



No. 11

**The Odonata Red Data List
for Great Britain**

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Line drawing: white-faced darter *Leucorrhinia dubia* © Helen Baker

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1. Introduction to the Series

This publication is one of a series set up under the auspices of the Species Status Assessment (SSA) programme established by JNCC in 1999. The programme aims to assess the status of all GB species against standard criteria based on the internationally accepted guidelines developed by the IUCN (see IUCN 2001).

A short history of Red Data Books

The Red Data Book system was initiated by the International Union for Conservation of Nature (IUCN) in 1966, with the publication of the first Mammal Red Data Book. Since then Red Data Books have been published that deal with many plants, fungi and animals at global, country and regional (and even local) scales. The aim has been to identify those species at greatest risk from extinction and to identify the critical factors responsible so that action may be taken to improve the chances of these species surviving in the long term. IUCN continues to publish Red Data Books of global scope and produces an annually updated Red List of all assessed taxa. The IUCN also revises and updates the criteria for assigning species to threat categories, the latest version of the guidelines was published by IUCN in 2001 (IUCN 2001). To help practitioners interpret the criteria at a sub-global level regional guidelines have also been produced (IUCN 2003).

In Britain the first published Red Data Book endorsed by the statutory conservation agency was by Perring and Farrell (1977) dealing with vascular plants, with a second edition following in 1983. The Red Data Book for insects edited by Shirt was published in 1987, with further volumes dealing with other animals and plants appearing thereafter. Only one volume has a combined treatment for Britain and Ireland together, namely that by Stewart and Church (1992) for Stoneworts. Red Data Books take considerable time and effort to compile and publish, with many volumes taking several years to complete.

Conservation assessments other than Red Data Listing for species in Britain

Conservation assessments that are broader in scope than the traditional Red Data Books have also been produced over the years. These assessments introduced additional, GB specific categories based on the geographical extent of a given species. For plant species known to occur in 100 or fewer 10 km squares (or hectads) the term Nationally Scarce was coined. For invertebrate species the synonymous term Nationally Notable was used. For some invertebrate taxa this category was further split in to Notable A for species occurring in 30 or fewer 10 km squares and Notable B for those occurring in 31 – 100 10 km squares.

Conservation assessments other than Red Data Books have been published in the form of National Reviews, which comprise data sheets for the included species, each with information about their biology, threats and conservation needs. These Reviews dealt with species assigned both to Red Data Book and to Nationally Scarce categories.

To avoid confusion the geographical extent category has now been standardised to Nationally Scarce, without further subdivision. This allows the GB system to be set in context alongside the IUCN criteria which themselves use some measure of geographical extent in making assessments.

An analogous system has been used for near-shore marine benthic species in GB (Sanderson 1996). Nationally Rare marine benthic species occur in eight or fewer 10 km x 10km grid squares, containing sea, within the three mile territorial limit. Nationally Scarce marine benthic species occur in nine to 55 such squares.

Species Status Assessment and conservation action

It is a sound principle that making good decisions to conserve species should, first, be based upon an objective process of determining the degree of threat to the survival of a species (by assigning the species to one of the IUCN threat categories). Furthermore, this assessment of threats to survival should be separate and distinct from the subsequent process of deciding which species require action and what activities and resources are to be allocated, if any. If this separation of assessing threats from allocating resources is not maintained, there is a real danger that assigning species to threat categories will be tainted and adversely affected by lobbying and special pleading to raise the threat category, and hence the conservation status, of species that are of particular interest to enthusiastic advocates for the taxa concerned.

Other factors that have been considered alongside IUCN threat category, when making decisions as to which species should be treated as priorities for conservation, action include: the likely chances of successful recovery being achieved, the cost of achieving recovery (and whether sources of funding are available or likely to be available), the benefits to other threatened species of a recovery programme, the fit of a recovery programme with other conservation activities (including conservation actions to be taken for habitats), the likely gains for the profile of conservation (publicity, media opportunities etc.), the relationship and fit between national and international obligations.

There have been global, regional and country scale assessments of extinction rates for species (see Lawton & May, 1995 and included references). Within Britain, the causes of extinction in recent decades have been habitat loss and change, with the fragmentation of many semi-natural biotopes and the growth of intensive agriculture and fishing causing declines and threatening the survival of many species. Other factors threatening biodiversity in Britain include lack of traditional management and the decline of low intensity farming practices, coupled with the spread of invasive non-native species, particularly in lowland habitats. The problems facing populations of species that occur in fragmented populations are reviewed by Young & Clarke (2000).

In summary, published species conservation assessments provide the solid basis from which conservation initiatives can be built.

The Species Status Assessment project

The SSA project was established by JNCC in 1999. The project is the means by which the statutory conservation agencies, in partnership with voluntary conservation organisations and leading specialists, assign conservation statuses to British species and regularly revise previous Red Data Books and National Reviews. By assessing all taxa to the same standards, comparisons between taxa and between geographic areas are made easier. Such an undertaking is not without difficulty: species that have different life spans, different ecological niches, different reproductive strategies etc. do not always lend themselves to easy comparisons.

The approach adopted by the Species Status Assessment project, endorsed by partner and participating organisations, is that conservation status assessments for species are assigned using agreed IUCN

Guidelines, adapted where necessary for use within the geographical extent of Great Britain. Part of the role includes establishing which taxa are considered native to GB at the time of assessment i.e. recognising that such categorisation may change over time. These species conservation assessments are prepared on the basis of the best available information for the group(s) concerned, although this will inevitably vary according to past and current levels of recording and study (typically by volunteer naturalists who are members of national recording schemes and specialist societies). The process therefore works to a rolling timetable. Some taxa are relatively data rich and can be assessed and re-assessed every three years or so, others require a much greater gap to allow sufficient data to build up and may only be assessed every 10 – 15 years.

One element of flexibility now built into the process is that if new information becomes available for one or a few species within a taxonomic group that will drastically change its conservation status, then it can be assessed and a new status assigned to take account of the new data. This is intended to be an emergency procedure and should not replace whole taxa assessments as such broader scale considerations reduce bias and give a more complete picture.

Assessments are produced as National Reviews or as Red Lists. Both styles of publication provide an audit trail of the assessment made, including details of the species included as well as the status list itself. National Reviews contain additional species specific information in the form of data sheets with summary information about the biology, distribution, status and known or perceived threats to the species. To enable assessments to reach as many practitioners as possible the texts are made freely available via the web and as published documents available at a low cost.

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2. Introduction to this Review

This report has been produced as part of the JNCC Species Status Assessment project, assigning conservation status to British flora and fauna using internationally-approved IUCN Red Data Book criteria and categories (JNCC, 2006). Within this project, the remit of the present report is to assess the status of Odonata throughout Great Britain, using the updated IUCN Red Data Book criteria and categories. The previous assessment of the conservation status of British Odonata using IUCN criteria and categories is in Shirt, 1987. This lists four species as Endangered, two as Vulnerable and three as Rare. Three of the Endangered species were regarded as extinct in Britain.

Over the last 20 years since the publication of the 1987 British Red Data list of Odonata (Shirt, 1987), improved recording, changes in the distribution of British Odonata and modifications to IUCN criteria and categories have meant that a review of the status of dragonflies and damselflies in Britain is now warranted. Specifically:

1. The recording of British Odonata has increased within the last 20 years (Figure 1). Targeted recording effort towards the publication of the Atlas of the dragonflies of Britain and Ireland (Merritt, *et al.*, 1996) led to improved understanding of the distribution of British Odonata species. The production of local atlases similarly led to a clearer perception of species status at the regional or county level.
2. The British Dragonfly Society (BDS), through its Odonata Recording Scheme and more recently Dragonfly Recording Network (DRN), has led various recording initiatives to further knowledge in the breeding status of rare British Odonata. Such initiatives included the Odonata Key Sites Project, launched in 1988 and the Rare Dragonfly project, which ran over five years between 1994 -1999.
3. The full-time employment of a Key Sites Project Officer (initially funded by Defra and the NBN Trust in 2005-06) enabled the collation into one database of all Odonata datasets held within the DRN and elsewhere, including local record centres. This collated dataset, currently holding 471,000 records in Recorder 2002, is now available through the NBN gateway (<http://www.searchnbn.net/>).
4. The distribution of a number of Odonata species has changed significantly over the past 20 years. A number of species have increased their range northwards, additional species have been found to regularly breed within Britain and others have lost populations at the edge of their range.
5. The IUCN Red List categories and criteria have undergone extensive review over the last 20 years. The current Version 3.1 was adopted by the IUCN Council in February 2000 (IUCN, 2001). This revised document has been accompanied by continually improved guidelines on the application of the IUCN criteria (IUCN, 2003; IUCN, 2005: IUCN Standards and Petitions Working Group 2006).

This report assesses the current status of British Odonata, using Version 3.1 of the IUCN Red List categories and criteria (IUCN, 2001). The current status of each species has been determined through the analysis of records held within the Dragonfly Recording Network (DRN), along with expert opinions from members of the British Dragonfly Society's Dragonfly Conservation Group (DCG). In qualifying the Odonata status determined by information held within the DRN database, it is hoped that a more appropriate assessment of each Odonata species may be made and current gaps in Odonata recording highlighted.

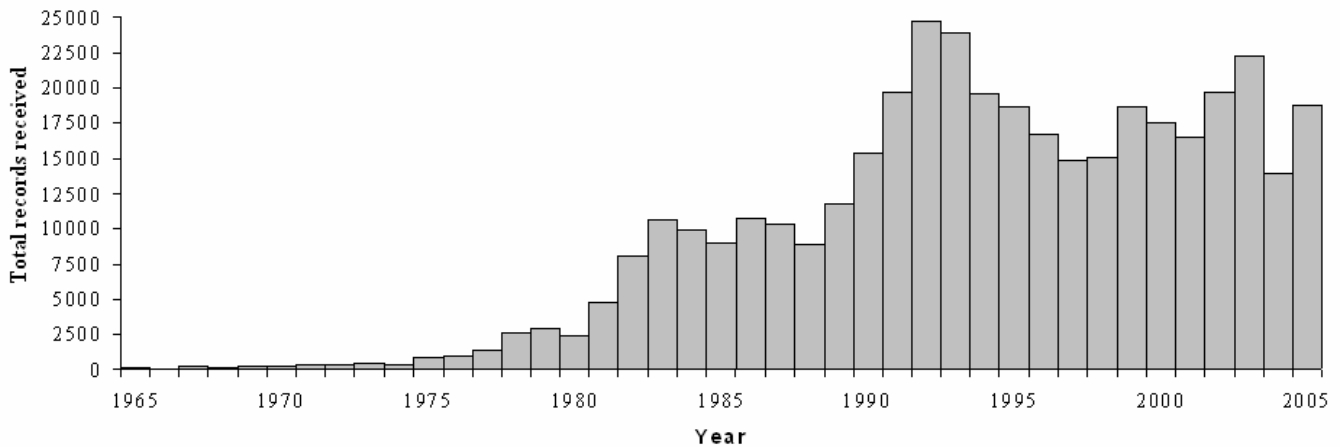


Figure 1: Number of records in the Dragonfly Recording Network database for each year since 1965.

3. Methods and sources of information

The records used in this review have been compiled over the last 20 years by the Dragonfly Recording Network (DRN). The chosen 20-year period allows the incorporation of a significant number of Odonata records (320,054 records out of the total 471,000 records held within the DRN) whilst still providing information on the current status of British Odonata. Records within the current year, 2006, were excluded due to their ongoing collection, computerisation, validation and collation. In order to assess current trends in British Odonata species, the 20-year time period (1986 – 2005) was split into two 10-year groups. Trends were then determined by comparison of records held within the earlier group, 1986 – 1995, with those held within the later group of 1996 – 2005. The number of records for each of these two 10-year groups was approximately equal (see Table 1).

In using the data held within the DRN database it must be acknowledged that this dataset does not provide a complete picture of the current distribution of British Odonata. Records are collected by volunteers who, on the whole, do not apply a systematic approach to their recording but rather a more “ad-hoc” one, often visiting and keeping notes of sites and species that are of interest to themselves. Odonata diversity is greater in southern England and less in northern England and Scotland. Sites and species in the south of Britain are generally covered better than those in northern areas, largely due to the greater number of recorders in the south.

The reasons for recording British Odonata have evolved over time and the changing patterns in recording effort are reflected in the current DRN database. Between 1986 and 1995, a significant amount of recording was targeted towards the production of a National Atlas (Merritt, *et al.*, 1996). This led to recording over a wide geographical area across Britain, including areas not normally visited. Following the production of the Atlas, recording in the second 10-year period, 1996 – 2006, lost this national goal, with recorders tending to focus towards the production of local atlases. These atlases were predominately produced in southern Britain (e.g. Taylor, 2003; Cham, 2004; Tyrell, 2006). Other factors that may have influenced Odonata recording behaviour include the increasing ease of record computerisation, availability of field identification guides (Brooks, 1999; Powell, 1999; Smallshire and Swash, 2004), the production of county Odonata websites and the increasing number of local record centres.

In addition to influencing British Odonata records as a whole, changing trends in recording have also affected particular species, such as *Aeshna isosceles* and *Coenagrion mercuriale*. Increased recording activity within Norfolk over the last ten years has provided a better picture of the distribution of *A. isosceles*; and following the inclusion of *C. mercuriale* in the UK Biodiversity Action Plan (UK Biodiversity Action Plan Steering Group, 1995), increased research (Purse, 2001; Thompson *et al.*, 2003; Thompson *et al.*, 2003; Rouquette, 2005) and surveys have led to a better understanding of its current distribution and status.

Despite the aforementioned limitations in the Odonata dataset, the information it holds has been informative in attributing IUCN categories to Odonata species in Britain. The analysis of the dataset, which led to a consensus on the appropriate category in which to place each species, was approached in two different ways:

1. **Area of Occupancy (AOO) analysis:** - The estimation of AOO for each species was performed at the tetrad (2km x 2km) spatial scale, as recommended in the IUCN guidelines (IUCN, 2005). Because most species were recorded at the tetrad or higher spatial level, all grid references were converted to tetrads prior to the analysis. This led to the exclusion of a small number of hectad (10km x 10km) records in each 10-year time period (Table 1). Records entered as year ranges that partly fell outside either time period were excluded. A higher number of tetrads were recorded in the earlier 10-year time period (1986 – 1995) than in the later 10-year time period (1996 – 2005) - see Table 1. This discrepancy is most likely the result of targeted recording for the National Atlas (Merritt *et al.*, 1996) during the earlier time period.

The status of each Odonata species was estimated by calculating the AOO during the later 10-year time period, 1996 – 2005, and comparing it with the AOO of the earlier 10 year time period, 1986 – 1995. Ideally each species' trend would have been estimated over the last 10-year period only, as recommended under IUCN guidelines (IUCN, 2005). However, limiting the time period to just 10 years resulted in insufficient data to reach meaningful conclusions, especially for the rarer and poorly-recorded species. Using the time period of three generations (IUCN, 2005), which for Odonata may be as small as three years, would have further reduced the information available on which to apply the IUCN criteria, and so was equally unsuitable.

Having agreed on the most suitable time periods for the analyses, an additional issue needed to be overcome: the comparison of AOOs, based on a differing numbers of tetrads recorded within each 10-year time period resulted in comparing mismatching tetrads. Even though this analysis allowed good coverage across Britain, the interpretation was perhaps difficult. In an attempt to standardise the comparison of AOOs across time periods, a second analysis was performed, only using tetrads that were recorded in both 10-year time periods (Table 1). This allowed for a better comparison of AOOs between time periods, but came at a cost of reduced information and poorer geographical coverage. The remaining 3,489 tetrads in this analysis came predominantly from southern and central England, with few tetrads represented in Scotland, Wales and northern England.

2. **Extent of Occurrence (EOO) analysis:**- The estimation of EOO was performed by fitting an alpha shape to each species distribution, calculated using hectads and adding up the areas of the resulting polygons, as recommended by IUCN guidelines (IUCN, 2005). Using macros incorporated within an Excel spreadsheet supplied by Dr Stuart Ball at JNCC, an alpha value of 1800 was chosen to produce

the best EOO for each species. The EOO was calculated for each 10-year time period and values were compared to estimate trends.

Table 1: Summary of AOO analysis statistics.

	1986 - 1995	1996 - 2005	All
Analysis 1: All recorded tetrads			
Total number of British records	165,591	154,463	320,054
Records excluded due to year unspecified	-2,530	-602	-3,132
Records only to hectad precision	-1,954	-394	-2,348
Total	161,107	153,467	314,574
Number of tetrads	10,077	7,444	14,032
Analysis 2: Recorded from tetrads in both time periods			
Number of British records	110,922	117,608	228,530
Number of tetrads	3,489	3,489	3,489

4. Criteria for including species in the review

IUCN criteria for the inclusion of species include those that have been determined as breeding, visiting, or regionally extinct species or as being taxonomically uncertain (IUCN, 2005). Out of the 56 Odonata species included in this report, 43 species fulfil one of these groups.

4.1. Breeding species (BR)

Thirty-nine Odonata species are classified as breeding in Britain. Evidence of breeding, as defined by the Dragonfly Conservation Group in 2003 (see Appendix 1) requires the observation of at least either copulating pairs, ovipositing females, larvae, exuviae or newly-emergent Odonata. Confirmation of long term breeding populations requires evidence for more than 10 years.

4.2. Visiting species (VI)

Species with no evidence of breeding may be included if their population is significant within the overall global population of the species (IUCN, 2005). No British Odonata taxon fulfils this criterion.

4.3. Regionally Extinct species (RE)

Three species, *Coenagrion scitulum*, *Coenagrion armatum* and *Oxygastra curtisii* have been known to breed in Britain but have not been recorded during the last 10 year time period, 1996 – 2005. The last observation of any of these three species in Britain was *Oxygastra curtisii* in 1963. As the British populations for these three species have been lost they all fulfil this Regionally Extinct category.

4.4. Taxonomic Uncertainty (TU)

There is taxonomic uncertainty over one British Odonata taxon, *Sympetrum nigrescens*. This species, known to have bred in Britain for more than the last 10 years, may represent a melanic form of *Sympetrum striolatum*. Uncertainty over its taxonomic status has led to variation in its recording over the past 20 years.

5. Species not included

IUCN criteria for exclusion include those species that have been determined as recent colonists, or vagrants (IUCN, 2005). Thirteen of the 56 Odonata species included in this report fall into one of these categories.

5.1. Recent colonists (RC)

Two species, *Anax parthenope* and *Erythromma viridulum*, have started breeding in Britain within the last 10 years. There is no recorded evidence of breeding prior to this. Under IUCN guidelines (IUCN, 2003), these two species are regarded as recent colonists and have not been evaluated under the IUCN Red List criteria.

5.2. Vagrants (VA)

Eleven Odonata species are vagrants to Britain, occurring irregularly with no evidence of breeding in the last 10 years. As these occurrences do not represent significant populations within the global population of any of the species, none of them may be classified under visiting species (see section 3.2.). IUCN criteria are not applicable to any of these 11 vagrant species (IUCN, 2003).

6. Criteria used for assigning species to threat categories

British Odonata were previously classified under three threat categories (Shirt, 1987): Endangered, Vulnerable and Rare. Since then the IUCN Red List categories have been revised and extensively modified over the last 20 years. This report uses the categories as defined in the latest IUCN Red List categories and criteria, Version 3.1 (IUCN, 2001). A brief outline of the categories is given below, but it is important that for a fuller description the IUCN Red List categories and criteria (IUCN, 2001) are consulted.

The definition of the categories is given in Box 1 and the hierarchical relationship of the categories in Figure 2. Location and severely fragmented populations are defined in Box 2 (after IUCN, 2001). Applying Red List criteria to British Odonata means that the global populations of the 56 Odonata species have not been fully assessed. To take into account the fact that only a part of the global population has been assessed for each species, the categories Extinct (EX) and Extinct in the wild (EW) are replaced by the Regionally Extinct (RE) category (IUCN, 2003).

Box 1: Definitions of IUCN categories (IUCN, 2001) including Regionally Extinct category (IUCN, 2003)

REGIONALLY EXTINCT (RE)

Category for a taxon when there is no reasonable doubt that the last individual potentially capable of reproduction within the region has died or has disappeared from the wild in the region, or when, if it is a former visiting taxon, the last individual has died or disappeared in the wild from the region. The setting of any time limit for listing under RE is left to the discretion of the regional Red List authority, but should not normally pre-date 1500 AD.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section 6.1.1.), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section 6.1.2.), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section 6.1.3.), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for, or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is of Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

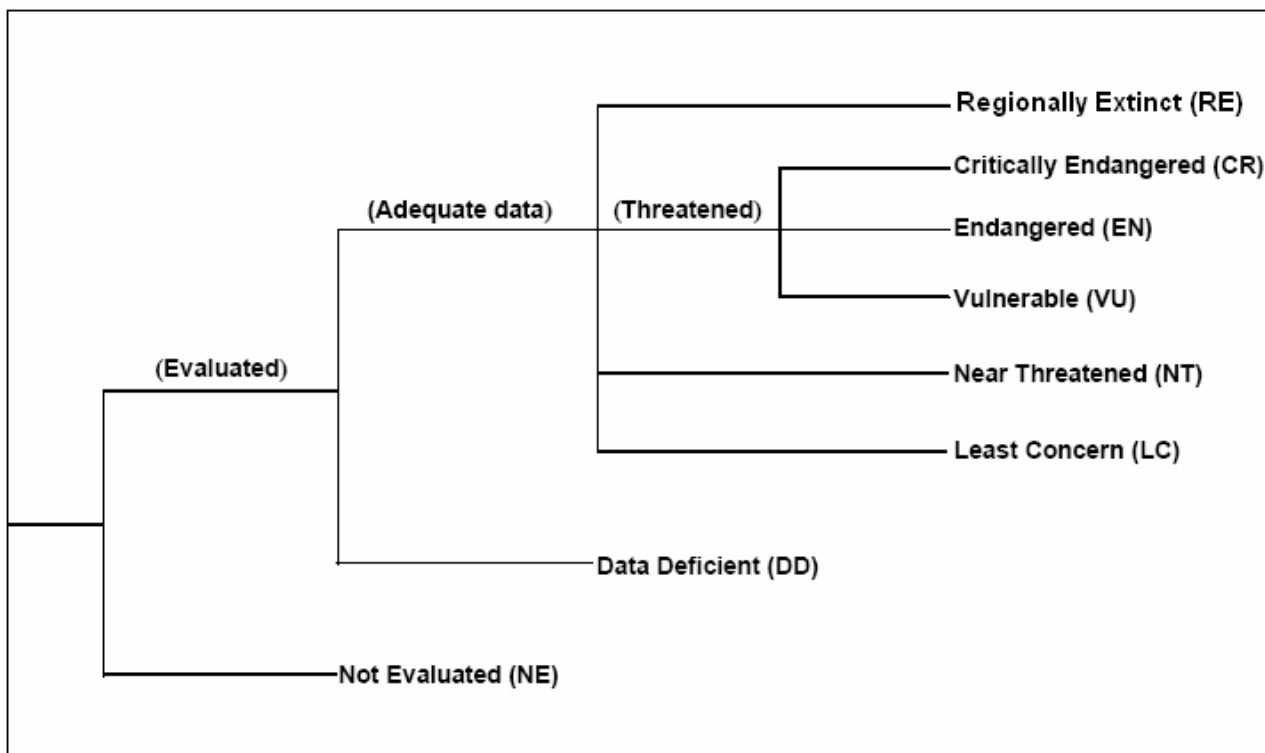


Figure 2. Hierarchical relationship of IUCN Red List categories, adapted from IUCN (2001). Extinct (EX) and Extinct in the wild (EW) are replaced by Regionally Extinct (RE) (IUCN, 2003).

Box 2: Definition of location and severely fragmented populations (IUCN, 2001).

Location defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat.

Severely fragmented refers to the situation in which increased extinction risk to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonization.

6.1. IUCN Red List Criteria

The revised IUCN criteria have been designed for global application and for a wide range of organisms. Not all the criteria are applicable to reviewing the threat status of British Odonata. Listed below are the IUCN threat categories, Critically Endangered, Endangered and Vulnerable, with those applicable to British Odonata highlighted in bold. A summary of these threat criteria as applied to British Odonata is given in Table 2.

6.1.1. Critically Endangered (CR)

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of $\geq 90\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
 - (a) **direct observation**
 - (b) an index of abundance appropriate to the taxon
 - (c) **a decline in area of occupancy, extent of occurrence and/or quality of habitat**
 - (d) actual or potential levels of exploitation
 - (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. **An observed, estimated, inferred or suspected population size reduction of $\geq 80\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.**
3. A population size reduction of $\geq 80\%$, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of $\geq 80\%$ over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. **Extent of occurrence estimated to be less than 100 km², and estimates indicating at least two of a–c:**
 - a. Severely fragmented or known to exist at only a single location.
 - b. Continuing decline, observed, inferred or projected, in any of the following:**
 - (i) **extent of occurrence**
 - (ii) **area of occupancy**
 - (iii) **area, extent and/or quality of habitat**
 - (iv) **number of locations or subpopulations**
 - (v) number of mature individuals.
 - c. Extreme fluctuations in any of the following:**
 - (i) **extent of occurrence**
 - (ii) **area of occupancy**
 - (iii) **number of locations or subpopulations**
 - (iv) number of mature individuals.
2. **Area of occupancy estimated to be less than 10 km², and estimates indicating at least two of a–c:**
 - a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

- (i) extent of occurrence**
- (ii) area of occupancy**
- (iii) area, extent and/or quality of habitat**
- (iv) number of locations or subpopulations**
- (v) number of mature individuals.

c. Extreme fluctuations in any of the following:

- (i) extent of occurrence**
- (ii) area of occupancy**
- (iii) number of locations or subpopulations**
- (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
 - a. Population structure in the form of one of the following:
 - (i) no subpopulation estimated to contain more than 50 mature individuals, OR
 - (ii) at least 90% of mature individuals in one subpopulation.
 - b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

6.1.2. Endangered (EN)

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of $\geq 70\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
 - (a) direct observation**
 - (b) an index of abundance appropriate to the taxon
 - (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat**
 - (d) actual or potential levels of exploitation
 - (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. **An observed, estimated, inferred or suspected population size reduction of $\geq 50\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.**
3. A population size reduction of $\geq 50\%$, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of $\geq 50\%$ over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km², and estimates indicating at least two of a–c:

- a. Severely fragmented or known to exist at no more than five locations.
- b. Continuing decline, observed, inferred or projected, in any of the following:**
 - (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) area, extent and/or quality of habitat
 - (iv) number of locations or subpopulations
 - (v) number of mature individuals.
- c. Extreme fluctuations in any of the following:**
 - (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) number of locations or subpopulations
 - (iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km², and estimates indicating at least two of a–c:

- a. Severely fragmented or known to exist at no more than five locations.
- b. Continuing decline, observed, inferred or projected, in any of the following:**
 - (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) area, extent and/or quality of habitat
 - (iv) number of locations or subpopulations
 - (v) number of mature individuals.
- c. Extreme fluctuations in any of the following:**
 - (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) number of locations or subpopulations
 - (iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

- 1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR
- 2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):
 - a. Population structure in the form of one of the following:
 - (i) no subpopulation estimated to contain more than 250 mature individuals, OR
 - (ii) at least 95% of mature individuals in one subpopulation.
 - b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

6.1.3. Vulnerable (VU)

A. Reduction in population size based on any of the following:

- 1. An observed, estimated, inferred or suspected population size reduction of $\geq 50\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are:

clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of $\geq 30\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of $\geq 30\%$, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of $\geq 30\%$ over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km², and estimates indicating at least two of a–c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km², and estimates indicating at least two of a–c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

- 1. An estimated continuing decline of at least 10% within 10 years** or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR
- 2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a–b):**
 - a. Population structure in the form of one of the following:**
 - (i) no subpopulation estimated to contain more than 1000 mature individuals, OR**
 - (ii) all mature individuals are in one subpopulation.**
 - b. Extreme fluctuations in number of mature individuals.**

D. Population very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1000 mature individuals.
2. Population with a very restricted area of occupancy (typically less than 20 km²) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

6.1.4. Regional adjustments to categories

Species may be downgraded to a lower threat category where the British population is known to be regularly augmented from mainland European populations (Rescue Effect, RE), unless this immigration is expected to decrease in the future (IUCN, 2003).

The level of augmentation of populations from mainland European population is not known for most of British Odonata. However regular immigration in two out of the 39 breeding British Odonata is thought to be frequent enough to warrant their downgrading from threat categories. These two species are *Sympetrum flaveolum* and *Sympetrum fonscolombii*.

Table 2. Summary of threat categories as applied to Odonata in Britain. Table modified from IUCN Standards and Petitions Working Group (2006).

Use any of the criteria A,B,C	Critically Endangered	Endangered	Vulnerable
A. Population reduction Declines measured by comparing 1996 – 2005 10-year time period, to 1986 – 1995 10-year time period			
A2	> 80%	>50%	>30%
A2. Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible, based on (a) direct observation (c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality			
B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy)			
B1. Either extent of occurrence	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. or area of occupancy	< 10 km ² (2.5 tetrads)	< 500 km ² (125 tetrads)	< 2,000 km ² (500 tetrads)
and 2 of the following 3:			
(a) severely fragmented or number of locations =	1	2-5	6-10
(b) continuing decline in (i) extent of occurrence (ii) area of occupancy, (iii) area, extent and/or quality of habitat, (iv) number of locations or subpopulations.			
(c) extreme fluctuations in any of (i) extent of occurrence, (ii) area of occupancy, (iii) number of locations or subpopulations.			
C. Small population size and decline			
Number of mature individuals and either C1 or C2			< 10,000
C1. An estimated continuing decline of at least			10% in 10 years
C2. A continuing decline and (a) and/or (b)			
(a i) number of mature individuals in largest subpopulation			<1,000
(a ii) or % mature individuals in one subpopulation =			100%
(b) extreme fluctuations in the number of mature individuals			

7. Criteria used for assigning species to non-threat categories

7.1. IUCN Red List Criteria

IUCN Red Data List categories (IUCN, 2001) include ones where the threat is perceived to fall outside the three threat categories. These non-threat categories are Near Threatened, Least Concern and Regionally Extinct (Figure 2). Listed below are the criteria for these categories, with those highlighted in bold applicable to British Odonata.

7.1.1. Near Threatened (NT)

- 1. A taxon is Near Threatened when the best available evidence indicates it does not qualify for any of the threatened categories but is close to qualifying or likely to qualify for a threatened category in the near future (IUCN, 2005).**
2. A taxon is Near Threatened if it is the focus of a continuing taxon or habitat specific conservation programme targeted towards that taxon (conservation dependent), and if cessation of which would result in the taxon qualifying for one of the threatened categories within the next 5 years (IUCN, 2005)

7.1.2. Least Concern (LC)

Taxa that have been evaluated against IUCN criteria but do not qualify for threatened categories or Near Threatened categories.

7.1.3. Regionally Extinct (RE)

Category for a taxon when there is no reasonable doubt that the last individual potentially capable of reproduction within the region has died or has disappeared from the wild in the region, or when, if it is a former visiting taxon, the last individual has died or disappeared in the wild from the region. The setting of any time limit for listing under RE is left to the discretion of the regional Red List authority, but should not normally pre-date 1500 AD.

8. Criteria used for assigning species to remaining categories

8.1. IUCN Red List Criteria

In addition to the threat and non-threat categories listed above, a further three categories are defined within the IUCN Red Data List (IUCN, 2001). These three are Data Deficient, Not Applicable and Not Evaluated. Below are listed the criteria for these categories.

8.1.1. Data Deficient (DD)

Species where there is insufficient information to make direct or indirect assessment of its risk of extinction, based on its distribution and/or population status. In the case of Odonata this was applied to taxa where there is taxonomic uncertainty regarding species status.

8.1.2. Not Applicable (NA)

Species not qualifying for evaluation against IUCN criteria as they are vagrant species (IUCN, 2003).

8.1.3. Not Evaluated (NE)

Species not qualifying for evaluation against IUCN criteria as they are recent colonists, as defined in section 4.1.

9. Odonata Red Data List

Taxon name	Inclusion	AOO Analysis 1 using all tetrads		AOO Analysis 2 only using tetrads recorded in both time periods		EOO Analysis		Endangered			Vulnerable			NT	Rescue Effect	Notes
		1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (km ²)	1996 - 2005 (km ²)	A2 Criteria	B1 Criteria	B2 Criteria	A2 Criteria	B1 Criteria	B2 Criteria	C Criteria		
REGIONALLY EXTINCT (RE)																
<i>Coenagrion scitulum</i>	RE															Extinct in Britain since 1953 (1956 in Guernsey).
<i>Coenagrion armatum</i>	RE															Extinct in Britain since 1958.
<i>Oxygastra curtisii</i>	RE															Extinct in Britain since 1963
CRITICALLY ENDANGERED (CR)																
ENDANGERED (EN)																
<i>Coenagrion mercuriale</i>	BR	52	84	48	76	2450	3350		B1a, B1b, iii,iv	B2a, B2b, iii,iv						Increase attributed to recording effort. Qualifies under B1a and B2a due to declining severely fragmented populations.
<i>Coenagrion hastulatum</i>	BR	23	14	15	10	1900	1800		B1a, B1b, i,ii	B2a, B2b, i,ii						Qualifies under B1a and B2a as occurs in < 5 locations.
<i>Aeshna isosceles</i>	BR	35	63	29	43	1400	1300		B1a, B1b, iii,iv	B2a, B2b, iii,iv						Whole population in < 5 locations in Norfolk and Suffolk, predicted decline from loss of habitat due to future sea rise.
<i>Leucorrhinia dubia</i>	BR	64	41	32	30	10300	8700			B2a,						Qualifies under B2a due to

Taxon name	Inclusion	AOO Analysis 1 using all tetrads		AOO Analysis 2 only using tetrads recorded in both time periods		EOO Analysis		Endangered			Vulnerable			NT	Rescue Effect	Notes
		1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (km ²)	1996 - 2005 (km ²)	A2 Criteria	B1 Criteria	B2 Criteria	A2 Criteria	B1 Criteria	B2 Criteria	C Criteria		
																declining severely fragmented populations.
VULNERABLE (VU)																
<i>Aeshna caerulea</i>	BR	67	42	22	18	9950	6900				B1a, B1b i,ii	B2a, B2b, i,ii				Qualifies under B1a and B2a as present in more than 5 but less than 10 locations.
<i>Somatochlora metallica</i>	BR	127	65	69	60	4000	2750				B1a, B1b i,ii	B2a, B2b, i,ii				Qualifies under B1a and B2a as occurs in less than 10 locations.
NEAR THREATENED (NT)																
<i>Lestes dryas</i>	BR	44	29	17	17	2850	2950							1		Not qualifying for EN or VU as in more than 10 locations.
<i>Ischnura pumilio</i>	BR	178	117	105	92	25950	# 8750							1		Not qualifying for EN or VU as in more than 10 locations.
<i>Coenagrion pulchellum</i>	BR	196	109	93	89	27050	# 44450							1		Not qualifying for EN or VU as in more than 10 locations.
<i>Somatochlora arctica</i>	BR	45	54	23	23	9300	16400							1		Not qualifying for EN or VU as in more than 10 locations
<i>Libellula fulva</i>	BR	83	74	41	50	3000	11650							1		Rare species with slow rate of increase although locally abundant so precautionary principle used.
<i>Gomphus vulgatissimus</i>	BR	173	141	99	88	11550	16850							1		Not qualifying for EN or VU as in more than 10 locations.
LEAST CONCERN (LC)																
<i>Calopteryx virgo</i>	BR	908	676	351	401	82550	78000									
<i>Calopteryx splendens</i>	BR	1795	2002	937	1176	123450	122500									

Taxon name	Inclusion	AOO Analysis 1 using all tetrads		AOO Analysis 2 only using tetrads recorded in both time periods		EOO Analysis		Endangered			Vulnerable			NT		Rescue Effect	Notes
		1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (km ²)	1996 - 2005 (km ²)	A2 Criteria	B1 Criteria	B2 Criteria	A2 Criteria	B1 Criteria	B2 Criteria	C Criteria	Criteria		
<i>Lestes sponsa</i>	BR	1923	1443	937	881	233750	237400										
<i>Platycnemis pennipes</i>	BR	516	575	285	363	56150	52050										
<i>Pyrrhosoma nymphula</i>	BR	3641	2681	1441	1537	254450	250600										
<i>Ischnura elegans</i>	BR	5080	3557	2145	2030	256100	262150										
<i>Enallagma cyathigerum</i>	BR	4455	3151	1896	1827	255550	253950										
<i>Coenagrion puella</i>	BR	3413	2639	1526	1571	186350	174700										
<i>Erythromma najas</i>	BR	768	857	438	624	75250	81100										
<i>Ceriagrion tenellum</i>	BR	176	188	141	165	14550	# 3850										Does not qualify for VU as increasing trend according to data and DCG opinion.
<i>Brachytron pratense</i>	BR	352	356	173	281	91050	70450										Does not qualify for VU as increasing trend according to data and DCG opinion.
<i>Aeshna juncea</i>	BR	1445	1105	594	545	221300	196650										
<i>Aeshna grandis</i>	BR	2457	1975	1233	1216	105750	99450										
<i>Aeshna cyanea</i>	BR	2232	2145	1129	1256	148350	144700										
<i>Aeshna mixta</i>	BR	1388	1751	706	1108	119950	136450										
<i>Anax imperator</i>	BR	1711	1992	870	1252	135950	149750										
<i>Cordulegaster boltonii</i>	BR	1500	918	544	532	141650	132300										
<i>Cordulia aenea</i>	BR	256	188	164	170	26950	23650										Does not qualify for VU as increasing trend according to AOO analysis 2 and DCG opinion
<i>Libellula depressa</i>	BR	1600	1507	823	960	125050	139500										

Taxon name	Inclusion	AOO Analysis 1 using all tetrads		AOO Analysis 2 only using tetrads recorded in both time periods		EOO Analysis		Endangered			Vulnerable			NT		Rescue Effect	Notes
		1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (km ²)	1996 - 2005 (km ²)	A2 Criteria	B1 Criteria	B2 Criteria	A2 Criteria	B1 Criteria	B2 Criteria	C Criteria	Criteria		
<i>Libellula quadrimaculata</i>	BR	1582	1443	798	954	234600	227200										
<i>Orthetrum cancellatum</i>	BR	1013	1289	562	870	97600	117650										
<i>Orthetrum coerulescens</i>	BR	384	326	257	247	47500	54600										Does not qualify for VU as stable trend according to DCG opinion.
<i>Sympetrum striolatum</i>	BR	3693	3448	1680	1922	234050	255450										
<i>Sympetrum fonscolombii</i>	BR	22	158	20	90	4050	97650									Y	Downgraded due to Rescue Effect
<i>Sympetrum flaveolum</i>	BR	137	70	108	52	51150	17900									Y	Downgraded due to Rescue Effect
<i>Sympetrum danae</i>	BR	859	714	404	424	197500	204350										
<i>Sympetrum sanguineum</i>	BR	1080	1318	564	860	109400	134450										
DATA DEFICIENT (DD)																	
<i>Sympetrum nigrescens</i>	TU	58	7	11	4	9450	0										Taxonomically uncertain
NOT APPLICABLE (NA)																	
<i>Lestes barbarus</i>	VA																
<i>Lestes viridis</i>	VA																
<i>Gomphus flavipes</i>	VA																
<i>Aeshna affinis</i>	VA																
<i>Anax junius</i>	VA																
<i>Hemianax ephippiger</i>	VA																
<i>Crocothemis erythraea</i>	VA																
<i>Sympetrum vulgatum</i>	VA																

Taxon name	Inclusion	AOO Analysis 1 using all tetrads		AOO Analysis 2 only using tetrads recorded in both time periods		EOO Analysis		Endangered			Vulnerable			NT	Rescue Effect	Notes
		1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (tetrads)	1996 - 2005 (tetrads)	1986 - 1995 (km ²)	1996 - 2005 (km ²)	A2 Criteria	B1 Criteria	B2 Criteria	A2 Criteria	B1 Criteria	B2 Criteria	C Criteria		
<i>Sympetrum pedemontanum</i>	VA															
<i>Pantala flavescens</i>	VA															
<i>Pachydiplax longipennis</i>	VA															
NOT EVALUATED (NE)																
<i>Erythromma viridulum</i>	RC															Colonisation within last 10 years
<i>Anax parthenope</i>	RC	0	53	0	36	0	9300									First recorded breeding in Cornwall, 1999 (Jones S.P. (2000)).

BR = Breeding, RE = Regionally Extinct, TU = Taxonomical Uncertainty, VA = Vagrants, RC = Recent Colonists, UK = UK species

AOO (Area of occupancy). Analysis 1 performed on all tetrads recorded in either time period

AOO (Area of occupancy). Analysis 2 performed on tetrads recorded in both time periods

EOO = Extent of Occurrence

= erroneous result from EOO analysis

Y = Yes

10. Additional information on species in IUCN Threat Categories

The following table is extracted from Appendix 2 (Summary of Odonata Red Data List):

Species	IUCN Threat Category	Previous status in Shirt, 1987	For more information on the species
<i>Coenagrion mercuriale</i>	EN•	Category 3 - Rare	www.dragonflysoc.org.uk/comer.htm
<i>Coenagrion hastulatum</i>	EN•	Category 2 - Vulnerable	www.dragonflysoc.org.uk/cohas.htm
<i>Aeshna isosceles</i>	EN•	Category 1 - Endangered	www.dragonflysoc.org.uk/mffanisofull.htm
<i>Leucorrhinia dubia</i>	EN	not listed	www.dragonflysoc.org.uk/mffledubfull.htm
<i>Aeshna caerulea</i>	VU	not listed	www.dragonflysoc.org.uk/aecae.htm
<i>Somatochlora metallica</i>	VU	not listed	www.dragonflysoc.org.uk/mffsometfull.htm
<i>Lestes dryas</i>	NT•	Category 2 - Vulnerable	www.dragonflysoc.org.uk/mffledryfull.htm
<i>Ischnura pumilio</i>	NT	not listed	www.drgaonflysoc.org.uk/mffispumfull.htm
<i>Coenagrion pulchellum</i>	NT	not listed	www.dragonflysoc.org.uk/copul.htm
<i>Somatochlora arctica</i>	NT•	Category 3 - Rare	www.dragonflysoc.org.uk/soarc.htm
<i>Libellula fulva</i>	NT•	Category 3 - Rare	www.dragonflysoc.org.uk/mffliflfulfull.htm
<i>Gomphus vulgatissimus</i>	NT	not listed	www.dragonflysoc.org.uk/govul.htm

• species listed in previous Red Data list (Shirt, 1987).

Coenagrion mercuriale (EN)

The result of the analyses in section 8 appears to show an increase in this species' distribution in Britain. However, because *C. mercuriale* was listed on the UK BAP in 1995, there has been a tremendous increase in recording effort over the last ten years, including data collection for two PhDs, and an extensive assessment of its condition status on Sites of Special Scientific Interest (SSSIs) in England and Wales. It is the DCG's opinion that the increase in distribution shown in the above data analyses reflects the increase in recording effort, rather than the actual trend of this species, which has disappeared from at least five sites in Britain since 1985 (Purse, 2001), including the St David's Peninsula in West Wales, and four sites in the New Forest. This species is known to be a weak flier and poor disperser, with mature adults moving less than 50 metres in their lifetime (Purse *et al.*, 2003). The limited movement between populations is supported by molecular research (Watts *et al.* 2004), showing significant genetic isolation among UK populations. *C. mercuriale* is undergoing observed continued decline and shows a severely fragmented population in Britain, thus qualifying under Endangered criteria B1a, B1biii, B1biv and B2a, B2biii, B2biv.

Coenagrion hastulatum (EN)

This species is undergoing observed decline. It only occurs in four British locations, all in Scotland, and qualifies under Endangered criteria B1a, B1bi, B1bii and B2a, B2bi, B2ii. As with all Scottish specialist species, there is a lack of consistent recording for the remote parts of its distribution; this will need to be addressed before the next review of the Odonata Red Data List can take place.

Aeshna isosceles (EN)

The result of the analyses in section 8 shows an increase in this species' distribution in Britain. However, owing to the historically Endangered status of this dragonfly (Shirt, 1987), particular attention has been paid to recording it in the Broads. It is the DCG's opinion that the rate of

expansion in its distribution, as shown in the data analyses mainly reflects an increase in recording efforts. The species is facing a projected decline linked to a serious risk of extinction in Britain as a result of habitat loss. The expected sea level rise, itself a consequence of climate change and global warming, combined with Defra's policies on coastal re-alignment and guidance on Shoreline Management Plans (Defra, 2005; Defra, 2006) are anticipated to have serious adverse effects on the freshwater habitats of the Norfolk Broads and the coastline of East Anglia, on which this species entirely depends. This species therefore qualifies under Endangered criteria B1a, B1biii, B1biv and B2a, B2biii, B2biv.

***Leucorrhinia dubia* (EN)**

In the last ten years, this species has disappeared from Surrey, its most southern location in Britain, possibly due to a combination of habitat loss and increasing temperatures resulting from climate change. In addition it has also disappeared from Cheshire in the last five years. *L. dubia* is undergoing an observed decline and has a northerly, severely fragmented population, thus qualifying under Endangered criteria B2a, B2bi, B2bii, B2biv.

***Aeshna caerulea* (VU)**

This species, undergoing inferred decline, only occurs in seven British locations, all in Scotland and qualifies under Vulnerable criteria B1a, B1bi, B1bii and B2a, B2bi, B2bii. As with all Scottish specialist species, there is a lack of consistent recording throughout its distribution; this will need to be addressed before the next review of the Odonata Red Data List can take place.

***Somatochlora metallica* (VU)**

This species, undergoing inferred decline, only occurs in two distinct geographical areas of Britain, the main one in Scotland and the other in South-east England, altogether adding up to less than 10 locations. There is a particular lack of consistent recording at the species' Scottish locations. It qualifies under Vulnerable criteria B1a, B1bi, B1bii and B2a, B2bi, B2bii.

***Lestes dryas* (NT)**

In Shirt (1987) this species was listed as Vulnerable (Category 2). This is still a rare species, occurring in less than 50 hectads (10-km squares) in Britain. It is however found in more than 10 locations, thus not qualifying in the Endangered category. The status of this species is uncertain. Some of this species' locations are coastal and subject to threats linked to the expected sea level rise. Furthermore, as it is thought to be undergoing a small decline, the DCG favours a cautious approach, listing it in the Near Threatened category.

***Ischnura pumilio* (NT)**

This species has recently undergone a significant decline in its distribution, having for instance disappeared from East Anglia in the last three years. It does however occur in more than 10 locations in Britain, thus not qualifying in any of the threat categories. The DCG decided to list it in Near Threatened, with the recommendation that it should be closely monitored throughout its range.

***Coenagrion pulchellum* (NT)**

It is uncertain whether the analyses in section 8 are an accurate reflection of the rate of decline in this species' distribution. *C. pulchellum* could be overlooked by recorders. Nevertheless, the DCG considered it likely that it was declining, and agreed on the precautionary approach to list it in Near Threatened.

***Somatochlora arctica* (NT)**

In Shirt (1987) this species was listed as Vulnerable (Category 2). Its current status is uncertain. It is a rare species occurring in just over 50 hectads (10-km squares), all in Scotland. It is the DCG's opinion that *S. arctica* should be closely monitored throughout its range, and that particular

attention should be paid to the effects of climate change and global warming on its distribution and should be listed in the Near Threatened category.

***Libellula fulva* (NT)**

In Shirt (1987) this species was listed as Vulnerable (Category 2). This rare species appears to have undergone a very slow rate of increase in recent years, although locally abundant, so that the DCG agreed on the precautionary approach to list it in Near Threatened.

***Gomphus vulgatissimus* (NT)**

This species' strongholds are on the large, slow-flowing rivers of England and Wales. A significant population decline has been observed along the rivers Severn and Arun in the last 7 years. This species does not qualify for the IUCN threat categories, but it is the DCG's opinion that its status is of concern and should be investigated further, hence its placing in Near Threatened.

11. Recommendations and the future of Odonata records

The Odonata Red List (see section 8 above) was established using the latest available update of the DRN database, combined with the best, current knowledge of experts in the DRN and DCG.

Particular attention needs to be paid to the twelve Odonata species listed in the threat categories, and to *Sympetrum nigrescens* (Data Deficient). These species need to be closely monitored to ascertain their status and / or follow their trend over the next few years, working on the next revision of the Odonata Red Data List.

A possible way to go about regular, systematic monitoring would be to concentrate on Key Sites for Dragonflies. Dr Graham French, Key Site Project Officer for the British Dragonfly Society worked closely with members of the DCG to establish a way of determining such Key Sites. The DCG-approved criteria were placed on the BDS website in 2006, together with instructions on how to apply them.

The *Dragonflies in Focus* project¹, proposed to run from 2007-2013, aims to achieve a long-term, sustainable programme of volunteer recording activities, to provide better quality information on dragonflies and their aquatic environment. This programme is also intended to build on the base-work already in place with regards to establishing and monitoring a network of Key Sites across the UK.

A major product of the *Dragonflies in Focus* project is intended to be a new, revised Atlas of UK Dragonflies in 2013. It is therefore recommended that the present Odonata Red list for Great Britain should be reviewed at that time, as a significant amount of valuable data will have been gathered and analysed for the production of the National Atlas.

For more information on any dragonfly-related subject, including Key Sites, please visit the BDS website at www.dragonflysoc.org.uk

For more information on British Odonata species, with regards to:

- Habitat management – Management Fact Files (MFFs) are available on the BDS website at www.dragonflysoc.org.uk, by selecting “UK Species” and choosing the species of

¹ The *Dragonflies in Focus* project proposal is available on request from the BDS Conservation Officer, c/o Natural England (West Midlands), Attingham Park, Shrewsbury, Shropshire, SY4 4TW.

interest. Please note that more MFFs are due to be added to the seven currently posted on the website, and existing ones are regularly reviewed and updated.

- Identification – a number of excellent books are available, including: Dijkstra & Lewington (2006), Smallshire & Swash (2004), Brooks & Lewington, (1999), Powell, (1999) and Hammond (1983).
- Biology and ecology – the most comprehensive publication on Odonata worldwide was written by Corbet (1999).

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13. Appendix 1: Odonata breeding criteria

As defined and agreed by the BDS's Dragonfly Conservation Group in March 2004

- **Successful Breeding**
 - **Confirmed** - exuvia present (presence of an exuvia constitutes absolute proof that at least one specimen has completed a cycle from egg to adult at the site).
 - **Probable Breeding** - larva present or female ovipositing or teneral (newly emerged adult) or regular presence of both sexes (normally annual presence in reasonable numbers or a repeated period consistent with the species' life-cycle length). All records to be at, or adjacent to, a suitable water body.
- **Possible Breeding** – pair copulating or female seen at a water body suitable for the species where at least one male has been observed to be engaged in some form of reproductive behaviour, such as territoriality or pursuing females.
- **Adult(s) Present**, but none of the above breeding evidence or behaviour observed.

Note: - Care should be taken with breeding records at water bodies less than 1 year old, especially those newly created with imported weed that might contain larvae.

For outside agencies seeking 'Proof of Breeding' everything in Confirmed and Probable Breeding would be included under a simplified heading of 'Breeding'.

In Probable Breeding, the “repeated period consistent with species' life-cycle length” will be different for different species. For example in bivoltine species there will be two 'repeats' per year, but for semivoltine species the repeated time span will be two years, and so forth for other species.

The Adult(s) Present category is included to tie in with the established recording scheme and to provide a place to put all those records that fail to meet the criteria for Breeding, but which may contribute to that evidence in the future.

14. Appendix 2: Summary of Odonata Red List

Species	IUCN Category	Previous status in Shirt, 1987	For more information on the species
<i>Coenagrion scitulum</i>	RE•	Category 1 – Endangered +	www.dragonflysoc.org.uk/cosci.htm
<i>Coenagrion armatum</i>	RE•	Category 1 – Endangered +	www.dragonflysoc.org.uk/coarm.htm
<i>Oxygastra curtisii</i>	RE•	Category 1 – Endangered +	www.dragonflysoc.org.uk/oxcur.htm

Species	IUCN Threat Category	Previous status in Shirt, 1987	For more information on the species
<i>Coenagrion mercuriale</i>	EN•	Category 3 - Rare	www.dragonflysoc.org.uk/comer.htm
<i>Coenagrion hastulatum</i>	EN•	Category 2 - Vulnerable	www.dragonflysoc.org.uk/cohas.htm
<i>Aeshna isosceles</i>	EN•	Category 1 - Endangered	www.dragonflysoc.org.uk/mffanisofull.htm
<i>Leucorrhinia dubia</i>	EN	not listed	www.dragonflysoc.org.uk/mffledubfull.htm
<i>Aeshna caerulea</i>	VU	not listed	www.dragonflysoc.org.uk/aecae.htm
<i>Somatochlora metallica</i>	VU	not listed	www.dragonflysoc.org.uk/mffsometfull.htm
<i>Lestes dryas</i>	NT•	Category 2 - Vulnerable	www.dragonflysoc.org.uk/mffledryfull.htm
<i>Ischnura pumilio</i>	NT	not listed	www.dragonflysoc.org.uk/mffispumfull.htm
<i>Coenagrion pulchellum</i>	NT	not listed	www.dragonflysoc.org.uk/copul.htm
<i>Somatochlora arctica</i>	NT•	Category 3 - Rare	www.dragonflysoc.org.uk/soarc.htm
<i>Libellula fulva</i>	NT•	Category 3 - Rare	www.dragonflysoc.org.uk/mffliflfull.htm
<i>Gomphus vulgatissimus</i>	NT	not listed	www.dragonflysoc.org.uk/govul.htm

Species	IUCN Category	Previous status in Shirt, 1987	Fore more information on the species
<i>Sympetrum nigrescens</i>	DD	not listed	www.dragonflysoc.org.uk/synig.htm

Species	IUCN Non-Threat Category	Previous status in Shirt, 1987	Fore more information on the species
<i>Calopteryx virgo</i>	LC	not listed	www.dragonflysoc.org.uk/cavir.htm
<i>Calopteryx splendens</i>	LC	not listed	www.dragonflysoc.org.uk/caspl.htm
<i>Lestes sponsa</i>	LC	not listed	www.dragonflysoc.org.uk/lespo.htm
<i>Platycnemis pennipes</i>	LC	not listed	www.dragonflysoc.org.uk/plpen.htm
<i>Pyrrhosoma nymphula</i>	LC	not listed	www.dragonflysoc.org.uk/pynym.htm
<i>Ischnura elegans</i>	LC	not listed	www.dragonflysoc.org.uk/isele.htm

Species	IUCN Non-Threat Category	Previous status in Shirt, 1987	Fore more information on the species
<i>Enallagma cyathigerum</i>	LC	not listed	www.dragonflysoc.org.uk/encya.htm
<i>Coenagrion puella</i>	LC	not listed	www.dragonflysoc.org.uk/copue.htm
<i>Erythromma najas</i>	LC	not listed	www.dragonflysoc.org.uk/ernaj.htm
<i>Ceriagrion tenellum</i>	LC	not listed	www.dragonflysoc.org.uk/ceten.htm
<i>Brachytron pratense</i>	LC	not listed	www.dragonflysoc.org.uk/brpra.htm
<i>Aeshna juncea</i>	LC	not listed	www.dragonflysoc.org.uk/aejun.htm
<i>Aeshna grandis</i>	LC	not listed	www.dragonflysoc.org.uk/aegra.htm
<i>Aeshna cyanea</i>	LC	not listed	www.dragonflysoc.org.uk/aecya.htm
<i>Aeshna mixta</i>	LC	not listed	www.dragonflysoc.org.uk/aemix.htm
<i>Anax imperator</i>	LC	not listed	www.dragonflysoc.org.uk/animp.htm
<i>Cordulegaster boltonii</i>	LC	not listed	www.dragonflysoc.org.uk/cobol.htm
<i>Cordulia aenea</i>	LC	not listed	www.dragonflysoc.org.uk/mffcoaenfull.htm
<i>Libellula depressa</i>	LC	not listed	www.dragonflysoc.org.uk/lidep.htm
<i>Libellula quadrimaculata</i>	LC	not listed	www.dragonflysoc.org.uk/liquad.htm
<i>Orthetrum cancellatum</i>	LC	not listed	www.dragonflysoc.org.uk/orcan.htm
<i>Orthetrum coerulescens</i>	LC	not listed	www.dragonflysoc.org.uk/orcoe.htm
<i>Sympetrum striolatum</i>	LC	not listed	www.dragonflysoc.org.uk/systr.htm
<i>Sympetrum fonscolombii</i>	LC	not listed	www.dragonflysoc.org.uk/syfon.htm
<i>Sympetrum flaveolum</i>	LC	not listed	www.dragonflysoc.org.uk/syfla.htm
<i>Sympetrum danae</i>	LC	not listed	www.dragonflysoc.org.uk/sydan.htm
<i>Sympetrum sanguineum</i>	LC	not listed	www.dragonflysoc.org.uk/sysan.htm
<i>Lestes barbarus</i>	NA	not listed	www.dragonflysoc.org.uk/lebar.htm
<i>Lestes viridis</i>	NA	not listed	www.dragonflysoc.org.uk/levir.htm
<i>Gomphus flavipes</i>	NA	not listed	
<i>Aeshna affinis</i>	NA	not listed	www.dragonflysoc.org.uk/aeaff.htm
<i>Anax junius</i>	NA	not listed	www.dragonflysoc.org.uk/anjun.htm
<i>Hemianax ephippiger</i>	NA	not listed	www.dragonflysoc.org.uk/heeph.htm
<i>Crocothemis erythraea</i>	NA	not listed	www.dragonflysoc.org.uk/crery.htm
<i>Sympetrum vulgatum</i>	NA	not listed	www.dragonflysoc.org.uk/syvul.htm
<i>Sympetrum pedemontanum</i>	NA	not listed	www.dragonflysoc.org.uk/syped.htm
<i>Pantala flavescens</i>	NA	not listed	www.dragonflysoc.org.uk/pafla.htm
<i>Pachydiplax longipennis</i>	NA	not listed	
<i>Erythromma viridulum</i>	NE	not listed	www.dragonflysoc.org.uk/ervir.htm
<i>Anax parthenope</i>	NE	not listed	www.dragonflysoc.org.uk/anpar.htm