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**Cover illustration:** *Lestes sponsa* ovipositing into *Schoenoplectus lacustris*. Photograph by Mark Tyrrell.

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# Migrant and dispersive dragonflies in Britain during 2022

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## Summary

In Britain, the year 2022 started dramatically, with the country's second-ever record of *Sympecma fusca* being made near Hedge End, Hampshire, on 5 May; despite the species' current rarity, it may be a potential future colonist. Later highlights included the continuing rapid internal spread of *Aeshna isoceles*, with an apparent new breeding colony being found at Slapton Ley in Devon and with wandering individuals being noted in Somerset, Wiltshire, north Hampshire and, remarkably, near Wigan in south Lancashire. The discovery of a male *Crocothemis erythraea* at Minsmere, Suffolk, on 28 July, and the sighting of a male *Sympetrum flaveolum* at Kilnsea Wetlands near Spurn, East Yorkshire, on 5 September, were also of considerable interest. The record of *S. flaveolum* is the first in Britain for nearly a decade.

Meteorologically, summer 2022 was notable for periods of high temperatures and drought over large parts of western Europe. This clearly had an impact on events in the dragonfly world, with seemingly both positive and negative consequences for migration. All of our commoner recent 'traditional' migrants such as *Aeshna affinis*, *Anax parthenope*, *Anax ephippiger* and *Sympetrum fonscolombii* apparently showed influxes during the year, though the growing strength of resident populations of the former two species here made detailed analysis difficult. The numbers of individuals seen were, however, generally unspectacular with the exception of *A. parthenope*, which had a record-breaking season. Much of this good showing by *A. parthenope* seemingly reflected good local breeding, though there were several unexpected records, particularly from northern England and Scotland, that imply that some long-distance movement also took place.

## Account of species

Notable sightings reported to the BDS Migrant Dragonfly Project during 2022 are detailed below; for information on events during 2021, see Parr (2022).

### ***Chalcolestes viridis* (Vander Linden) – Willow Emerald Damselfly**

A large number of new sites for *Chalcolestes viridis* were discovered during 2022, this new colonist's rate of range expansion having, if anything, accelerated over recent years. The major find of the year must surely be the discovery of an individual at Gosforth, Newcastle upon Tyne, on 12 October; this is some 60 km further north than any prior record for Britain. Considerable consolidation of populations in the Yorkshire area also took place. Other significant finds included sightings from Burnley and the Crewe area in the north-west of England, Worcester in the west and Trowbridge in the south-west.

A female *C. viridis* was observed coming in off the sea then resting on the shore at Dungeness, Kent, on 18 September (DWa). Whether this reflects fresh immigration, or merely an individual recovering itself after having been blown out to sea is, however, difficult to determine.

### ***Lestes barbarus* (Fab.) – Southern Emerald Damselfly**

Following a record year for the species in Britain during 2021 (Parr, 2022), the present reporting year saw a huge reversal of fortune, with virtually no sightings of *Lestes barbarus* at either known breeding sites or elsewhere. Isolated singles were reported from 3–4 localities in their Thames Estuary stronghold but, apart from a female seen at an undisclosed site in west Norfolk on 16 July, no other sightings were made. It has been suggested that high water levels at many of their breeding sites during summer 2021 may have been unfavourable for the species (D. Chelmick in Freeman, 2022). Hopefully *L. barbarus* has not been totally lost as a breeding species, but fresh immigration is to be expected in years to come and further colonies will no doubt become established.

### ***Sympecma fusca* (Vander Linden) – Common Winter Damselfly**

Only the second-ever record of *Sympecma fusca* for Britain was made when a female was discovered at Wildern Local Nature Reserve near Hedge End, Hampshire, on 5 May (TC) – the first record having been from Tonna, Neath Port Talbot, south Wales, back in December 2008 (Cham *et al.*, 2014). The damselfly was discovered in typical habitat for the species but was only noted on one day; further details of the find are given in Crow (2022). *S. fusca* is perhaps a potential future colonist to southern England; it is currently widespread on the



**Plate 1.** *Sympecma fusca* (female). Wildern Local Nature Reserve, Hampshire, 5 May 2022. Photograph by T. Crow.

near Continent and in recent years has spread as far north as southern Sweden (Boudot & Kalkman, 2015).

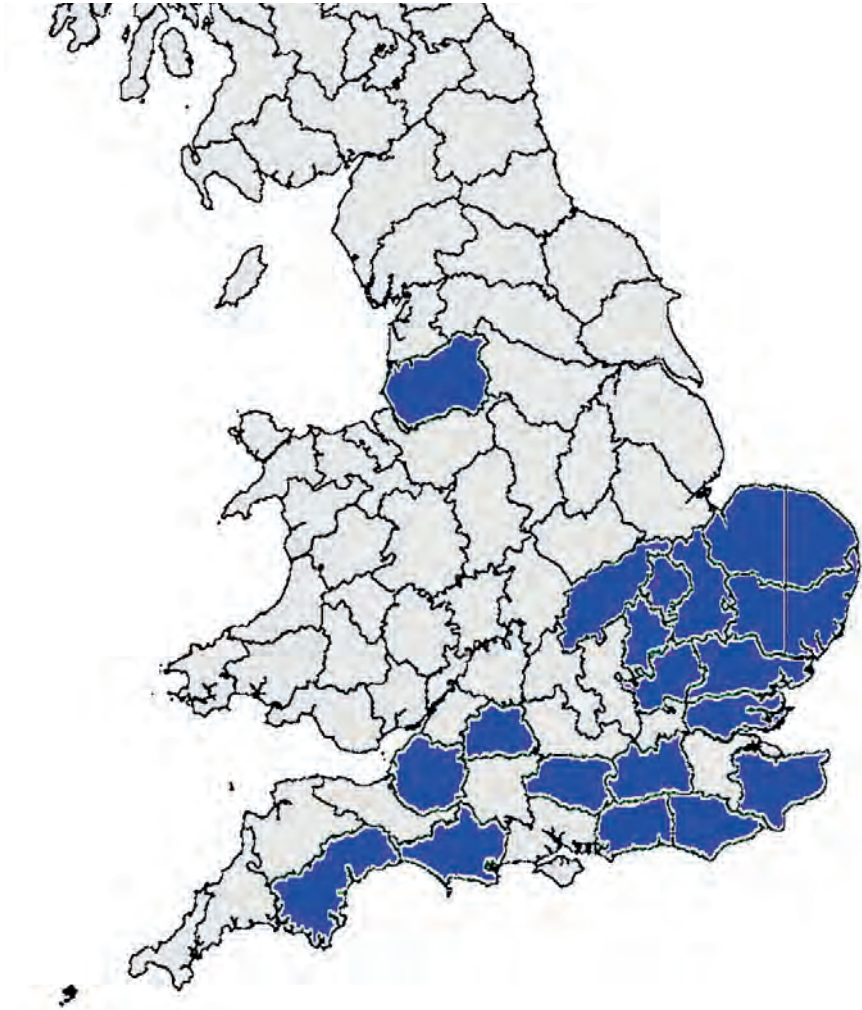
### ***Erythromma viridulum* (Charp.) – Small Red-eyed Damselfly**

'Many' were found and photographed on ponds at the Red River Valley near Camborne, Cornwall, during late August (DC). There are few previous sightings from the county, and records have only ever been erratic, so the origin of these individuals remains unclear.

### ***Aeshna affinis* (Vander Linden) – Southern Migrant Hawker**

*Aeshna affinis* appeared at most of its recently established breeding sites during 2022, though numbers seen tended to be lower than in other recent years. There were also signs of local range expansion and maybe even the establishment of some totally new breeding populations. After records in 2021, *A. affinis* was, for instance, noted once again from the Langton Herring area of Dorset (MPI) and from Marazion, Cornwall (CM). Away from likely breeding sites, various immigrant or dispersing individuals were also seen during the year, though again numbers reported were less than in the previous few years. Two sightings were received from the Isle of Wight, at Brading Marshes over 2–11 August (LG) and at Wheeler's Bay on 5 August (ABu). Further north, significant sightings came





**Figure 1.** Watsonian vice counties recording *Aeshna isoeles* during 2022. Attribution: Contains Ordnance Survey data © Crown copyright and database right (2006), licensed under the United Kingdom Open Government Licence v3.0

from Kenfig, Glamorganshire, on 12–13 August (ND, MPo, JHe), from Spurn, East Yorkshire, on 20 August (HA) and from Saltholme, County Durham, on 12–16 August (MS, DPe). The Kenfig sighting is only the sixth record for Wales, while that from Saltholme represents the most northerly-ever British record. In addition to this range of coastal/sub-coastal reports, notable inland records included sightings at Stewartby, Bedfordshire, over 24–30 July (NW, LE, SBI) and at Clifton-upon-Dunsmore, Warwickshire, on 9 August (PB).

### ***Aeshna isoceles* (Müller) – Norfolk Hawker**

Once rare and highly localised in Britain, *Aeshna isoceles* has been significantly expanding its British range over the last 10 years or so (Taylor *et al.*, 2021), with the rate of this expansion apparently increasing. The current reporting year saw records from no less than 21 vice-counties (Fig. 1), centred as would be expected on East Anglia and nearby areas such as Hertfordshire and east Kent, where well established breeding populations are already now present. The recently established colonies at Radipole in Dorset and Chichester in West Sussex both seemed to do well, and the discovery of good numbers of *A. isoceles* at Slapton Ley, Devon, over the period 17 June–29 July (AST *et al.*) would seem to indicate that an established colony is similarly now present there, its initial founding having obviously gone unnoticed. Following records during 2021, the discovery during 2022 of further individuals on the coastal marshes between Eastbourne, East Sussex, and Dungeness, Kent, may similarly hint at the presence of new breeding colonies in that area. Two *A. isoceles* were, for example, noted near Hooe on 24 June (SC), with a singleton at Dungeness on 2 June (DBI) and up to five there on 24 June (DBr).

Well away from areas with established colonies, there were a number of totally unexpected finds during 2022, presumably resulting from long-distance internal dispersal, though a degree of immigration is also possible. Individuals were noted in Somerset near Burnham-on-Sea on 22 June (ASI) and along the River Parrett on 9 July (JP), while a male *A. isoceles* was present at Lower Moor Farm, Wiltshire, over 3–4 July (HE, DPI *et al.*). A further individual was photographed at Claycart Flash on the Basingstoke Canal, north Hampshire, on 23 July (CD), but perhaps the most dramatic sightings were from Lancashire. Here, a male was photographed at Amberswood Common near Wigan on 21 June (DT), with a female then being seen there on 9 July (JC). This site is almost 250 km from the nearest known British breeding population.

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

Late summer/autumn migration of *Aeshna mixta* along the southern shores of the Baltic Sea has now been well documented (Knoblauch *et al.*, 2021). During 2022, there were few signs of major movements of *A. mixta* in Britain, though some large gatherings seen in eastern coastal counties could be related to migration. A group of 60–100 was present at Somerleyton, Suffolk, on 7 August (RKR), roughly 100 were at Ringstead Downs, Norfolk, on 11 August (SR) and similar numbers were seen at Hanthorpe End, Lincolnshire, on 23 August (CG). Later in the year, over 100 were present at Ladyburn Lake, Northumberland, on 13 September (AG), this being an exceptional number for this far north in

Britain. Over 50 were also seen at Mildenhall, Suffolk, on 29 September (FB). In addition to these records, reports of individuals attracted overnight to moth traps might similarly be related to migration (see Parr, 2006). A single *A. mixta* was caught at Portland Bill, Dorset, on the night of 15 August (MC), with another (a female) caught in south Devon on 10 September (KM).

### ***Anax ephippiger* (Burmeister) – Vagrant Emperor**

There was a small autumn influx of this primarily Afrotropical migrant species, as has now become virtually an annual occurrence in Britain. The first record of the year was from Preston Park, Devon, on 10 September (ABI) and the last was from Bedgebury Pinetum, Kent, on 28 November (SM); in all seven confirmed records were made, with a number of other 'possibles' being reported. Confirmed reports were largely from south and south-east coastal counties (Devon, East Sussex, Kent, Suffolk and Norfolk), but a female was photographed at Heysham south harbour, Lancashire, on 25 October (KE). All records involved single individuals seen for one day only.

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

It was a record-breaking year for *Anax parthenope* in Britain, with reports from nearly 100 sites and with oviposition being widely reported. The first record of the year was from near Sampford Peverell, Devon, on 11 June (RJ), with several other sightings following over the next few days; the last was from Housel Bay, Cornwall, on 10 September (ASI), this perhaps reflecting an autumn emergence (though not necessarily locally). A distinct peak in new sightings occurred around mid-July, coincident with a period of very hot, sunny, weather (Met Office, 2023a), though to what extent this reflected immigration, local dispersal, increased dragonfly activity, leading to individuals being easier to find, or simply increased recorder effort is difficult to say. Probably all these factors were involved to a degree.

Records of *A. parthenope* during 2022 were predominantly from southern and central England, but there were reports as far north as Moray in Scotland as well as several in south Wales. As in 2021 (Parr, 2022), a good many reports came from localities that had also recorded the species during the previous few years. Coupled with observations of unusually large numbers at some sites – e.g. up to eight together were reported from Longham Lakes in Dorset (MG, PS) and eleven from the River Lee Navigation near King George's Reservoir, Greater London (RW) – it would seem that local breeding has now become widespread. Although relatively few exuviae have as yet been found to confirm this, the species tending to favour larger sites where discovery and collection of exuviae is not always straightforward, a well-grown male larva was found at



Seaford Head, East Sussex, on 27 June (MK).

Amongst the more unusual records, many of which likely reflect long distance dispersal/immigration, up to four *A. parthenope* were present at Mire Loch in the Scottish Borders over 18–20 July (CH, DG) and a report of oviposition there is only the second record of attempted breeding for Scotland. Other Scottish records included an individual seen at Loch Spynie, Moray, on 19 July (LJ) and an unusual ‘blue-phase’ male somewhat resembling *A. imperator* was present at Seton Sands, East Lothian, over 11–14 August (ABr, BH). Further south, in England, a male photographed at Brasside Pond, County Durham, on 14 August (RH) was also unusually far north, as were the several records from North Yorkshire. These included a male at Scarborough Mere on 18 June (MH), one or more individuals at Wykeham Lakes over 18–23 June (MMN, CB, KG *et al.*) and 4–14 August (JHo, CB *et al.*) plus a female at Nosterfield on 9 August (KG).

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

A male *Crocothemis erythraea* was photographed at Minsmere, Suffolk, on 28 July (LC); this is only the 12th confirmed British record, all since 1995. Given that, as a consequence of recent range expansions, *C. erythraea* has now become a reasonably common breeder on the near Continent (Boudot & Kalkman, 2015), the species seems a potential future colonist to Britain. Perhaps the fact that all British records currently relate to solitary males might in part explain the delay in colonisation.

### ***Libellula fulva* Müller – Scarce Chaser**

*Libellula fulva* is currently expanding its range in Britain, and some individuals can stray a significant distance from natal sites (e.g. Parr, 2017). The first record for the Welsh island of Flat Holm in the Bristol Channel on 19 May (JA) is thus perhaps not particularly surprising given that known breeding colonies now lie only some 15–20 km away in Somerset, but 10 km of this distance will be over open water.

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

The species showed significant movement during the year. A male photographed on Skokholm Island, Pembrokeshire, on 22 June (GE) was the first record for the island, while one seen on Tresco, Isles of Scilly, on 10 July (KW) is only the third record for the island group, which lies some 45 km off the Cornish mainland. In Scotland, individuals were seen both at Newmains in the Scottish Borders on 9 July and 13–14 August (DG), and at Seton, East Lothian, on



**Plate 2.** *Crocothemis erythraea* (male). Minsmere RSPB Reserve, Suffolk, 28 July 2022. Photograph by L. Cater.

20 July (BH). There have been very few previous Scottish records, and the East Lothian sighting is the most northerly ever for Britain. Interestingly, the late July/August Scottish sightings coincide with the appearance of *Sympetrum fonscolombii* at both sites, perhaps suggesting a non-local origin for some of the 'wanderers' of *O. cancellatum* reported in Britain during 2022.

### ***Orthetrum coerulescens* (Fab.) – Keeled Skimmer**

A number of unusual sightings were made during the reporting year, indicative of significant dispersal. This was perhaps stimulated by the extreme weather conditions encountered during parts of the summer (see Met Office, 2023a,b,c). Up to three males at Ryall Pits, Worcestershire, over 6–13 August (AW, EL) constitute the first record for the county, while a male at Colney Heath, Hertfordshire, on 21 June (RW) is only the third confirmed county record. Several reports were also received during the year from gardens or garden ponds, these not normally being considered typical habitat for the species. Records of males from gardens in the chalk areas of Hampshire at Winchester on 16 June (DV) and at an undisclosed site in the north-west of the county on 20 June (AJ) are of particular interest, as is a male photographed in Colchester, Essex, on 23 July (DJ). The latter record, in particular, is some considerable distance from known breeding sites.

### ***Sympetrum danae* (Sulzer) – Black Darter**

Adult *Sympetrum danae* are capable of dispersive/migratory movements in both the immature and fully mature state (Corbet, 1999). During the current reporting year few unexpected records were received, rather implying that only limited longer range movement took place during 2022. A mature male was, however, noted at Bushy Park, Greater London/Surrey, on 18 August (SD), this being well away from typical habitat for the species.

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

A male was photographed at Kilnsea Wetlands near Spurn, East Yorkshire, on 5 September (DWO). This is the first confirmed sighting of *Sympetrum flaveolum* in Britain since 2015 (Parr, 2016), and the dragonfly was clearly associated with a small influx into the Netherlands seen during early September (Waarneming.nl, 2022). Although arrivals of *S. flaveolum* have always been somewhat erratic, the species currently appears to be in decline in western Europe (e.g. Bowler *et al.*, 2021).

### ***Sympetrum fonscolombii* (Sélys) – Red-veined Darter**

The first report of *Sympetrum fonscolombii* in Britain during 2022 was of two fully mature males at Windmill Farm Nature Reserve, Cornwall, on 28 May (CM), and a steady stream of records over the next four weeks saw sightings from just over twenty further sites, with individual counts usually being in low single figures, or very occasionally as high as ten. Again, the dragonflies were typically fully mature when first seen, and a significant migratory influx had clearly taken place. A teneral found at Beeston Common, Norfolk, on 8 June (FF) does, however, indicate the presence of a small number of locally-bred individuals. After the end of June, sightings of mature *S. fonscolombii* at new sites continued at irregular intervals until mid-August, and by then the species had been recorded from roughly 35 sites. Although there were a few inland records from London and the Home Counties, most notably at Tice's Meadow, Surrey, where individuals were present on 3 June (ME) and between 10 July–7 August (ME, RS *et al.*), the great bulk of records were coastal or sub-coastal, with most reports being from East Anglia or along the south coast of England. Welsh records comprised small numbers at Kenfig, Glamorganshire, over 8–22 June (PP, ND, SBe), and both a male and female on Skokholm Island, Pembrokeshire, on 22 June (GE). Although there were no records from northern England during the current reporting year, there were a few from Scotland, where up to three *S. fonscolombii* were present at Seton, East Lothian, over 20–21 July (BH, ABr) and a male was seen at Reston in the Scottish Borders



**Plate 3.** *Sympetrum flaveolum* (male). Kilnsea Wetlands, Spurn, East Yorkshire, 5 September 2022. Photograph by D. Wood.

on 14 August (DG). Oviposition was indeed noted at Seton on 21 July (ABr).

In contrast to the events of spring and early summer, the autumn period saw only a very small number of further sightings, implying that both late season immigration and the emergence of a locally-bred second generation resulting from eggs laid during the spring had been limited. A recently emerged female was, however, found at Windmill Farm, Cornwall, on 27 August (CM), and four *S. fonscolombii* were reported from Kelling Water Meadows, Norfolk, on 3 September (HV). A mature male was then photographed at Portland Bill, Dorset, on 15 September (MA) and further males were present at Soar, Devon, on 22 September (RM).

### ***Sympetrum striolatum* (Charp.) – Common Darter**

A number of individuals were attracted overnight to both actinic and MV moth traps over the period 22 July–17 October. Records showed a strong bias towards coastal south-east England, with the counties involved comprising Lincolnshire, Suffolk, Essex, Kent and West Sussex. Records of dragonflies at light frequently seem to involve migrants (Parr, 2006), and the potential for autumnal movements of *Sympetrum striolatum* in north-west Europe has

recently been reiterated by Schröter *et al.* (2023).

## Discussion

The summer of 2022 was characterised by periods of high temperatures and severe drought that affected much of Britain and large parts of western Europe (Met Office, 2023c; Toreti *et al.*, 2022). These conditions might perhaps have been expected to stimulate dragonfly dispersal and migration as many waterbodies became increasingly suboptimal or even dried out completely. In practice, although some interesting internal movements and range expansions were noted, many of our long-distance migrants appeared in lower numbers than in many other recent years. *Sympetrum fonscolombii*, for instance showed a moderate influx during spring and early summer, but there were virtually no records at all of later season, second generation individuals. *Anax ephippiger* did show an autumn influx, as has now become essentially annual, but numbers involved were very low. The only 'migrant' species to be seen in notable numbers was *Anax parthenope*, which indeed had a record-breaking year, but the evidence suggests that much of this was due to the growing number of locally-bred individuals from a now resident sub-population rather than to any unusual immigration. While weather conditions in summer 2022 might have been broadly favourable for migration, it would seem that population levels in source areas of Europe and/or north Africa were often depressed. Perhaps some waterbodies had dried up completely before all species had finished emerging, and it will be of great interest to follow what happens over the next few years. How long, for instance, will it take populations to recover? Might there also be changes in migration patterns as a result of an altered balance between different local sub-populations?

With *A. parthenope* now seemingly becoming a widespread breeder in Britain, anything other than large-scale immigration might soon become difficult to follow for this species. *Aeshna affinis* may also be reaching a similar position as it too consolidates itself in Britain. These species may thus soon join the likes of mobile species such as *Aeshna mixta* (Migrant Hawker), whose modern-day movements are already very difficult to track in this country (e.g. Parr, 2015). This phenomenon of facultative migration, where some individuals of a species migrate while others do not, is clearly worthy of further study, and there may be several ways forward. Observations at coastal migration hotspots may offer opportunities to follow migration/dispersal of a wide range of Odonata, including predominantly 'resident' species, and perhaps in the future a coordinated network of such sites might be established, as has long existed in ornithological circles. Recent developments using stable isotopes to determine the likely natal area of specific individuals (Hobson *et al.*, 2012a,b; Schilling *et al.*, 2021) also offer the chance to study the migration of a wide variety of Odonata including



those that also occur as residents. It will be of considerable value to see the application of these techniques to European species.

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# On the success of *Chalcolestes viridis* (Vander Linden) (Willow Emerald Damselfly) and the decline of *Lestes sponsa* (Hansemann) (Emerald Damselfly) at Finedon Pocket Park, Northamptonshire

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## Summary

The small pond at Finedon Pocket Park, Northamptonshire was the first in the County to be recorded with a colony of *Chalcolestes viridis* (Willow Emerald Damselfly). The species was discovered by the author in 2017, and has been the subject of several papers (Tyrrell, 2019a, Tyrrell, 2020). The pond hosts a strong colony of *Lestes sponsa* (Emerald Damselfly) which the author has monitored, along with all other species recorded for the past 15 years. Since 2017, the colony of *C. viridis* has increased, with maximum counts in 2022 close to 100 adults while, over the same period, the colony of *L. sponsa* has declined from a maximum of approximately 75 to 5 adults, and adults have now become very hard to find even in their traditional areas. During the same period, the pond has seen several floods (that killed some willow trees) and has had droughts. This review considers the factors that could contribute to the decline in *L. sponsa*, and how the behaviour of *C. viridis* might contribute to its success and the decline in *L. sponsa*, including inter-species competition, egg mortality during winter floods and natural extinction events.

## Introduction

*Lestes sponsa* (Emerald Damselfly) has a scattered distribution in Northamptonshire, favouring smaller, well-vegetated ponds. Unlike other areas, these ponds do not tend to dry out in the height of summer. It is not exclusive to ponds and can be found in reservoirs such as Cransley Reservoir (British Grid Reference SP8278) and Pitsford Nature Reserve (SP7869), but only in areas of shallow water with dense vegetation within the water margins. *Chalcolestes viridis* (Willow Emerald Damselfly) on the other hand is recorded in areas with overhanging trees, whether small ponds or larger bodies of water, both in areas that support *L. sponsa* and those that do not. In Northamptonshire, populations

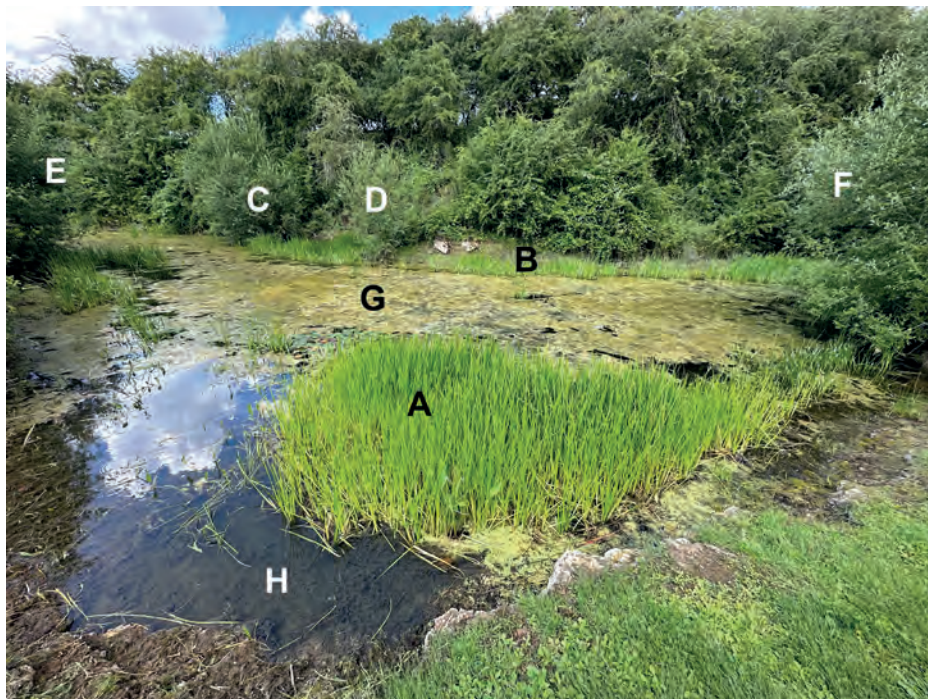
of both species overlap at a few sites such as Yardley Chase (small woodland ponds) (SP855540), Lyveden New Bield (linear ditches and tree lined moat) (SP985852), Fermyn Woods Country Park (small tree-lined ponds with dense vegetation) (SP854850) and Finedon Pocket Park (small tree-lined pond with dense vegetation) (SP911727). At Irthlingborough Lakes (gravel pits with large open water, tree-lined margins and dense vegetation as well as shallow ditches) (SP9570) and Summer Leys (gravel pit with large open water, tree-lined margins and dense vegetation as well as shallow ditches) (SP 866633) both species are recorded but in separate areas so that they do not co-exist. Of these sites where the two species overlap, only Fermyn Woods offers comparable habitat to Finedon, but it is not as thoroughly recorded, and so no meaningful data are available.

Finedon Pocket Park (also known as Finedon Cally Banks) is the site of a former iron ore extraction quarry from the 1810s, where the current footpaths were formerly railway tracks to take the ore to nearby Wellingborough. The extracted iron ore was burned there, leaving a layer of calcinated iron ore which left the soil in poor quality, ideal for the growth of wildflowers. When extraction was completed, the site became the UK's first Pocket Park in 1984 (Finedon Town Council, 2023; Wildlife Trust BCN, 2023). The Pocket Park has held several small ponds, all but one of which have become overgrown, leaving this study pond, which is now managed with tree and scrub clearance (Wildlife Trust BCN, 2023).

The pond at Finedon Pocket Park is well vegetated with six young *Salix* spp. (Willow) trees, overhanging the water (Plate 1). All of these trees are used by *C. viridis* (Plate 2) for copulation and oviposition. The pond is also surrounded by *Taxus baccata* (Yew) and *Tilia x europaea* (Lime) trees. Within the waterbody there are extensive areas of *Sparganium erectum* (Branched Bur-reed), *Schoenoplectus lascastris* (Common Club-rush), and *Eleocharis palustris* (Common Spike-rush). *Lestes sponsa* has been observed ovipositing into all three of these (Plate 3). *Nymphaea alba* (European White Waterlily) has also started to appear since 2020. The growth of *Ceratophyllum demersum* (Rigid Hornwort) has attracted *Erythromma viridulum* (Small Red-eyed Damselfly) to the pond, a species first recorded by the author in 2018.

## Observations

Records for the pond at Finedon Pocket Park show that 15 odonate species have been confirmed as breeding, with a further four either visitors from the nearby River Ise or not proven to breed (Table 1). Of the breeding species, only *Lestes sponsa* and *Pyrrosomma nymphula* (Large Red Damselfly) have been recorded in decline, a situation similar to that at many sites in Northamptonshire.



**Plate 1.** The pond at Finedon Pocket Park. (A, B) areas of dense *Sparganium erectum* (Branched Bur-reed) offering oviposition substrates for *Lestes sponsa*; (C-F) overhanging *Salix* spp. (Willow) trees which are used by *Chalcolestes viridis* for copulation and oviposition; (G,H) areas of *Chlorella* spp. (green algae) with *Ceratophyllum demersum* (Rigid Hornwort) offering shelter for larvae.

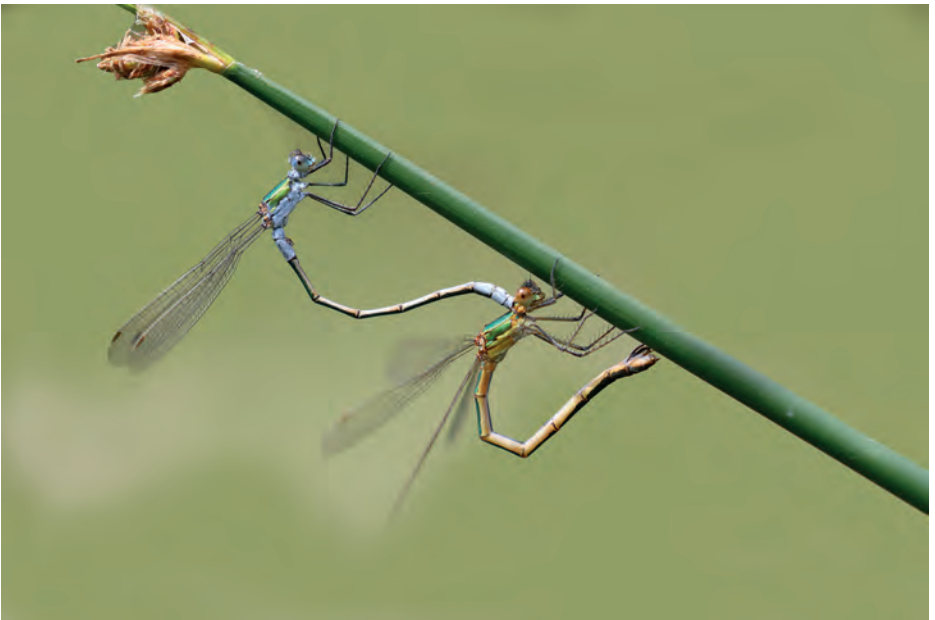
The irregular visitor, *Aeshna affinis* (Southern Migrant Hawker), has been recorded in two separate years (13 August 2019 & 22-26 July, 2021).

Counts of observed adults of *L. sponsa* and *C. viridis* at a single visit were made from 2017, the year *C. viridis* was first recorded (Fig. 1). There was a rapid increase in the numbers of adult *C. viridis* coinciding with a decline in those of *L. sponsa*. *Chalcolestes viridis* (2022) now outnumbers the highest previous count (in 2017) of *L. sponsa*.

Emergence of *C. viridis* typically starts in mid-July, and is complete by early August. For example, in 2021 the first emergence was recorded on 19 July and the last on 12 August, and the first adults were recorded at territory on 11 August. In contrast, *Lestes sponsa* adults were recorded at territory within a few days of emergence.



**Plate 2.** *Chalcolestes viridis* ovipositing into *Salix* spp. (Willow), in the area the E marked on Plate 1, 30 August 2019.



**Plate 3.** *Lestes sponsa* ovipositing into the stem of *Schoenoplectus lacustris* (Bulrush), 26 June 2017.



**Table 1.** Species recorded at Finedon Pocket Park and their breeding status.

Species		Status
<i>Pyrhosoma nymphula</i>	Large Red Damselfly	Breeding; in decline
<i>Ischnura elegans</i>	Blue-tailed Damselfly	Breeding; stable
<i>Coenagrion puella</i>	Azure Damselfly	Breeding; stable
<i>Anax imperator</i>	Emperor Dragonfly	Breeding; stable
<i>Libellula depressa</i>	Broad-bodied Chaser	Breeding; stable
<i>Brachytron pratense</i>	Hairy Dragonfly	Breeding not established
<i>Libellula quadrimaculata</i>	Four-spotted Chaser	Breeding, stable
<i>Calopteryx splendens</i>	Banded Demoiselle	Visitor from nearby River Ise
<i>Calopteryx virgo</i>	Beautiful Demoiselle	Visitor from nearby River Ise
<i>Aeshna mixta</i>	Migrant Hawker	Breeding; stable
<i>Aeshna grandis</i>	Brown Hawker	Breeding; stable
<i>Aeshna cyanea</i>	Southern Hawker	Breeding; stable
<i>Sympetrum striolatum</i>	Common Darter	Breeding; stable
<i>Sympetrum sanguineum</i>	Ruddy Darter	Breeding; stable
<i>Lestes sponsa</i>	Emerald Damselfly	Breeding; declining
<i>Chalcolestes viridis</i>	Willow Emerald Damselfly	Breeding; increasing
<i>Erythromma viridulum</i>	Small Red-eyed Damselfly	Breeding; increasing
<i>Enallagma cyathigerum</i>	Common Blue Damselfly	Breeding; stable
<i>Aeshna affinis</i>	Southern Migrant Hawker	Irregular visitor

Several instances of heterogeneric mixed pairings (i.e. between individuals of different genera but within the same family) have been observed since 2017, both Male-Female and Male-Male-Female (Plate 4).

## Discussion

Data held in iRecord (2023) and NBN Gateway (2023) suggest the start of a national decline in records of *Lestes sponsa* (Fig. 2), for undetermined reasons. The dip in records of both species in 2020 may be due to reduced recording during the Covid-19 pandemic.

The causes of this national decline in *L. sponsa* are not documented, and are reflected in the situation at Finedon. A number of possible causes have been established, either related to the expansion of *C.viridis* or independent of it.

## Larval habitats

Both species show rapid larval growth, from eggs hatching in the early spring



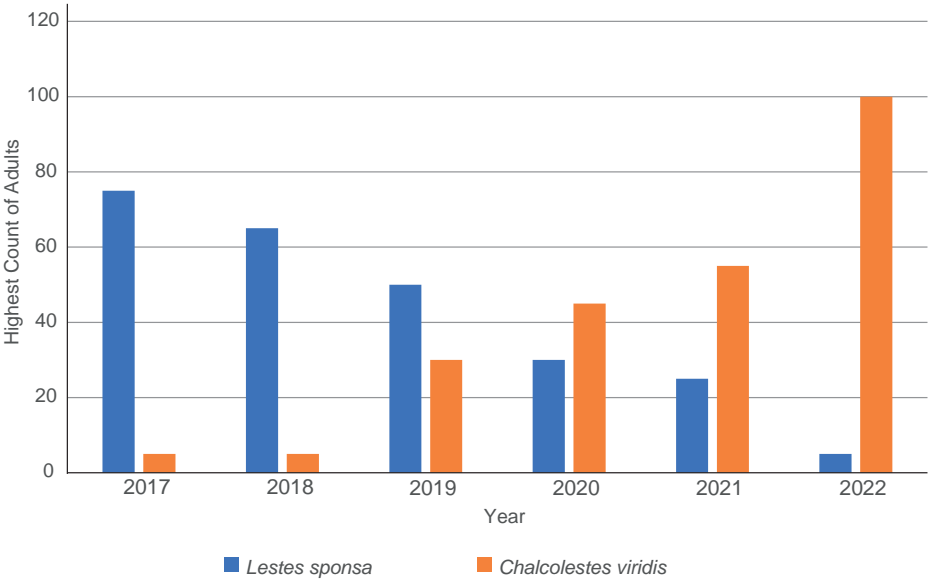


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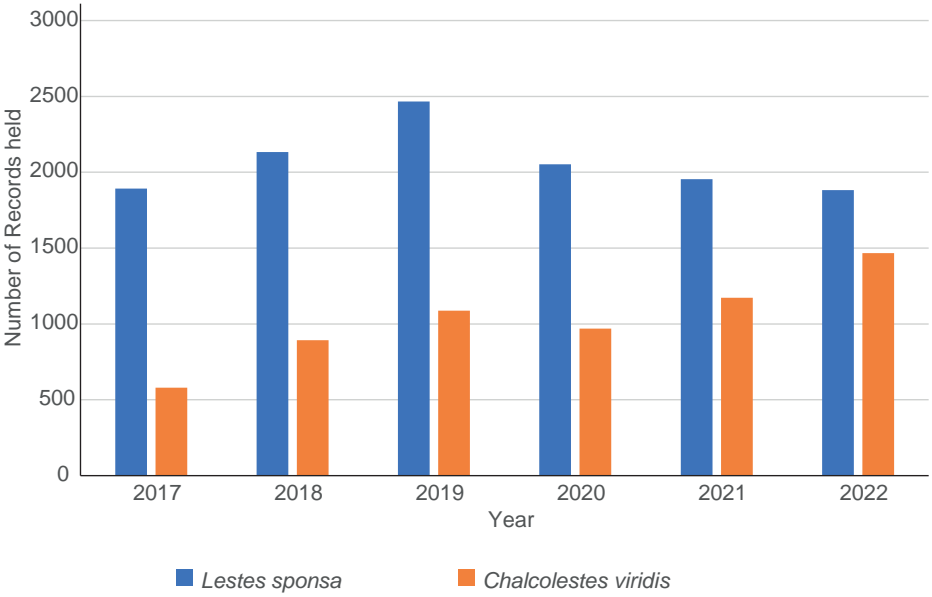


B

**Plate 4:** A) Heterogeneric tandem by a male *Lestes sponsa* with a male *Chalcolestes viridis*, already in-cop with a female *C. viridis*, observed for >1 hour, 15 August 2023; B) Heterogeneric tandem of a male *L. sponsa* with a female *C. viridis*, 23 August 2019.



**Figure 1.** Highest counts of adult *Lestes sponsa* and *Chalcolestes viridis* from single visits since 2017.



**Figure 2.** Number of records held in the NBN gateway for *Lestes sponsa* and *Chalcolestes viridis*.

to adult emergence in June (*L. sponsa*) and July (*C. viridis*). Cham (2021) demonstrated that egg hatching in *C. viridis* occurs from mid-April, with adults emerging in late June through July. This agrees with observations of emergence at Finedon (Tyrrell, 2019b), where adults emerged from mid-July onwards. Brooks & Cham (2014) suggested the typical larval stage for *L. sponsa* is between 68 and 83 days, with a similar egg hatching date to *C. viridis* but with *C. viridis* emerging later (by about 28 days) and having a much slower larval development time (90-100 days) (Cham, 2021). Do they share the same larval sites and is there competition for food? Or do *C. viridis* larvae consume *L. sponsa* larvae? With the larvae of *L. sponsa* growing more rapidly, over a shorter time, it might be expected that they can outcompete the larvae of *C. viridis*, so these hypotheses may not be valid.

### **Flooding of submerged eggs**

Oviposition sites are very different, with *L. sponsa* ovipositing into marginal and emergent vegetation and *C. viridis* in overhanging Willow trees (among others) (Parr, 2016). By ovipositing high into trees, the eggs of *C. viridis* are protected from flooding. Cham (2021) established that submerged eggs are unable to hatch under water, a possibility suggested by Tyrrell (2019a) during a study of the visual appearance of egg scars from Willow branches that over-wintered above and below water. The study pond has been under observation for many years and very little has changed in terms of habitat quality. It is rain-fed and is prone to drying out in extreme, prolonged high temperatures. However, it is also highly susceptible to flooding overwinter as it sits in a depression and receives run off from surrounding fields during heavy rainfall. The author has visited the study pond many times in early spring and found it to be inaccessible due to winter flooding (Table 2). The study reported by Tyrrell (2019a) is one such recent event. Dolný *et al.* (2014) observed *L. sponsa* purposefully selecting to oviposit underwater, suggesting that eggs do survive submersion, while Harabiš *et al.* (2015) established that egg mortality decreased for eggs laid underwater, up to a depth of ~30cm, in areas of high parasitism, suggesting that submersion offers at least some protection to the eggs. However, at depths greater than 30cm, mortality began to increase again, suggesting that this is not an entirely safe mechanism for egg protection. In sites of low egg parasitism, egg mortality increased with depth, closely mirroring the high parasitism sites at depths above 30cm (Harabiš *et al.*, 2015). While this study did not record egg oviposition at greater than 40cm depth, the data suggest that there are factors that affect egg mortality underwater, such as reduced dissolved oxygen levels and greater water pressure (Miller, 1994). Flooding of the study pond would certainly lead to eggs overwintering at depths greater than 40cm (the limit of the Harabiš *et al.* (2015) study), so could these flooding events on a regular basis impact the emergence rate, with fewer eggs surviving through the main hatching period in

**Table 2:** Observations of the flooding or drying out of the pond at Finedon.

Year	Observation
2012	Dried out in early spring; flooded in April/May.
2013	Flooded April - June
2014	Flooded April - June; water appeared contaminated with run-off from surrounding fields
2015	No visit in spring
2016	Not recorded
2017	Not recorded
2018	Flooded April-May
2019	Dried out in early spring
2020	No spring visit due to COVID lockdown;
2021	Stable conditions through spring & summer
2022	Stable conditions through spring & summer
2023	Flooded in April-May

April? Could this also help explain the observed national decline?

### Mixed Pairings

Corbet (1999) discussed heterospecific tandems (pairings between individuals of different species in the same genus) and heterogeneric tandems (pairings between individuals from different genera but in the same family). Although Corbet (1999) did not record *Lestes-Chalcolestes* mixed pairings, *Lestes* spp. are considered one of the few zygopterans that form such pairings. Male *Lestes sponsa* use body shape and colour as cues for detecting a female. Both male and female *Chalcolestes viridis* are similar in shape and colour to female *L. sponsa* and this could cause confusion. In the present study heterogeneric pairings have been observed between *L. sponsa* and *C. viridis*, both of the form Male-Male-Female (MMF) (using Corbet's nomenclature (Corbet, 1999)) (Plate 4A) and of the form Male-Female (MF) (Plate 4B). Corbet concluded that tandem pairings such as this must be disadvantageous to the individuals involved. This may result in reduced mating attempts by male *L. sponsa* with female *L. sponsa*, especially in low population densities, as they are distracted and confused by the increasing number of female *C. viridis*. This could result in fewer successful copulations and a decline in the population of *L. sponsa*.

## Dispersal & Extinctions

Dumont (1971) discussed observations that show how *L.sponsa* can suffer territorial competition from male *C. viridis*, with males being driven away when approaching the water close to the territory of *C. viridis*. While the traditional habitat for male *C. viridis* is trees, they are known to take up territory in marginal vegetation, particularly on windy days (Parr, 2016), where they will be found in the same territorial zone as male *L. sponsa*.

*Lestes sponsa* also has the habit of becoming extinct at a site through natural changes (such as population changes and natural habitat succession), as well as recolonisation, (Harabiš & Dolný, 2020). Natural successional changes can be a result of extreme vegetation growth reducing the amount of open water. Both *Sparganium erectum* and *Ceratophyllum demersum* have grown extensively over the last decade with one area of the pond now completely overgrown with *S. erectum* and areas of this plant have begun to expand in the main water body. *Ceratophyllum demersum* now covers a large area of the main water body which does not yet seem to be to the detriment of other odonate species. D'Amico *et al.*(2004) noted the influence of conductivity and pond vegetation on populations and drew attention to the significant impact of aquatic vegetation on *Lestes* spp., and, particularly, on *C. viridis*.

## Conclusions

The reasons for the decline in *Lestes sponsa* both at Finedon and nationally will be difficult to establish, and may indeed be due to a number of factors combining, or may be different at different sites. Further study of the interaction of *L.sponsa* and *C.viridis* at sites where they come into close contact is warranted to help understand the impact of new migratory species on the success of native ones.

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