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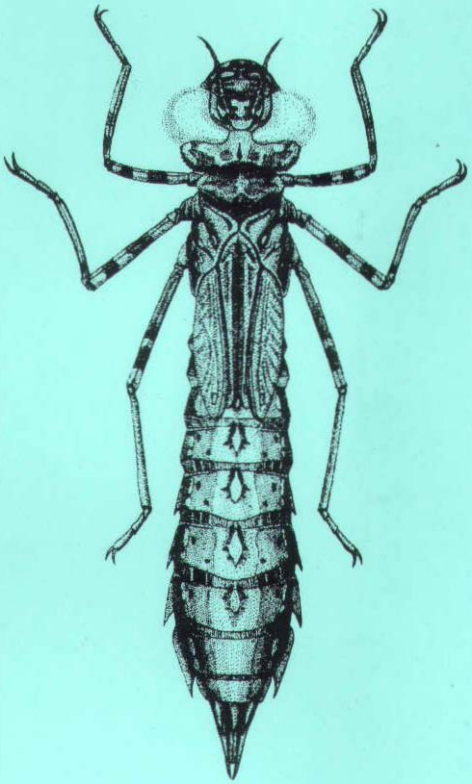

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ADDRESSES

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Front cover illustration of final-instar larva of *Aeshna mixta* by S. Jones

Leucorrhinia dubia (Vander Linden) at Shooters Pool, Chartley Moss, Staffordshire, in 1994

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Chartley Moss NNR was described by Bailey (1992). The moss is a subsidence-raised basin-mire; the only other known in Britain is the much smaller Wybunbury Moss in Cheshire. Shooters Pool has a roughly rectangular open-water surface, with a perimeter of approximately 90m. It is dystrophic, acidic (pH 3.4), and peat-stained, situated in the *Sphagnum* lawn of the western basin of the moss. The basin, about 25ha in area, consists of a raft of peat some 4–6m thick, floating on a reservoir of water up to 10m deep. The fringing *Sphagnum* is mostly *S. cuspidatum*. Shooters Pool is the main breeding-site for *Leucorrhinia dubia* (Vander Linden) on Chartley Moss.

Since Bailey (1992) gave an account of *L. dubia* at this site, all but one of the fringing Scots Pine (*Pinus sylvestris*) on the south-west edge were felled in 1991 to reduce shading of the pool. The remaining Scots Pine is dying rapidly and this edge is now one of the more favoured emergence areas, possibly because it receives the morning sun. Variable densities of Common Cotton Grass (*Eriophorum angustifolium*) grow through both the marginal water-edge and the semi-submerged *S. cuspidatum* all around the pool. The *Sphagnum* lawn grades away to less wet ground with Bog Rosemary (*Andromeda polifolia*), Cranberry (*Vaccinium oxycoccos*), Bilberry (*V. myrtillus*), Cross-leaved Heath (*Erica tetralix*), Heather (*Calluna vulgaris*), Purple Moor-grass (*Molinia caerulea*) and Common Sundew (*Drosera rotundifolia*) the most obvious plants. A few clumps of Soft Rush (*Juncus effusus*) occur on the western edge, and there are also invasive seedling Birch (*Betula pubescens*) and Scots Pine.

Method

After preliminary visits in 1992 and 1993, a visit schedule was decided for 1994 consisting of weekends and three single weeks: 16–22 May, 20–26 June, 8–14 August. With hindsight, the last of these should have been a week earlier. Spring weather in different years will change the timing slightly, but the third week of May, fourth week of June and first week of August should cover key episodes in the emergence and flight period of *L. dubia* in Britain.

Emerging dragonflies were counted during a circuit of the pool lasting 75–90 minutes, sometimes repeated, noting the stages of emergence. Binoculars were used to see the water side of otherwise inaccessible clumps of *Juncus*, and a monocular was used where necessary at close range to attempt to determine sex. No systematic collections of exuviae were made so as to avoid damage to the very fragile *Sphagnum* lawn.

Larvae

Pre-emergence larvae can be seen moving in the waterlogged *Sphagnum* towards the shore at any time of day. Their sight is keen and they submerge into the mat at observer movement. On 15 June at 1530h, one was watched moving quite rapidly in short spurts, generally

towards the shore but apparently unwilling to crawl out over small, emergent humps of *Sphagnum* between the tiny pools on the mat. Pajunen (1962) observed larvae moving with much of their bodies out of water, perhaps because at his site in Finland a dense growth of *Drepanocladus fluitans* sometimes covered almost the whole of the water surface.

On 14 June, a dip by D. Gibbons (pers. comm.) appeared to show the presence of two age-classes of immature larvae.

The extent of predation on larval *Leucorrhinia* is uncertain. There are no fish in the pool, but aeshnid larvae and Dytiscidae are possible predators. The large numbers of *L. dubia* emerging in 1994, and the relatively small numbers of aeshnids, might indicate that the latter have little effect on the *Leucorrhinia* population.

Exuviae

The most frequently used emergence supports were *Eriophorum* stems and leaves, less frequently *Juncus* and *Molinia*, and rarely *Erica*. Ecdysis was often completed horizontally on the *Sphagnum* with no other support. In one instance only, a case was found on a more substantial support: 4cm above ground on a dead pine trunk, about 5cm in diameter, emerging from the *Sphagnum* at the edge of the water. Other similar, equally accessible trunks in the area were not used. Several dragonflies emerged successfully from inverted larvae hanging from the undersides of horizontal *Eriophorum* and *Juncus* stems or leaves.

The vast majority of exuviae were no more than 2–3cm above the water or *Sphagnum* substrate. Pajunen (1962) found most exuviae at a height of 10cm, but those on *Drepanocladus* were at 2–3cm.

Most exuviae were within 80cm of the ill-defined water's edge, about 75 per cent over water (usually just over, but a few up to 1m from the edge) and 25 per cent over land. The inland distance varied enormously, particularly during peak emergence. Examples of inland emergence are two at 40cm and four at 75cm on the lawn (no supports used) on 14 May, and several up to 2m inland (two on *Erica*) on 29 May. By mid-June, no exuviae were seen other than over water, and by late June the number of visible exuviae had markedly decreased through knockdown by wind and rain, and extensive clogging of the emergent vegetation by windblown *Eriophorum* seeds. On 25 July only three exuviae could be found.

A considerable number of exuviae were found in twos and threes, often in contact and even on top of each other, despite being adjacent to apparently equally suitable but unoccupied *Eriophorum* stems. Even when not in physical contact, several exuviae were often grouped closely together.

Emergence

The first adult emergence was between 8–13 May, probably on 11 or 12 May. This compares with Bailey's (1992) dates of earlier than 5 May 1987, 17 May 1988, 15 May 1989 and 2 May 1990. T. Coleshaw (pers. comm.) records first emergence as no more than seven days earlier than 21 May 1991, 27 May 1992 and 25 May 1993. Coleshaw noted mass emergences in 1991 on 21 May and 15 June. Last emergence in 1994 was on either 9 or 10 July. Thus emergence took place over a period of probably 58 days (possible maximum 62 days).

Pajunen (1962) gives dates of 4 June 1959 and 25–27 May 1960 for first emergence in Finland, and a last emergence date of 30 June in 1959 and 1960. These dates are for a site at 62°13′ N and 24°35′E, and first emergence is later than at Chartley (52°51′N, 1°58′W), some 1000km further south and 1900km further west. Last emergence dates are earlier, producing a more concentrated emergence period, perhaps typical of higher latitudes.

At Shooters Pool in 1994, emergences over the first nine (possibly 15) days, up to 21 May, were all of males. The first females were observed on 23 May when they were probably in the majority (42 females, 32 males, 12 unsexed). Pajunen (1962) records no difference in the emergence periods of the sexes.

Emergence progresses through the following stages:

Stage 1. Larva in emergence position, mostly 2–3cm above the substrate; adult head may be free of exuviae but legs not withdrawn.
Stage 2. Legs withdrawn, imago in layback position.
Stage 3. Adult completely free of exuviae; wings may be completely expanded but are still closed, sometimes touching the water or *Sphagnum*. If the abdomen, when fully expanded, touches water, the adult climbs a little higher.
Stage 4. Ascends the support (if used), usually to 10–15cm above the substrate; wings open, more or less horizontal.

On 31 May at 0900h there were two insects at stage 4 (as well as ten at stage 1, 20 at stage 2 and 25 at stage 3), implying an early start to emergence, probably before 0700h. On the other hand, on 2 July one stage 4, and on 18 June at least two stage 2 and several stage 3, were found at 1500h, indicating a prolonged diurnal emergence period. Whilst there was an ill-defined peak of emergence in early- to mid-morning, there was not the clear morning peak of emergence noted by Pajunen (1962) in Finland.

Emergence occurs all round Shooters Pool, with some concentration from NNW clockwise to SSE. This coincides with *Eriophorum* stands which are not too dense and not too sparse; most emerge in a particular stand on the NW edge which receives early morning sun. Aeshnids also slightly favour this stand for emergence.

L. dubia emerges under almost any weather conditions, including times of total overcast and low air-temperature. This does not coincide with Pajunen's (1962) finding that emergence is possible only in sunshine. However, in cold conditions there appear to be more emergence failures and cripples, the former mainly resulting from failure to extract legs to enter stage 2. On 21 May the temperature was below 10°C all morning, with drizzle, following six cold and sometimes wet days. Nevertheless, emergence was proceeding and being completed, some having reached stage 4 by 1100h. The newly-emerged adults were all extremely torpid, their wings covered with water droplets, and several had failed to ascend their supports so that abdomens and wing tips touched the water. Two had failed at stage 1, unable to extract their legs, but many successfully emerged as did others on other poor mornings.

Newly-emerged adults fly away from the pool on their maiden flights, mostly towards belts of pine and birch to the WNW and NE. The first flight is often short, less than two or three metres, but is followed by a flight which takes them well away from the pool.

Predation

In the early period of emergence, there was predation of soft, newly-emerged *L. dubia* by wolf spiders, probably *Pardosa amentata* (Clerck). Those which had crawled on to the *Sphagnum* lawn were most vulnerable. On 14 and 21 May, *Pardosa* appeared to be actively hunting the edges of the pool. Ants also directly predated newly-emerged dragonflies, in addition to taking corpses left by *Pardosa*.

Pajunen (1962) recorded that in 1958 a pair of White Wagtails (*Motacilla alba*) accounted for 10–30 per cent of a day's emergence, and birds are certainly occasional predators of *L. dubia* and other Odonata at Shooters Pool also. In 1993, remains of two exuviae plus remnants of a teneral adult *Aeshna juncea* (L.) were found close together on the mat in circumstances strongly indicating that a Snipe (*Gallinago gallinago*) was the predator.

On 17 July 1994, a large wet pellet, 50 x 20 x 15mm in size and almost certainly that of a Grey Heron (*Ardea cinerea*), was found on the edge of the mat. On examination the following remains were found, and unless otherwise stated are of penultimate- or final-instar larvae:

a) *Aeshna juncea*
1 complete male; 2 headless females; 1 female abdomen + 3 other abdomens; 1 stage 2 thorax and wings + 2 other thoraces; 2 heads; 3 masks.
Minimum total 7 individuals.

b) *Aeshna grandis* (L.)
1 headless female; 1 female abdomen + 1 abdomen; 1 thorax + 1 stage 2 thorax and wings; 1 mask. Minimum total 3 individuals.

c) *Aeshna juncea* or *A. grandis*
1 female abdomen; 1 stage 2 thorax and wings + 1 thorax; 4 heads; 2 masks.
Minimum total 4 individuals.
There were also eight separated sets of wing-buds which could be attributed to the above *Aeshna* species.

d) *Leucorrhinia dubia*
1 teneral, probably pre-maiden flight; 1 part head; enough fragments for 1 other.
Minimum total 3 individuals.

e) *Libellula quadrimaculata* L.
1 abdomen; 1 mask; 1 set of wing-buds. 1 individual.

f) Zygoptera
1 head and 1 thorax (both probably *Enallagma cyathigerum* (Charpentier)); enough adult wings for 4 individuals. Minimum total 4 individuals.

There were also some small, unidentified Odonata remains, and a very few fragments of beetle elytra.

If herons have discovered a seasonal source of food in the emerging dragonflies at Shooters Pool, it would seem from the evidence of the analysed pellet that their impact upon the aeshnid populations is considerably greater than on *L. dubia*.

Size of the *L. dubia* population in 1994

Progress of the 1994 emergence of *L. dubia* is presented in Table 1 in which numbers of observed exuviae (X), adults in each of the four stages of emergence (1,2 above), predated emerging dragonflies (P), dragonflies before taking their maiden flight (M) and other teneral dragonflies (T) are recorded. The figures are minima and their accuracy is estimated as at least 95 per cent for emergent dragonflies, but much less for exuviae. The latter are more difficult to see, particularly when inland or in dense vegetation. Wind and rain dislodge exuviae and an unknown number was taken by visitors.

A total of 420 *L. dubia* was observed to emerge,
emergences on non-visit days. These may be estimated by using the 'hatch-rate' of neighbouring days to give a crude mean for the intervening non-visit days as follows:

15–20 May	6 days x 19.5	117
22 May	1 day x 57	57
24–28 May	5 days x 72.5	362.5
1–4 June	4 days x 53	212
7–10 June	4 days x 29.5	118
13–14 June	2 days x 2	4
16–17 June	2 days x 4	8
19–21 June	3 days x 3.5	10.5
24 June	1 day x 6	6
27 June–1 July	5 days x 6	30
4–8 July	5 days x 2	10
10 July	1 day x 1.5	1.5
	Total	936.5

Using the minima and maxima of contiguous days,
number of emergences on non-visit days ranges from 677 to 1196. Thus the total population is most likely to be about 1356 (420+936) with a possible minimum of 1097 (420+677) and a possible maximum of 1616 (420+1196). These figures compare favourably with previous annual estimates of between two and five hundred for the *L. dubia* population of Shooters Pool.

Predation was known to account for 27 individuals (including three in the Heron's pellet) or 6.4
complete ecdysis.
individuals from non-visit days may remain to be counted, unlike those which emerge successfully.
respectively are obtained, and these will be nearer to the true values although possibly too low.

Adults

The last male was seen sunning alone on 4 August, and the last female, also sunning alone, on 9 August. This is 30 (possibly 31) days after the last observed emergence.

Table 1. Summary of the 1994 emergence of *Leucorrhinia dubia* with observed numbers of individuals at different stages. Time is BST at start of visit, hours are duration of visit, totals are of all pre-flight dragonflies plus tenerals, p signifies present but not counted. For further explanation see the text.

Date	Time	Hours	X	1	2	3	4	P	M	T	Totals
08.5	0920	1.7	0	0	0	0	0	0	0	0	0
13.5	1200	2.0	p	2	1	0	1	0	4	0	8
14.5	1100	1.7	32	0	1	4	2	3	1	0	11
21.5	1040	1.7	p	1	2	17	3	5	0	0	28
23.5	1330	1.5	p	2	3	20	58	3	0	0	86
29.5	1000	3.0	100 +	5	9	40	2	3	0	0	59
30.5	1000	2.5	p	0	0	6	2	0	12 +	p	20 +
31.5	0800	4.0	p	10	20	25	2	5	4	p	66 +
05.6	0815	2.3	p	0	5	12	16	3	2	2	40
06.6	1215	2.8	p	4	6	15	1	2	0	12 +	40 +
11.6	1110	3.0	402	1	3	11	4	0	0	p	19 +
12.6	1430	0.3	p	0	0	1	0	0	0	0	1
15.6	1320	2.3	p	1	0	2	0	0	p	p	3 +
18.6	0930	4.5	p	<.....			5 +			..... >	5 +
22.6	0900	2.3	p	0	0	1	0	0	1	0	2
23.6	0900	4.5	p	1	1	4	4	0	1	p	11 +
24.6	0930	5.0	p	0	0	4	1	0	p	p	5 +
26.6	0945	4.8	p	1	0	6	0	0	p	p	7 +
02.7	1345	3.0	p	0	0	0	2	0	0	3	5
03.7	1100	3.0	p	0	1	0	0	0	0	0	1
09.7	0830	5.6	<20	0	0	3	0	0	0	0	3
11.7	1130	2.0	<10	0	0	0	0	0	0	0	0
16, 17, 18.7,	-	9.5	p	0	0	0	0	0	0	0	0

Grand total: 420 +

of longevity were made. The flight period lasted probably 90 days with a possible maximum of 96 days.

Copulating pairs were first seen on 11 June, 29 days after the first female emergences. This indicates a long maturation period, supported by the fact that sunning and territorial males were not observed until 6 June. Belated sexual activity may be partly due to very poor weather from 15–27 May, and again from 1–5 June. Pajunen (1962) found that males usually reached sexual maturity at 8–12 days, females at 10–15 days, but that cool weather delayed maturation. On 25 July, two copulating pairs only were seen, out of a total of seven adults, and the last copulating pair was seen on 31 July with probably no more than three other males still present.

Most copulating pairs move only a little distance away from the water into the marginal vegetation, many resting on the *Sphagnum* lawn within 60cm of the water. About half are in the fringing *Eriophorum*.
discrete object such as a twig or stem, and often in a small hollow.

The male of a resting copulating pair vibrates his wings whenever another male *Leucorrhinia*, or indeed any dragonfly,
close. Pajunen (1962) noted perched single males responding by vibrating their wings when approached within 5–10cm by another flying male. This wing vibration appears to be a different behaviour to the wing fluttering of copulating males.

In the few pairs watched from catch-up to separation,
20–25 minutes. Numbers of pairs are difficult to estimate, as many can be seen only when disturbed from the vegetation. However,

Oviposition behaviour was seen first on 11 June and last on 25 July,
four days. The vast majority of ovipositing females dipped the tips of their abdomens amongst the *Eriophorum* growing through the water or semi-submerged *Sphagnum* and always into clear water,
danae (Sulzer), in contrast, oviposits on emergent or marginal *Sphagnum* or on exposed peat, as often as in open water.

Females began ovipositing either directly after separation, or when they arrived alone at the pool; some of the latter could be from copulating pairs settled away from the pool. During a period of oviposition (seen as abdominal dipping), females would occasionally rest very briefly on emergent *Sphagnum* with their abdomen tips just in the water. The total numbers of abdominal dips delivered by females during bouts of ovipositing were counted as 75, 68, 60+, 20+28,
July when most females were old and perhaps not producing many eggs.
dips were performed by a female on 25 July.

During oviposition, females usually did not seem to be disturbed by patrolling males (or by *L. quadrimaculata*). On several occasions passing individuals undoubtedly saw ovipositing females but showed no reaction.

Females are attended,
briefly but often throughout. The following selection of examples,
after copulation,

a) 23 June: a copulating pair in the fringeing *Eriophorum* separated and the male first perched and then hovered briefly near the ovipositing female before moving away.
b) 24 June: a copulating pair in the *Eriophorum* separated and the female immediately began dipping, attended throughout by the male hovering within 15cm. When finished she flew off, chased unsuccessfully by the male.
c) 3 July: a female began dipping at 1340h, attended throughout by the male who hovered within 40cm or so, about 25cm above the surface,
on *Juncus* stems. He followed her, quite 'gently', when she flew off after finishing ovipositing, up through the branches of a dead pine,
third individual joined in. The three then separated and went off out of sight.
d) 9 July: at 1115h a copulating pair dropped on to the wet *Eriophorum*. On separation both perched briefly before the female began to dip. After only five dips she rose some

30cm and was approached 'gently' by the male,
normal fashion of a female finished ovipositing. The male did not follow. At 1130h another pair separated in the *Eriophorum* and the female began to dip. Initially the male perched nearby,
the female perched briefly while the male continued hovering. She returned for 28 more dips and the male followed as she moved through the *Eriophorum*. When finished,
about two metres before dropping back to perch.
male flew away to perch and the female continued to oviposit alone.

e) A male after separation,
only 15cm away throughout the period of copulation. The female,
on the *Sphagnum* after separation,
followed,
to each other on the wet *Sphagnum*, seemingly exhausted.

f) A male,
site after the female had flown away.

From these examples,
contact guarding) appears to be rather weak in *L. dubia*; it is often not shown, nevertheless does exist. The 'gentle' following noted above is quite unlike the normal pre-copulatory approach,
protective: 'when the female flies away,
her for several metres' and 'protective behaviour is manifested even when the pair parts far from water'. The comment by Askew (1988) that females of *Leucorrhinia* species oviposit unaccompanied by males is not wholly accurate.

Departure from the pool of females which have finished ovipositing is very striking. Usually they fly to a height of 30–60cm,
then ascend rapidly and almost vertically (with a few tight orientation (?) circles) to a height of 25–40m before flying away at this height.

No examples of mixed species tandems involving *L. dubia* were noted,
S. danae male/ *S. striolatum* (Charpentier) female tandems were seen,
twenty-five minutes.
rubicunda (L.), and attempts by male *L. dubia* to mate with *S. danae*.

Males are mildly territorial and will investigate passing male conspecifics and *L. quadrimaculata* when on patrolling flights; this leads sometimes to short skirmishes, but seldom contact. When sunning they are extremely tolerant,
centimetres of each other in twos and threes (a group of seven has been observed). There is very little interaction with large aeshnids (*Anax imperator* Leach,
juncea, *A. grandis*) at the pool,
Some reciprocal interest is shown with male *L. quadrimaculata*, which have a similar style of patrolling,
L. dubia and usually 'wins' encounters.

Predation of adult *L. dubia* was mainly by web-building spiders in the marginal vegetation,
quadrimaculata easily.
and below it,

puella (L.) and a copulating pair of *C. puella*, the latter still alive.
gibbets throughout the flying season.

On 9 July,
and had not previously shown any interest in *Leucorrhinia*, took one over the middle of the pool. It carried it upright by the head with the abdomen drooping in front,
on *Juncus* at the waters' edge. After a minute or so it flew inland some five metres to land on dead *Molinia*,
legs attached to scraps of thorax,
(1962) noted a male *Aeshna juncea* taking a single *L. dubia* on each of two successive days, but this was his only record of predation by Anisoptera.

A female *L. dubia* was found on 9 July,
a *Drosera* leaf,
the fresh remains of two *Leucorrhinia* were found 5cm apart on *Drosera*, with another older corpse 40cm away. On this south-east edge of the pool,
open, inviting insects to sun.

Very occasionally, *L. dubia* males are knocked into the water during rare contact clashes, and females during attempts to complete the wheel position.
was struggling intermittently in the water between long periods of no movement. It attracted something subsurface which, from the spacing of the three menisci, was very probably *Notonecta glauca* L. (Hemiptera Heteroptera). The struggles of the dragonfly gradually ceased after the *Notonecta* reached it.

Bird predation of newly-emerged adult *L. dubia* is described above. With regard to mature adults, Swallows (*Hirundo rustica*) were seen to take Zygoptera over the pool surface, but no instances of their taking Anisoptera were recorded.

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A population study of *Coenagrion mercuriale* (Charpentier) in the New Forest. Part 6. Mark/recapture programme

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Introduction

Previous work (Jenkins, 1986) has concentrated on using maximum numbers of *C. mercuriale*, counted under specific conditions while walking along stream banks, to follow changes in population from year to year. Although this provides a reasonable and rapid measure of fluctuation, the actual numbers counted at maximum emergence are lower by an unknown factor than the total numbers of insects present at the time,
(1993) and give no indication at all of the total emerging over the flight season. In an attempt to provide such data, a mark/recapture programme was carried out in the New Forest in 1991 with permission from the Forestry Commission.

There was some concern about starting an amateur project on such a rare and delicate insect but a successful study had been reported previously (Knights, 1983) on *mercuriale* in East Devon. To establish a practical technique,
and mark *P. nymphula* (Sulzer) at the start of the season in preparation for subsequent *C. mercuriale* emergence. This was discouraging, as although *P. nymphula* are robust and easily marked, they tended to frequent bushes,
extremely difficult to net. Fortunately *C. mercuriale* proved extremely easy to capture and only one insect out of the total netted and marked throughout the season was obviously damaged.

Site

Considerable thought was given to selection of a suitable study site. Some ideal, isolated populations of *mercuriale* were ruled out as too vulnerable, while the major population centres contained too many insects spread over extensive lengths of stream. Eventually an area was chosen at the southern end of the main Crockford stream which was isolated to the north by a small copse, and to the south by dense scrub marking the limit of *C. mercuriale* colonization. Unfortunately, a tributary from Peaked Hill,
concentration of *mercuriale*, entered the main stream a quarter of the way down the site but at the intersection this was again blocked off by a short stretch of scrub. As a bonus, the site was quickly reached by foot from the main road.
through a small area of Forest 'lawn', varied in width from about 0.5m–1.5m with depth varying from a few centimetres to 40cm, a flow of approximately 0.3m/sec and pH of 6.8. Three short sections of the stream were basically open on both sides although lined with a scattering of small Bog Myrtle (*Myrica gale),* bushes, while most of the remainder had mixed scrub – typically Willow, Bramble and Blackthorn, (*Salix, Rubus, Prunus spinosa*) – on the west bank only. *C. mercuriale* inhabited the more open parts. There was a short section in the centre with scrub on both sides. The main aquatic vegetation consisted of Soft Rush (*Juncus*

effusus) at the stream edges and Marsh St. John's-wort (*Hypericum elodes*), Bog Pondweed (*Potamogeton polygonifolius*) and Water Mint (*Mentha aquatica*) in the stream. In the six years prior to 1991 only one or two *C. puella* had been recorded from this stretch of the stream but in 1991 a small colony established itself in one small area, adjacent to, but separate from *mercuriale*. It survived for only one year. The other main breeding species were *Cordulegaster boltonii*, (Donovan), *Pyrrhosoma nymphula*, *Sympetrum striolatum* (Charpentier), *Ischnura elegans* (Vander Linden).

Marking

Insects were marked with a unique number, on one wing only, using a pattern of dots whose position represented 1, 2, 3, 5, 10, 20, 30, or 50. numbers, so beyond this, the same system was used in a different marking colour. Marks were applied with Staedtler Lumocolor 318 Waterproof fine-tip pens by supporting the wing over thin card. Black or red marks were still clearly visible after four weeks although, by this time, the colours had faded somewhat and the black had turned to dark brown. Green marks were unsatisfactory, fading very rapidly to pale brown. Later it was realised that giving all insects captured on a given day the same number would have been simpler and equally valid in the estimations. Insects were marked and released immediately but this led to the capture of some insects more than once in the same session and a different procedure has since been adopted.

Results and discussion

The site was visited at approximately seven-day intervals but around the period of maximum emergence, marking was done on three consecutive days in order to evaluate the 'triple catch' method (Bailey, 1951) of population estimation (– a violent electrical storm occurred on the second night of the three but the weather cleared by dawn and there was no apparent effect on numbers). The weekly results were used to calculate total populations by the Jolly method in the form described by Parr *et al.* (1968), since it was simple to understand and use, although perhaps not the most accurate for small populations. There seems no obvious reason to suppose that using weekly intervals over a long period is less valid than daily intervals over a short period.

During the complete flight season, 139 individuals were marked and 46 per cent of these were recaptured at least once. The number of females caught was only 22 per cent of the total. In previous annual counts the number of females at maximum emergence averaged around 25 per cent and it had been assumed that a proportion of the females present were overlooked due to their drab colouring.

The present study involved meticulous searching but confirmed a similar low female to male ratio at the water. The same situation has been reported for other Zygoptera (Corbet, 1952; Lord, 1961; Parr, 1965). The mark/recapture programme also confirmed previous observations that males emerged first in the season, were the last survivors, and were first on the water during the day and last to leave (the only exception to this occurred recently, when the first four *C. mercuriale* found after emergence in the Crockford area on 15 May 1993

were a single male, single female and a pair *in copula*.

Fig.1 shows the number of *mercuriale* marked and recaptured and the calculated total population for a given date. The scatter in results may be a result of the small sample and the variable weather encountered. The overall pattern of emergence mirrors the weather conditions over the season. Thus very few *mercuriale* were recorded during June, which was generally dull and wet, but a sudden change to dry, sunny weather at the end of the month resulted in an immediate and rapid rise in numbers which was maintained as conditions remained good through July and into August. The flight season at this site was shorter than elsewhere in the area and could perhaps be related to the small population size, since the longest season has invariably been at Upper Peaked Hill which has the highest number and density of *mercuriale*. The calculated total of 104 at the time of maximum emergence can be compared with 40 different insects marked or recaptured over the corresponding four-hour period, i.e. about 40 per cent of that total, although at this and other times it seemed as if all the insects present at the water had been captured. A single walk along the stream at 12.30pm on the same day gave a count of 18 *mercuriale* suggesting that the previous annual figures at maximum emergence could be as low as 20 per cent of the total population present. Insects captured during the whole season proved to be 45 per cent of the estimated total and comparable to the 39 per cent at maximum emergence. The 'triple catch' estimate of the population on 5 July was about 15 per cent lower than that from the Jolly method. This was consistent with the low figures found in a direct comparison of the two methods by Parr (1965) and attributed to the small populations involved. In the present instance, where the

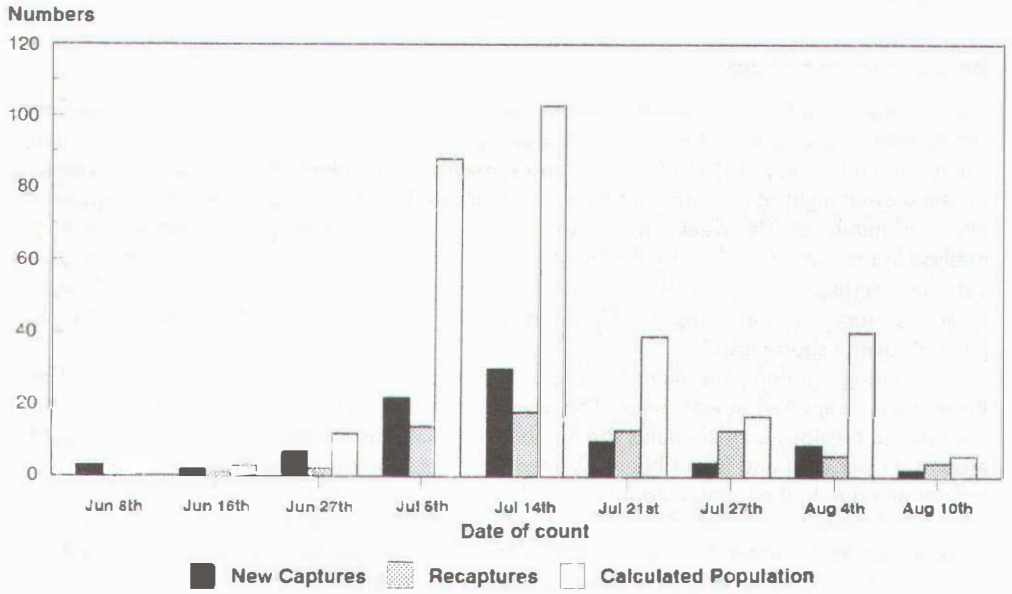

Figure 1. Mark/recapture data for *C. mercuriale* on part of Lower Crockford Stream, 1991

'triple catch' was used only to estimate the population for a single day, the Jolly method may give higher results because it takes into account recaptures from up to three previous weeks.

An approximate survival curve (Fig. 2) shows that the majority of insects are short-lived but that a few survive for at least 28 days. This latter period is comparable to 31 days found for *P. nymphula* in the wild (Corbet, 1952) and 41 days for *I. elegans* in captivity (Lord, 1961). Average lifetimes, calculated from numbers of C. *mercuriale* and days survived, were 5.5 for males and 2.6. for females. These figures were surprisingly close to those published for *I. elegans*, 5.3/3.5 or 3.5/2.4 depending on calculation method (Parr,1965) and 4.0 days (male + females) for *P. nymphula* (Lord, 1961), since this and data used for the survival curve were derived mainly from weekly and not daily captures. The values should be too high for this reason but compensated to some extent by the low values expected from the method (Parr, 1965).

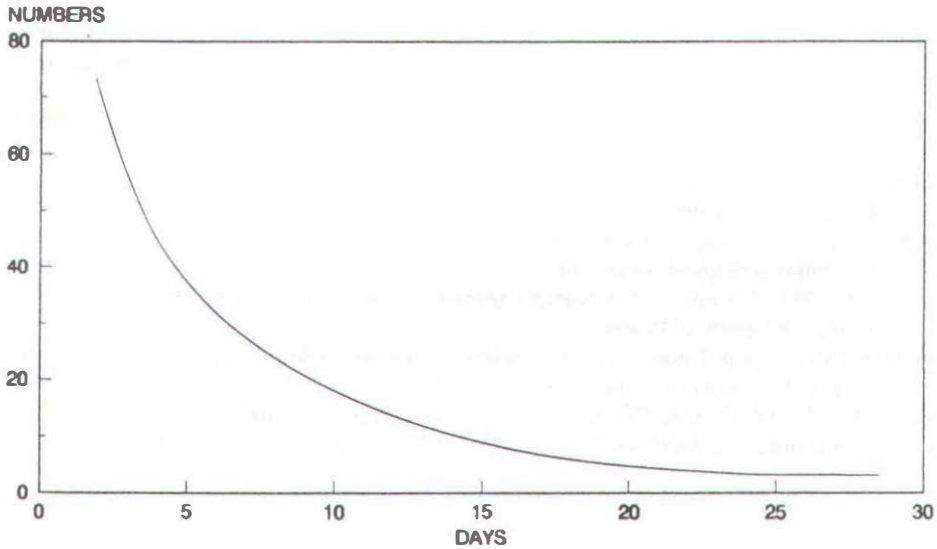

Figure 2. Survival curve for C. *mercuriale*

Observations in 1991 suggested that the study site was divided naturally into two parts by the short, central area of scrub on both banks, with no mixing of *mercuriale* between the halves. In addition, the high, calculated population with respect to the numbers captured raised the question of whether additional insects were flying in from the adjacent tributary. These two problems were specifically addressed in 1992 and will be discussed in a subsequent article.

Conclusions

The mark/recapture programme was successfully carried out with very little apparent damage to the insects and provided ideas on improved techniques for use in future work. In spite of limitations due to weekly counting, lifetime and maximum survival were similar to those found for other Zygoptera. The results suggest that the populations are very much higher at maximum emergence than numbers seen during 'Pollard' type walks.

I wish to thank S. Cham for advice on marking and Dr M. J. Parr for encouragement and helpful comments.

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Anax imperator Leach in Edinburgh

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Mrs E. M. Smart reported that *Anax imperator* Leach had emerged from her garden pond in the Morningside district of Edinburgh (SS°SS' N) between 29 June and 1 July 1994. This species is common in southern England, becoming scarcer further north, and it has never previously been recorded from Scotland (unpublished records, Biological Records Centre, ITE, Monks Wood).

A total of six exuviae (4 ♂♂, 2 ♀♀) of *Anax* were collected and their identity confirmed. Four emerged on sedge and the others on overhanging grasses. None of the winged insects was seen though Mrs Smart and her daughters were able to watch the progress of the last larva to emerge, during the late evening of 1 July 1994, until it was too dark to see clearly. In southern England *Anax* emerges at night and the first flight usually occurs at dawn the following morning (Corbet *et al.* 1960). Occasional observations by the author suggest that, in Scotland, emergence of Anisoptera occurs altogether later with the first flight taking place during daylight hours, sometimes well into the afternoon. At least four *Anax* in Edinburgh emerged in hot weather during daylight hours. There was no sign of them between 11.00 and 13.30 BST but by 15.30, when the pool was next visited, four empty exuviae were found. With no evidence to the contrary, we assume that the winged insects emerged successfully and flew off.

The circular garden pond, approximately 2.5m in diameter and 60cm deep in the centre, was made in June 1992. At the same time the pond was planted with emergent and submerged aquatic plants. All of the plants were obtained from Wychwood Carp Farm, Odiham, Hampshire. Unidentified blue damselflies emerged in June 1993 and, that same month, dragonfly larvae about 2cm long were first noticed in the water. In June 1994 blue damselflies again emerged and two *Pyrrhosoma nymphula* (Sulzer) were seen flying in the garden.

Undoubtedly the *Anax*, probably the blue damselflies and possibly the *Pyrrhosoma*, had been introduced as eggs in the aquatic plants sent from Hampshire. In Corbet *et al.* (1960) it is stated that 'in Britain, it is probable that about 90 per cent of *Anax* adults emerging each year are two-year-old individuals which have spent their second winter in diapause'. By contrast *Anax* larvae resulting from eggs laid in a newly created pond in Stockwood on the south-east outskirts of Bristol, Avon, all completed their life-cycle within one year (Holmes & Randolph, 1994). The two year life-cycle of *Anax* in Edinburgh is therefore not unexpected. The chance of a viable population resulting from this accidental introduction is considered to be very remote.

Pyrrhosoma nymphula occurs locally and could have flown in. However no evidence of egg-laying was observed. Its larval life is normally of two years duration so it could well have been introduced with the plants.

From a portion of a shattered exuviae of a blue damselfly that had died during its final ecdysis, I was able to confirm that it was of the genus *Coenagrion*. It is likely to be *C. puella*, though *C. pulchellum* is a possibility. *C. puella* occurs locally in S.E. Scotland. An accidental introduction of *C. puella* to a garden pond near Memus, Angus (56° 42'N) in the mid-1970s resulted in a viable population still present ten years later (Prendergast, 1986). This is the most northerly record of this species in eastern Scotland.

The popularity of garden ponds undoubtedly increases the chance of accidental introduction of Odonata outside their normal range, and this factor must be considered when records are being evaluated.

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Management of RSPB Nature Reserves and their benefit to dragonflies

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Introduction

The Society has established over 120 nature reserves, which are widely scattered over the length and breadth of the United Kingdom (Map 1). Almost all of these nature reserves are designated as Sites of Special Scientific Interest (SSSI) – or in Northern Ireland (ASSI) – of national or international importance. With few exceptions, all contain water-bodies in one form or another.

Dragonflies have two advantages to the naturalist: there is a small number of species in the United Kingdom and they can be studied using binoculars. It is therefore not surprising that our reserve wardening staff have become very interested in these insects (Pickess, 1989). Other than butterflies, we know more about dragonflies of our nature reserves than any other order of invertebrates.

Of the 39 breeding species in the U.K., only one species, the Irish Damselfly *Coenagrion lunulatum* (Charpentier), has yet to be recorded from RSPB nature reserves and no fewer than 35 species are breeding on them. On some of the nature reserves there are dragonfly populations of national importance. Few species of dragonfly can tolerate pollution. Dragonflies therefore serve as an indicator of the water quality of a particular site. The rich assemblages to be found on many of our nature reserves point to their high water quality.

Aquatic habitats represented on RSPB Nature Reserves

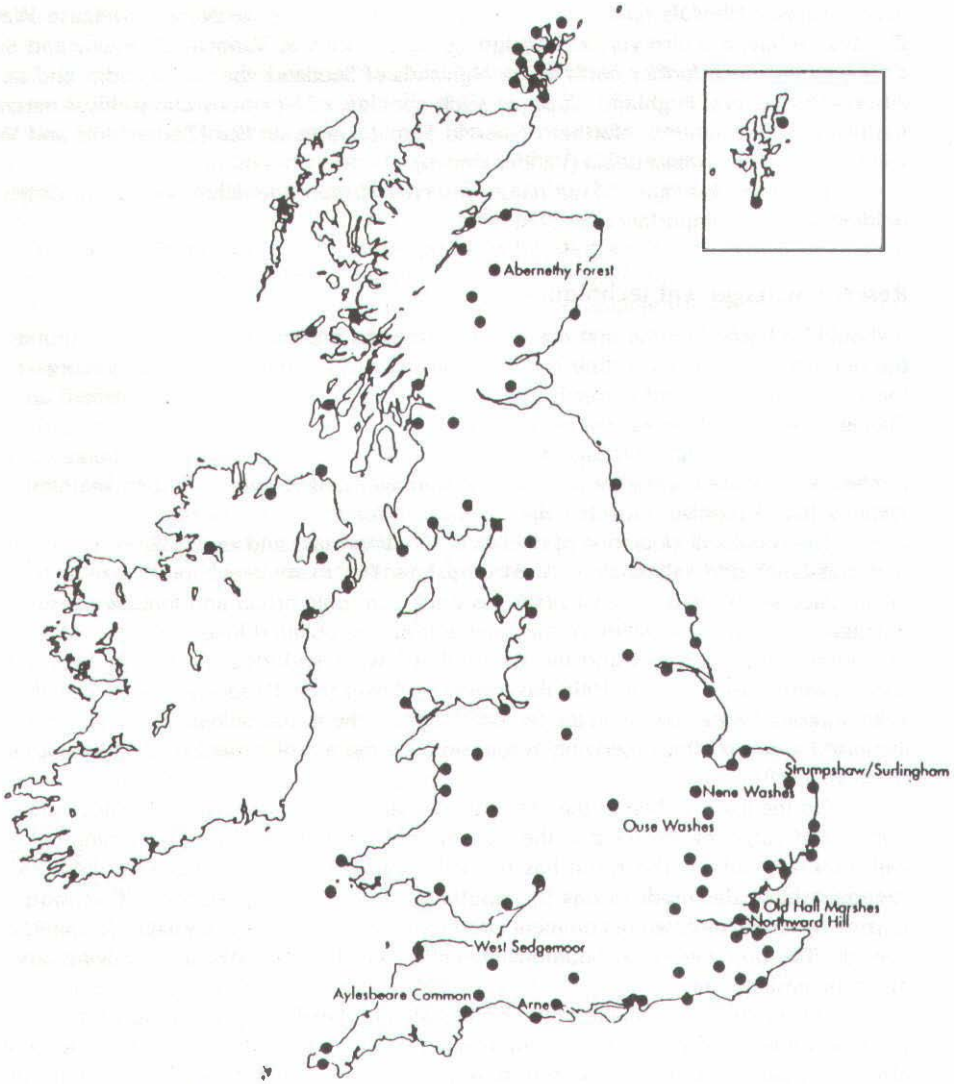
The suite of nature reserves that the Society manages are by their very designation recognized as sites of national importance and particularly noted for their bird populations.

An indication of the diversity of aquatic habitats that support dragonfly populations can be illustrated by the following examples from around the U.K. A number of nature reserves hold important Red Data Book populations.

The ditches of the lowland wet grasslands of **West Sedgemoor**, Somerset, support good populations of Hairy Dragonfly *Brachytron pratense* (Müller) and Variable Damselfly *Coenagrion pulchellum* (Vander Linden). The lowland heaths and mires represented by **Aylesbeare Common**, Devon, and **Arne**, Dorset, are very rich in Odonata fauna. Among the

MAP 1

Location of RSPB Nature Reserves
naming those sites mentioned in the text



species of note are the Southern Damselfly Coenagrion *mercuriale* (Charpentier) (Aylesbeare) and Small Red Damselfly *Ceriagrion tenellum* (Villers) (Arne). On two coastal marshes at **Northwood Hill**, Kent, and **Old Hall Marshes**, Essex, the Scarce Emerald Damselfly *Lestes dryas* Kirby is present in low numbers. **Strumpshaw Fen**, in the Norfolk Broads is a rich site for Odonata; its grazing marshes and fen support populations of Red-eyed Damselfly *Erythromma najas* (Hansemann), the Norfolk Hawker *Anaciaeschna isosceles* (Müller) and Scarce Chaser *Libellula fulva* Müller. The nature reserves of the **Nene** and **Ouse Washes**, Cambridgeshire, are also very rich including species such as Variable Damselfly and Scarce Chaser. Very much further north in the highlands of Scotland, the moors, bogs and tarns at **Abernethy Forest**, Highland, support such species as Northern Damselfly Coenagrion *hastulatum* (Charpentier), Northern Emerald *Somatochlora arctica* (Zetterstedt) and White-faced Darter *Leucorrhinia dubia* (Vander Linden).

These few examples of our nature reserves illustrate the richness of the Society's land holdings and their importance for dragonflies.

Reserve management techniques

It should be borne in mind that these nature reserves are managed as ecological units, with the purpose of maintaining their biological diversity of the particular habitats represented. If the systems are managed correctly, then the Odonata interests will be maintained and more than likely improved because of management.

There is very little management possible with rivers and larger water bodies. It is with ditches and smaller water bodies, where management is carried out to maintain these systems, that dragonflies most benefit.

The rotational clearance of ditches is very important and especially so in the lowland wet grasslands and saltmarshes. At **Strumpshaw Fen** major mechanical management has taken place since 1978 to rehabilitate this once eutrophic broad and fen. As a result of this management and the isolation of the reserve from the polluted River Yare, the water quality has been much improved and the dragonflies have responded quickly. In 1980 only six species were present but by 1988 there were no fewer than 19 species (Tickner *et al.*, 1991). With improved water quality in the fen dike systems, the Water Soldier *(Stratiotes aloides)* has increased and it is almost certainly responsible for the establishment of the Norfolk Hawker (Pickess, 1989).

On the lowland heaths the cessation of management, particularly livestock grazing by ponies and cattle, has resulted in the mire system and their seepages becoming overgrown with rank vegetation. The result has been that many small plants needing these exposed seepages have declined, as has the Southern Damselfly. At **Aylesbere Common**, some grazing by cattle has been re-commenced to open up the base rich seepages favoured by this species. The populations of Southern Damelfly, which were only just surviving, are once again increasing.

The creation of smaller water-bodies should usually be considered for their multi-purpose wildlife and practical use. On lowland heaths and moorland, uncontrolled fires are always a great worry. The creation of ponds in suitable locations can provide much-needed water for fire-fighting and can be very beneficial to dragonflies. Ponds have been created using several methods. Digging ponds by hand is very hard work but the results are

rewarding. However, it is possible today to use machinery. The most efficient way is to use either a wheeled excavator with a back-operating shovel or a tracked vehicle with a shovel. Because the water from the ponds created may be needed in the event of a fire, their location may be governed by the suitability for vehicular access. Ponds are therefore usually located in humid heath where the water table is just below the surface and adjacent to dry heathland, where fires may occur, to facilitate ease of access. All ponds so created at **Arne** have been rapidly colonized by dragonflies and within two or three years can have as many as a dozen species present, and most are thought to be breeding. The ponds prove particularly attractive to species such as Small Red Damselfly, Emperor Dragonfly *Anax imperator* Leach and the Downy Emerald *Cordulia* aenea (L.). At Loch Garten at **Abernethy Forest** the bunding of small streams to create small water-bodies for emergency fire-needs has resulted in the spread and increase in numbers of the Northern Damselfly. On the same site, small mechanically-dug fire ponds have been rapidly colonized by the White-faced Darter.

The most spectacular way to create ponds is by using explosives. If one has a large homogeneous area of valley mire or bog, and water for fire-fighting purposes is not a reason for their creation, then small pools in such areas can have a valuable wildlife use. Where sites are remote from human habitation, the Army might be encouraged to have a training exercise making them. In this way six small ponds have been created on the Arne; all have been rapidly colonized by dragonflies.

The examples given illustrate the commitment of the Society in time and money to an active habitat-management policy for more than just birds. Furthermore some nature reserves have been enhanced by the creation of small ponds for multi-purpose wildlife use and emergency water-supplies. Our management aims have been to enhance each particular habitat system so as to benefit its associated flora and fauna. Nature reserves conserve scarce habitats and provide opportunities to manage the particular micro-environments required by many scarce insects.

Acknowledgements

I would like to acknowledge the assistance given me by my wardening colleagues in providing updated Odonata information for their nature reserves. Dr James Cadbury kindly read through the draft and made some very helpful comments.

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Notes on *Libellula fulva* Müller on the River Avon near Bristol

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Visits were made to the River Avon near Bristol during 1993 and 1994 in an attempt to ascertain the distribution and density of *Libellula fulva*. The river is slow-flowing with a few weirs along the stretch studied. Much of the bank is adjacent to arable land and pasture with hedgerows, but with very little woodland. Large sections of the bank have alder and willow trees growing to a range of heights.

During June 1993, two visits were made along a 12km stretch of the river between Crews Hole, Bristol (ST/620730) and Swineford (ST/690690). One bank only was walked, and the numbers of territorial males were counted as accurately as possible. Good numbers were found along the entire stretch except within the first three kilometres. Males were found where Bur Reed (*Sparganium* spp.) and Yellow Water Lily (*Nuphar lutea*) were growing along the margins of the river, and it seemed that the shallow, silty inlets were favoured habitats for males. They were using *Sparganium* leaves as territorial perches and flying over the *Nuphar lutea* close to the bank.

It is possible that *L. fulva* was not observed within the first three kilometres of bank walked because here *Sparganium* and *Nuphar lutea* were absent, and it may be that on the Avon *L. fulva* is dependent upon these two marginal plant species.

During June 1994, a visit was made to another 6km stretch of the river, just upstream from Swineford, between Saltford (ST/694680) and Newbridge, Bath (ST/716660). Once again, territorial activity was centred around *Sparganium* and *Nuphar lutea* vegetation.

Numbers counted in the two years of observation are as follows:

	1993	1994
Minimum number of males	115	66
Minimum number of copulating pairs	3	8

As only one bank was surveyed, the actual numbers of *L. fulva* present are likely to be much higher than these figures. Females were extremely hard to find, even when the surrounding vegetation was searched.

During the late 1960s, as a young boy, I used to fish along this particular stretch of river and remember quite plainly seeing stout-bodied, blue dragonflies which would land on my rod. As *Libellula depressa* L. does not breed here, it seems very probable that these blue dragonflies were *L. fulva* and that the species has been present in this region for longer than recent records suggest.

Dichromism in females of *Ischnura pumilio* (Charpentier), with special reference to homeochromic females

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Introduction

The recognition of homeochromic females of *Ischnura pumilio* requires an understanding of the colour changes that take place prior to full maturity. Colour changes in heterochromic females, from the immature orange form (*aurantiaca*) to the mature greenish form, are fully documented by Cham (1990, 1993), but the bluish homeochromic form has apparently not yet been reported in Great Britain, although it occurs in all other west Palaearctic countries in which *I. pumilio* is resident.

Methods

Observations on homeochromic female *I. pumilio* in Morocco, Spain, France, Germany, Austria, Yugoslavia and southern Turkey revealed variation in the intensity and extent of the bluish coloration. The results of more detailed observations on the homeochromic form in Germany are given below.

Observations

1. Homeochromic females were found at six out of ten sites visited during the last seven years.
2. Homeochromic females always occur in much lower numbers than heterochromic females.
3. During maturation, heterochromic females undergo a single colour change, from orange (*aurantiaca*) to green; homeochromic females have a double colour change, passing from orange to green and then from green to blue. Tricoloured individuals in changing phase were seen.
4. Homeochromic and heterochromic females both arise from immature orange females.
5. Change from the green phase to the bluish phase starts before the change from orange to green is completed.
6. Transition from green to bluish colour takes place in the following order: a) between wing bases, b) apical border of pronotum, c) postocular spots, d) sides of abdominal segments one to three. At this early stage, orange can still be seen on the sides of the thorax and on the abdominal segments. Melanism is just beginning on the dorsum of abdominal segments 1 to 3, but is further developed at the postocular margins.
7. The azure blue body colour soon becomes less bright. In hyperadult females, the colour of the eyes changes from greenish to dark blue.

Discussion

A prognosis can be made on whether a greenish female is homeochromic or heterochromic as follows. A green female with completed melanism on the dorsum of abdominal segments 1 to 3, and with the thorax between the wing bases brownish, is heterochromic. A green female without distinct blackening on the dorsum of abdominal segments 1 to 3, and with blue colour developed at least between the wing bases, is homeochromic.

As yet, it is not possible to distinguish the forms of immature orange females and further investigations are necessary.

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Notes and observations

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My thanks as usual to those who have provided the information for this section. The 1994 first and last dates appear in the Newsletter. For the next report, could I have all records by 15 July 1995 please?

Updates

Both these updates follow reports which appeared in Volume 10 (2) (October 1994).

Another observation of a Banded Demoiselle (*Calopteryx splendens*) at rest with open wings was made on 21 May 1991, when one was found on the riverbank of the Great Ouse near Brampton, Cambridgeshire. This was also a male. Has anybody seen this behaviour in the female? (B)

Another observation of 'headless life' was made on 28 May 1994 near Bewdley, Worcestershire. The species this time was the Club-tailed Dragonfly (*Gomphus vulgatissimus*); it was a male perched on the river bank with its wings folded over its abdomen, when touched it would move its legs and flick its wings. The head could not be found, there were no exuviae nearby, and there was no indication as to how the head had been removed. (A)

Odonata as prey and predator

At Tilford, Surrey, on 11 July 1994, a Brilliant Emerald (*Somatochlora metallica*) was caught and eaten by a Moorhen. (A)

At Chartley Moss NNR on 9 July 1994 a male Emperor (*Anax imperator*) suddenly caught one of the many White-faced Darters (*Leucorrhinia dubia*) which were present. It carried it upright by the head with the abdomen drooping down in front and landed on some *Juncus effusus* where it started its meal, before flying inland some 5m and landing on dead *Molinia* on the ground, where it finished it. The *Anax* was seen holding territory from 24 June to 4 August but this was the only time it was seen to take *L. dubia*. (C)

Mixed pairings

An error occurred in the last report - Elstree is in Hertfordshire and not in Staffordshire.

On 14 July 1994 at Thursley Common, Surrey a male Emperor (*Anax imperator*) was seen in tandem with a Golden-ringed Dragonfly (*Cordulegaster boltonii*), and whilst in flight the *boltonii* appeared to be attempting to curve its abdomen up to meet that of the *Anax*. (A)

On 23 September 1994 two mixed pairings of male Black Darter (*Sympetrum danae*) and female Common Darter (*Sympetrum striolatum*) were seen at the Chartley Moss NNR. The first pair landed several times, and on one of these occasions a second male *danae* landed on the head of the *striolatum*, curled its abdomen round, tried to grasp the head and neck, failed, and flew off. The second pair began to dip, and after several dips they flew around and the *striolatum* apparently tried several times to complete the wheel. (C)

Triple 'pairings'

On 21 September 1993 at the Saltwells LNR a triple of Common Darter (*Sympetrum striolatum*) was noted, where a pair which had completed the wheel appeared to be being carried by another male. Another triple was seen the same day, where one attached itself to a tandem pair. Further tandem triples of (*striolatum*) were also seen here on 17 and 22 September 1993. (C)

The Black Darter (*Sympetrum danae*) has also been noted in tandem triples, with observations from Chartley Moss NNR on 13 and 30 August 1993 and 2 September 1994. (C)

Behaviour

On 2 October 1994 at Roche's Point, Co. Cork, Eire, a pair of Common Darter (*Sympetrum striolatum*) were noted in tandem on the rocky shore. The female was apparently ovipositing in small intertidal rock pools. There is no suitable freshwater habitat within about 2.5km. (D) Has anybody else observed this behaviour; what would be the survival possibilities for eggs laid in such marine habitats?

On 21 August 1994, at Chartley Moss NNR, a male Brown Hawker (*Aeshna grandis*), after two minutes patrolling a pool, dived deliberately and strongly into the water three times in quick succession, each time rising and 'shaking' itself rather in the manner of a bathing bird. It then flew ashore to sun itself on a *Sphagnum* mat for thirty seconds, then briefly

resumed its flight over the pool, curling its abdomen up between its wings rather like a zygopteran cleaning its wings. There was no sign of possible prey on or just below the water surface and certainly nothing was carried away from the pool to the *Sphagnum*. It certainly appeared that this *Aeshna* was bathing, shaking and drying off in the sun. (C)

Range expansions and migrants

A population of Keeled Skimmers (*Orthetrum coerulescens*) was discovered in 1994 in south-west Avon. (via E)

A male Golden-ringed Dragonfly (*Cordulegaster boltonii*) was seen on 21 July 1994 near Westbury, Wiltshire, well outside the known breeding range. (E)

A Yellow-winged Darter (*Sympetrum flaveolum*) was present at Chew Valley Lake, Somerset, from 20–23 August 1994, proving a great attraction. This period also coincided with the arrival in that part of the country of large numbers of southern insects which included Migrant Hawkers (*Aeshna mixta*), Clouded Yellows (*Colias croceus*), Painted Ladies (*Vanessa cardui*), and a Queen of Spain Fritillary (*Argynnis lathonia*). (E)

One was also reported from East Anglia on 7 September 1994.

A few records of Red-veined Darter (*Sympetrum fonscolombei*) in 1994 included at least three or four in Cornwall and two in East Anglia.

A male Black-tailed Skimmer (*Orthetrum cancellatum*) at Elstree, Hertfordshire, on 15 August 1994, occurred at a site which does not support this species. (F)

List of observers

(A) M. Averill, 25 Oakhill Avenue, Kidderminster, Worcestershire DY10 1LZ.
(B) G. Barker, 188 Handside Lane, Welwyn Garden City, Hertfordshire AL8 6TD.
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(D) T. Gittings, Zoology Dept., University College Cork, Lee Maltings, Prospect Row, Cork, Eire.
(E) S. Preddy, 1 Fair View, New Road, High Littleton, Bristol BS18 5JH.
(F) S. H. Murray, 184 Thirsk Road, Borehamwood, Hertfordshire WD6 5BD.

Corrigendum

The following errors in Volume 10 Number 2 have been brought to our attention and we apologize to the authors concerned.

Page 29, line 28: The length of the living final-instar larva should read 'from c.33 to 39mm'.

Page 38, lines 2 and 3: The name and address of K. G. Goodyear, 26 Twynham Avenue, Christchurch, are incorrectly printed.

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
Anaciaeschna isosceles	Norfolk Hawker
Anax imperator	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
Leucorrhinia dubia	White-faced Darter

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