surrey	Ockham/Wisley	TQ0658	15/09/70						PFollett	181
Surrey	Ockham/Wisley	TQ077584	07/10/70						PFollett	182
Surrey	Ockham/Wisley	TQ077584	09/09/55						PFollett	183
Surrey	Ockham/Wisley	TQ078595	13/06/54						PFollett	184
Surrey	Ockham/Wisley	TQ078595	26/08/11						PFollett	185
Surrey	Ockham/Wisley	TQ078595	14/08/11						PFollett	186
Surrey	Ockham/Wisley	TQ0858	1900						PFollett	187
Surrey	Ockham/Wisley	TQ0858	Aug 1899						PFollett	188
Surrey	Ockham/Wisley	TQ0858	Sep 1898						PFollett	189
Surrey	Thursley	SU900415	06/08/95		1				AP-WHW	190
Surrey	Thursley	SU900415	06/08/95		1				PFollett	191
Surrey	Thursley	SU905416	06/08/95						PFollett	192
Surrey	Thursley	SU905416	13/06/64						PFollett	193
Surrey	Thursley	SU906414	05/09/95		2	1			D&J Dell	194
Surrey	Vann Lake	TQ157394	09/08/95						PFollett	195
Surrey	Whitmoor Common	SU983539	08/08/95						PFollett	196
Surrey	Wimbledon Common	TQ230720	03/09/95	06/09/95					PFollett	197
Surrey	Wimbledon Common	TQ224717	21/09/95	30/09/95					PFollett	199
Surrey	Wimbledon Common	TQ225717	21/09/55						PFollett	200
Surrey	Wimbledon Common	TQ27	08/10/95						D Element	201
Surrey	Wimbledon Common		01/10/95		1				M Bunce	202
Surrey	Wimbledon Common	TQ27	15/08/95		60				BDS 28	203
Surrey		SU893542	Aug 75						PFollett	204
Surrey		TQ229532	10/08/95						PFollett	205
Surrey		TQ158566	01/08/95						PFollett	206
Surrey		SU9043	Sep 1898						PFollett	207
Surrey			1898						PFollett	208
Surrey		TQ370647	Aug 1871						PFollett	209
Sussex	Beachy Head		05/08/95		3				RBA	210
Sussex	Brighton		05/08/95		2				RBA	211
Sussex	Heyshott	SU81			Few				BDS 28	212
Warwick	Alvecote	SK255046	08/08/95	10/08/95					BDS 28/BM	213
Warwick	Lighthorne-Heath	SP344568	12/08/95		1				R E Harbid	214
Warwick	Redditch	42 078676	07/08/95		1				RA70	215
Warwick	Ufton Fields NNR	SP378615	08/08/95	10/08/95	1				RL	216
Warwick	White Acre Heath	SP209931	08/08/95	11/08/95	1				BM/KW	217

County	Site	Grid ref.	First date	Last date	Max.	Fem.	Co.	Ov.	Source	
Westmorland	Killington Res	SD59	11/08/95		1				A F Gould	218
Worcs	Ashmoor Common	32 848469	19/08/95		25	2	2		RA70	219
Worcs	Belbroughton	32 925756	16/08/95		3				RA70	220
Worcs	Droitwich	32 893607	06/08/95		3				RA70	221
Worcs	Feckenham Wylde	32 012604	06/08/95		1				RA70	222
Worcs	Gallows Green	32 933627	06/08/95		2				RA70	223
Worcs	Hartlebury Cmmn	32 828706	05/08/95		1				RA70	224
Worcs	Hollybed Common	32 779374	12/08/95		3				RA70	225
Worcs	Kempsey	32 848469	02/08/95		30	2			RA70	226
Worcs	Madresfield Park	32 819480	15/08/95		1				RA70	227
Worcs	Malvern Interfields	32 781496	14/08/95		1				RA70	228
Worcs	Monkwood NR	32 803605	02/08/95	03/08/95	1				RA72	229
Worcs	Ravenshill Wood	32 739538	04/08/95		1				RA70	230
Worcs	Westwood Gt Pool	32 878635	15/08/95		25				RA70	231
Yorks/Humberside	Fairburn	SE42							BDS 28	232
Yorks/Humberside	Filey	TA18			1				BDS 28	233
Yorks/Humberside	Hornsea	TA24	03/08/95	06/08/95	20				AP.BP	234
Yorks/Humberside	Muston	TA07	08/08/95		1				PW/MIL	235
Yorks/Humberside	Spurn Head	TA31							BDS 28	236
Yorks/Humberside	Treeton	SK436863	04/08/95	07/08/95	1				IA/DW/PR	237
Yorks/Humberside	Staveley NR	SE36	18/08/95	21/08/95	3	2			PT CS	238
Yorks/Humberside	Wintersett Fishponds	SE31	23/08/95	09/09/95	4				Steven Denny	239
Scilly Isles	St Mary's	SV923110	13/09/95		1				Tom Gladwin	240
Armagh, Ireland	Middletown	H768397	26/08/95		1				Ian Rippey	241
Wexford, Ireland	Tacumshin	T07 05	31/08/95	08/09/95	5+				P A J Morris/IR	242

Some records are expressed using the codes:
A=1; B=2-5; C=6-20; D=21-100; Y=present in unspecified numbers

Latest update: 3 June 1996 I Ward-Smith

Lesser Emperor Dragonfly *Anax parthenope* (Sélys) in Gloucestershire; the first British record

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On 13 June 1996 at about 1300h, I was watching dragonflies at a small lake (c.100m x 20m) at Cinderford Linear Park, Gloucestershire (SO 650132), when my attention was attracted by a fairly large aeshnid flying rapidly over the open water. Through x10 binoculars I was startled to see a conspicuous area of blue at the base of the abdomen on an otherwise rather featureless dark-coloured dragonfly.

At first I assumed, with some excitement, that I was looking at *Hemianax ephippiger* (Burmeister). However I had seen numerous *H. ephippiger* abroad, though not for some years, and as I continued to watch I began to feel less certain about my initial identification. In particular, the blue area on the abdomen seemed larger than I remembered, 'wrapping around' on to the sides like the white rump patch on a Storm Petrel *Hydrobates pelagicus*.

I continued to get good flight views, down to about four metres, for about 15 minutes. I then left the site, but returned briefly at about 1700h, when the dragonfly was still there. On consulting Aguilar *et al.* (1986) that evening I discovered that my doubts were well founded, *Hemianax* having the blue on the second abdominal segment confined to the dorsal surface. Also, the ground colour of the thorax and abdomen appeared much too dark - not 'sandy' or 'yellow-brown' as described for *Hemianax*. The few field notes I had made on *Hemianax* in 1981 only served to add to my uncertainty: 'orange-buff' thorax, 'buff-orange' abdomen, and a 'square blue patch on the first (*sic*) abdominal segment', did not fit at all. The only species which did in fact fit was *Anax parthenope* (Sélys), but this had never before been recorded in the British Isles.

I was able to return to the site the next day at 1000h, and after half an hour of anxious waiting the dragonfly re-appeared. I obtained views down to about three metres, though unfortunately only in flight, and I was able to confirm the identity as a male *Anax parthenope*. Reference to Askew (1988) some time later supported the identification, although the illustration of *Hemianax* seems to be too dark, especially on the thorax, and does not correspond well with the text.

Compared with the single male *A. imperator* Leach present, this *A. parthenope* was slightly but noticeably smaller and slimmer, with not such a deep thorax and not such an exaggeratedly downcurved abdomen. I was unable to discern any shading or suffusion in the wings. The wholly green eyes were easy to see at these close ranges. From head-on a yellow area on the face (frons) was discernible. The thorax was darkish grey-brown with a vaguely purplish tinge - 'violet-brown' (Aguilar *et al.*, 1986) describes it well. The abdomen, apart from the base, appeared (in flight) generally nondescript dark brown-grey, with no yellowish or sandy tints. A dark mid-dorsal line was often discernible. Although on the views I had I was unable to see exactly which segments were included in the blue base of the abdomen, it looked quite extensive. The blue was always obvious and striking, except when the dragonfly was flying straight towards me or against the sky. It extended well down on to the sides of the segments and possibly even on to the ventral surface. The shade of blue appeared to be between the abdomen colours of *A. imperator* and *Libellula depressa* Linnaeus.

In flight it seemed if anything even faster, more manoeuvrable and more aerobatic than *A. imperator*, with perhaps more periods of hovering and frequent upward swoops. It spent more time patrolling over the middle of the lake than the *A. imperator* present, which kept more to the edges, but they frequently met and engaged in territorial fights which *imperator* usually, but not always, won. It was still present when I left the lake at about 1115h, but could not be found that afternoon or subsequently.

A. parthenope is quite common in southern continental Europe, the main range extending as far north-west as about Bordeaux and Luxembourg. It becomes scarcer in central Europe but there are records of migrants from Holland and northern Germany (Askew, 1988). Its arrival in Gloucestershire in 1996 (inadvertently reported as 1994 in *J. Brit. Dragonfly Soc.*, 12(2): 64) coincided with a large immigration of Painted Lady *Vanessa cardui* butterflies and migrant moths, and with the appearance of several Red-veined Darters *Sympetrum fonscolombei* (Sélys) in Norfolk.

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The rediscovery of *Ceriagrion tenellum* (De Villers) in West Sussex

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Introduction

Parr & Parr (1979) describe *Ceriagrion tenellum* (De Villers) as a zygopteran whose centre of distribution is the Mediterranean region extending northwards to Britain and Germany and occurring as far east as Syria. Askew (1988) states that it is local in southern England and Wales and in other northern European countries being absent from Scandinavia.

My personal experience of this species in southern Europe is that it is only locally common, being restricted to small open streams and seepages and avoiding without exception shady areas. In 1995, I spent some time in Portugal observing Odonata in the Coimbra region where *C. tenellum* was one of the commonest species, being particularly abundant in the shallow margins of sandy rivers and streams throughout the region.

Parr & Parr (1979) state that '*C. tenellum* is possibly under some ecological stress in Britain in that the habitats are suboptimal (being) often very restricted in size, specialised and climatically limiting.' These comments are certainly true in Sussex as a whole. The species survives in a few localities (isolated pools) on Ashdown Forest and in similar conditions at Eridge Park. Both of these sites are in East Sussex.

C. tenellum in West Sussex

The first sighting of *C. tenellum* in West Sussex was from West Chiltington where it was recorded by Henry Guermonprez on 2 September 1917 (Dannreuther, 1945). The only other reported West Sussex locality is Forest Mere near Liphook where it was recorded in the mid 1970s (Chelmick, 1979). This site is exactly on the boundary of West Sussex with Surrey and is a contiguous extension of similar habitat in that latter county. West Chiltington stands isolated as the single true West Sussex record for this dragonfly.

So what of this locality? In his essay on the habitats and vegetation of Sussex, Rose (1991) lists the major heaths remaining in West Sussex. Hurston Warren, described by Rose as 'having the finest valley bog in West Sussex...' is situated immediately adjacent to West Chiltington and must be assumed to be the locality described by Guermonprez. Hurston

Warren is owned by a golf club and has been the subject of a nature reserve agreement with the Sussex Wildlife Trust for many years. The reserve itself can be considered in two parts, the most important being the valley bog dominated by *Sphagnum* spp. with Bog Asphodel (*Narthecium ossifragum*), cotton-grass (*Eriophorum* spp.) and Cranberry (*Vaccinium oxycoccos*) being found in abundance. The second part comprises wet heath dominated by sedges (Carex spp.) and much overgrown by birch and pine. Management of the reserve has concentrated upon clearing birch and pine from the wet heath, creating and maintaining open water in the valley bog and continuing removal of woody saplings of birch and pine so as to maintain the quality of the habitat.

Throughout the 1970s and 1980s the odonate fauna was recorded intensively and whilst a reasonable list resulted, at no time was *C. tenellum* recorded. It was considered during this period that the bog was too dry and that the species (if it had ever occurred) was now extinct.

The rediscovery of *C. tenellum*

In early September 1990, I visited the Hurston Warren valley bog in the company of Anthony Winchester who was for a number of years the Reserve Manager on behalf of the Sussex Wildlife Trust. The bog was much wetter than previously remembered and to our not inconsiderable astonishment we observed many specimens of *C. tenellum*, some single individuals but also many *in copula*. If not abundant, the species could certainly be described as numerous.

No visits could be made in 1991 or 1992, but in 1993 two visits were made by Anthony Winchester and myself which were both somewhat depressing. On both occasions the whole area of the valley bog was so incredibly dry it hardly seemed possible that it would ever recover. The familiar quaking surface was firm and baked, the only standing water being adjacent to the outfall point, and the only odonate inhabitants were a few *Libellula quadrimaculata* Linnaeus. The visits took place in June and August and on neither occasion was *C. tenellum* observed.

In 1994 Anthony Winchester visited the bog and found that it had recovered some of its former quaking habit; some areas of open water were present and a few *C. tenellum* were observed.

On 30 July 1995 we both visited the bog, encouraged by the extremely heavy rainfall of the previous winter. The bog was in perfect condition; truly quaking and with extensive shallow pools. On this occasion *C. tenellum* could confidently be described as abundant. Individuals were seen immediately and many pairs were observed *in copula*. Even more encouraging was the fact that *C. tenellum* appeared to be colonizing some of the pools created many years previously by the conservation volunteers. One individual was even observed over a small pool on the adjacent wet heath area.

Discussion

The most interesting aspect of this rediscovery is that it did not occur earlier. During the 1970s and 1980s the area was extensively surveyed by many competent observers and it is

inconceivable that the species could have been overlooked. The occurrence or absence as witnessed in the years between 1990 and 1995 suggest that the Hurston Warren bog is not the centre or nucleus of the population but simply receives an overflow in favourable years. That begs the question of where the centre of population is situated. Parr & Parr (1979) considered that *C. tenellum* was one of the most sedentary damselflies with very few individuals in their study moving to new areas. They also found fluctuating populations; in one sector the insect was common in 1974 but absent from the area (which had dried out) in 1975.

Parr & Parr identify the key habitat in their survey as being open marshy stream areas dominated by Marsh St John's Wort (*Hypericum elodes*) as the main emergent vegetation. This plant is uncommon in Sussex and although it has been recorded from West Chiltington (Wolley-Dod, 1970), there have been no records from anywhere in the vicinity in recent years (Sussex Plant Atlas, 1990). The nearest adjacent wetland that could provide suitable habitat is the River Chilt which flows to the north of the bog and which warrants intensive study to see if it provides the solution to this mystery.

Acknowledgments and appreciation

Appreciation is due in the first instance to the West Sussex Golf Club who own the Hurston Warren valley bog and to the Sussex Wildlife Trust and its 'Body Shop' Conservation Volunteers whose dedication and persistence in managing this area have been rewarded. It is fair to assume that if the management had not been carried out, then the bog would be much drier and any opportunity for colonization much reduced.

My thanks are also owed to Anthony Winchester who managed the Reserve for a number of years and who has assisted me with the field work for this paper.

It must be pointed out that Hurston Warren is private and is accessible only by permit obtainable from the Sussex Wildlife Trust.

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The Ruddy Darter *Sympetrum sanguineum* (Müller) in South Lancashire

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Introduction

Sympetrum sanguineum (Müller) is found quite widely in central Ireland but, otherwise, has a mainly southern and eastern distribution in the British Isles (Askew, 1988; Hammond, 1983). On the western side of England, the species breeds as far north as south-west Cheshire, though its presence in that county was not confirmed until 1985 (Gabb & Kitching, 1992).

The distribution map in Hammond (1977) showed a pre-1950 record for Formby Point (SD/12) in VC 59 (South Lancashire), but this has been deleted in the second edition. In his review of the Odonata of Lancashire and Cheshire, Sumner (1985) made no mention of the Ruddy Darter.

S. sanguineum is said to have declined nationally in recent decades, perhaps due to loss of habitat (McGeeney, 1986) and/or to a reduction in the reinforcement of populations by immigrants from the Continent (Hammond, 1983). Indeed, Hammond's (1983) distribution map suggests a 50 per cent decline of occurrence in 10km squares between 1961 and 1982.

This paper gives details of a recent expansion of the Ruddy Darter's range, contrary to the national trend, and the establishment of a small colony in South Lancashire.

Invasion and establishment

The first authenticated record of *S. sanguineum* in VC 59 seems to be of a male photographed by R. Letsche at Ainsdale Sand Dunes National Nature Reserve (SD/286100) on 23 July 1989 (Hall & Smith, 1991). This extra-limital sighting was considered to be a result of immigration during a warm, sunny period.

None was seen in 1990, but I photographed a male at Platt's Lane clay-pits, Burscough (SD/441107) on 14 August 1991 and found another male at an Ince Blundell field pond (SD/331021) on 29 August 1991.

The only sighting in 1992 was of a male at Birkdale Hills Local Nature Reserve (SD/301133) on 22 July. I saw none in 1993 but R. Letsche (pers. comm.) reported a number of males at ponds in Ainsdale NNR on 20 July, the first multiple sighting of *S. sanguineum* in South Lancashire.

The following summer (1994), I made several visits to likely sites in the Sefton Coast sand-dune system during August and September. A total of five males was located at ponds in Birkdale Hills LNR between 13 and 16 August. However, at Ainsdale NNR, nine males were seen on 20 August and as many as 26 males, together with several tenerals/females, on 1 September. All the Ainsdale sightings were at a group of seven ponds in the central part of the NNR: this is the area where the first Ruddy Darter was found in 1989. Clearly, by 1994, *S. sanguineum* was well established in Ainsdale NNR, though no particularly convincing

evidence of breeding had been obtained.

Consolidation and breeding

The hot summer of 1995 was beneficial to many species of Odonata in South Lancashire, including *S. sanguineum*. My first visit to Ainsdale NNR (central area) on 25 July produced a count of 30 Ruddy Darters, two of which were teneral insects, 23 males and five females. More importantly, the females were all in tandem and ovipositing in marginal vegetation 1-3m from the water's edge. This was the first tangible evidence of attempted breeding in the vice-county, though the large numbers present at Ainsdale since at least 1994 were strongly suggestive of a breeding population.

Other records on the Sefton Coast in 1995 included two males at Wicks Lake, Formby Point (SD/277070) on 27 July, one being still present on 8 August. The latter date also saw a male on a scrape in the western part of Ainsdale NNR (SD/290116), while eight males held territory at Pinfold Pond (SD/302112) in the east of the NNR on 17 August.

Inland, a single male was recorded several times between 9 and 20 August at a pond on Preston Junction LNR, near Bamber Bridge 3km south of Preston (SD/553263).

It is not known whether the 1995 sightings of *S. sanguineum* away from Ainsdale NNR were due to dispersal from this site or to a national influx of *Sympetrum* spp. from the Continent which brought many *S. flaveolum* and *S. danae* into the vice-county (pers. obs.).

Habitat of *S. sanguineum* in South Lancashire

The Ruddy Darter sites on the Sefton Coast are man-made ponds dug during the 1970s, many of them for nature conservation purposes in existing dune-slacks. They vary in size from about 75 sq.m. to 75,000 sq.m. and also in depth, though most are quite shallow (less than 1m) and may dry out during summer droughts. All have shelving margins which have become colonized by extensive stands of emergent aquatic plants, especially Common Spike-rush (*Eleocharis palustris*) and Sea Club-rush (*Bolboschoenus maritimus*). Other common associates include Water Horsetail (*Equisetum fluviatile*), Yellow Flag (*Iris pseudacorus*), Reed Canary-grass (*Phalaris arundinacea*), Glaucous Bulrush (*Schoenoplectus tabernaemontani*) and Branched Bur-reed (*Sparganium erectum*).

The seven ponds in the central area of Ainsdale NNR, which support the core population of *S. sanguineum*, are further characterized by shelter from adjacent Corsican Pine (*Pinus nigra laricio*) plantations and marginal willow (*Salix* spp.) scrub. Similarly, at Birkdale Hills LNR, the most favoured ponds are sheltered by dune topography and/or dense scrub patches, particularly of Sea-buckthorn (*Hippophae rhamnoides*). These findings accord with the habitat characteristics of the Ruddy Darter described by Askew (1988) as 'Weedy ponds and ditches, frequently in woodland.'

Other species of Odonata associated with *S. sanguineum* in the central area of Ainsdale NNR in 1995 were *Lestes sponsa* (Hansemann), *Coenagrion puella* (L.), *Ischnura elegans* (Vander Linden), *Aeshna grandis* (L.), *Anax imperator* Leach, *Libellula quadrimaculata* L. and *Sympetrum striolatum* (Charpentier).

Hall & Smith (1991) recorded fourteen species of Odonata during the previous decade at

the Sefton Coast dune ponds. They confirmed breeding of ten species, the qualifying number for nationally important dragonfly sites in northern England (Nature Conservancy Council, 1989). The presence of an eleventh breeding species, *S. sanguineum*, emphasizes further the regional importance of these sites for this group of insects.

Acknowledgement

I am grateful to English Nature for access to Ainsdale Sand Dunes NNR.

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Evidence of breeding in Odonata; a personal view

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The finding of larvae or exuviae is at present regarded as necessary evidence for confirming the breeding of Odonata. It is suggested that these criteria need re-examining. Finding and identifying larvae and exuviae is very time-consuming and can be done only at the expense of other worthwhile activities. Furthermore, breeding distribution maps based solely on these criteria omit valuable information and give a false impression, a blank representing anything from complete absence to the presence of many copulating and ovipositing insects.

It is considered that a system based on that used in the British Trust for Ornithology *Atlas of breeding birds* (Sharrock, 1976) would result in a truer and far more comprehensive picture. In the *Atlas*, records are divided into three categories - possible breeding, probable breeding and confirmed breeding - represented by dots of different sizes on the species distribution maps. The disadvantage of having three categories instead of one is more than outweighed by the additional information made available and the spur to observers to upgrade records.

BTO *Atlas* categories and their suggested Odonata equivalents are:

BTO Atlas	**Odonata equivalent**
1. *Possible breeding* Birds in breeding season in possible nesting habitat	1. *Possible breeding* Insect in normal breeding season in suitable breeding habitat
2. *Probable breeding* Bird apparently holding territory Courtship and display	2. *Probable breeding* Male behaving territorially Copulating pair
3. *Confirmed breeding* Nest and eggs or bird sitting and not disturbed Nest with young	Oviposition at species-suitable water-body Larvae
Eggshells found away from nest Recently fledged young	3. *Confirmed breeding* Exuviae Teneral insects

There are valid arguments against accepting oviposition as confirmed evidence of breeding: first, what may appear to be a suitable water-body to the observer may not turn out to be so for the insect's breeding endeavours, and *vice versa;* and secondly, eggs laid and subsequent larvae may not survive to complete emergence. The latter argument applies also to the presence of larvae, so both of these are relegated to the 'probable' category.

Reference

Sharrock, J. T. R. 1976. *Atlas of breeding birds in Britain and Ireland.* British Trust for Ornithology and Irish Wildbird Conservancy, Tring, 477pp.

Notes and observations

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This section is dedicated to the publication of members' observations which, although perhaps limited or incomplete, are nevertheless considered to be worth placing on permanent record.

Unusual oviposition sites

On 22 September 1996, a female Common Darter (*Sympetrum striolatum*) was seen ovipositing in tandem directly into the sea at Cala Sa Nau, a tiny cove in south-east Mallorca, and on 28 September 1996 a further seven females in tandem were ovipositing into the sea at Cala Mondraga, a double cove beach on the south-east coast of Mallorca.

Cala Sa Nau is only about 15m wide and Cala Mondrago is about 180m wide. Both are long channels with rocky sides headed by gently shelving, sandy beaches. The water was calm at both sites and oviposition took place about 10-30m from the shore where the water was about 1.5-2.5m deep. At Mondrago, activity was concentrated towards the sides of the channel rather than in the middle.

A possible reason for this behaviour is that Mallorca has had several years of very low rainfall and fresh-water is scarce on the island. (NRS)

On 20 July 1995 an Emperor (*Anax imperator*) was caught at Bognor, Sussex. It was originally thought to be a male and was taken home to be photographed, resting quietly on my hand for this to be done. However, it commenced probing movements with the end of its abdomen and a sharp burning and stinging sensation in the crease of my little finger made me realise that this was in fact a female Emperor in male colours, and she was trying to make an incision in my finger in order to lay an egg. An involuntary jerk of the finger caused the dragonfly to fly off; she was found later laying eggs into a waterlily in the garden pond. (LGH)

On 22 August 1994, a female Southern Hawker (*Aeshna cyanea*) flew around the garden in Aldwick, Sussex attempting to oviposit in many places, including the side of a black plastic flower-pot. Eventually it settled at the bottom of my left trouser leg and began to lay an egg into the fabric of my woven slipper. Afterwards I could see a blob of liquid where the end of the ovipositor had been. (LGH)

Unusual markings

An unusual variant female homeochrome Common Blue Damselfly (*Enallagma cyathigerum*) was caught on 30 August 1996 at Bewl Water, Sussex. The antehumeral stripes were almost identical to those of a male Variable Damselfly (*Coenagrion pulchellum*), being very narrow and broken. Segments 9 and 10 were dorsally all black. (PCB)

Mixed pairing

A male Southern Hawker (*Aeshna cyanea*) and female Migrant Hawker (*Aeshna mixta*) were flying in tandem near North Walsham, Norfolk on 20 September 1996. (DLH)

Triple coupling

At Chartley Moss on 1 August 1996 a triple group of *Lestes sponsa*, consisting of male-male-female, was seen on *Eriophorum*. The two males were perched, the female was hanging free. The centre male arched its abdomen and transferred sperm to its accessory genitalia whilst still in triple. The group then flew a very short distance to another *Eriophorum* stem; here the hind pair completed the wheel with the other male still clasping the male of the pair. (TGB)

Behaviour

On 10 August 1995, at a small pond on Castle Law near Abernethy, Perthshire, up to eight male Common Hawkers (*Aeshna juncea*) were patrolling whilst a single female was ovipositing. At one stage the female flew up, to be promptly attacked by a male which knocked her into the water where she lay, unable to rise. After being rescued, she flew off apparently unharmed. (NE)

At the National Dragonfly Museum, Ashton, Northamptonshire, on 8 July 1996, a female Broad-bodied Chaser (*Libellula depressa*) was knocked into the water by a pursuing male. After a long struggle she eventually hauled herself out on to a stick. It was then noticed that the rear left wing was missing. Nevertheless, after drying in the warm sun, she flew away apparently unaffected by being a wing short. (SI)

Also at the National Dragonfly Sanctuary, Ashton Water, on 20 September 1996, a female Migrant Hawker (*Aeshna mixta*) was watched hawking in damp weather. She had been seen from time to time all through the day, and she continued hawking in ever-increasing drizzle and rain. (SI)

High flying

On 7 September 1996, an unidentified species of aeshnid flew above the observers' heads at approximately 986m (3235 feet) on one of the tops near Torridon, Wester Ross. (SAC)

Observers

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(TGB) T. G. Beynon, Saltwells LNR, Pedmore Road, Brierley Hill, West Midlands DY5 1TF.
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(LGH) L. G. Holloway, Wigeon Cottage, 30 Fernhurst Gardens, Aldwick, Sussex PO21 4AZ.
(SI) S. Irons, 69 Glinton Road, Helpston, Peterborough, Cambrigeshire PE6 7DG.
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INSTRUCTIONS TO AUTHORS

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

Manuscripts should be typewritten using black ribbon, double-spaced, on one side of the page only and with margins at least 25 mm at the left, top and bottom; text pages should be numbered. Footnotes should be avoided.

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

Use of these terms is acceptable: 'exuviae' for cast skin or skins (singular and plural); '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 typed, each on a separate, unnumbered page.

Legends for illustrations should be typed together in sequence on a single unnumbered page.

Illustrations (figures) should be prepared in black ink, and scaled to allow a reduction of 1.5 to 3 times. Lettering should be neat and uniform.

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
Erythromma najas	Red-eyed 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
Ceriagrion tenellum	Small Red Damselfly

ANISOPTERA	DRAGONFLIES
Aeshna caerulea	Azure Hawker
Aeshna juncea	Common Hawker
Aeshna mixta	Migrant Hawker
Aeshna cyanea	Southern Hawker
Aeshna grandis	Brown Hawker

ANISOPTERA	DRAGONFLIES
Anaciaeschna isosceles	Norfolk Hawker
Anax imperator	Emperor Dragonfly
Anax parthenope	Lesser Emperor Dragonfly
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
Crocothemis erythraea	Scarlet Darter
Leucorrhinia dubia	White-faced Darter

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