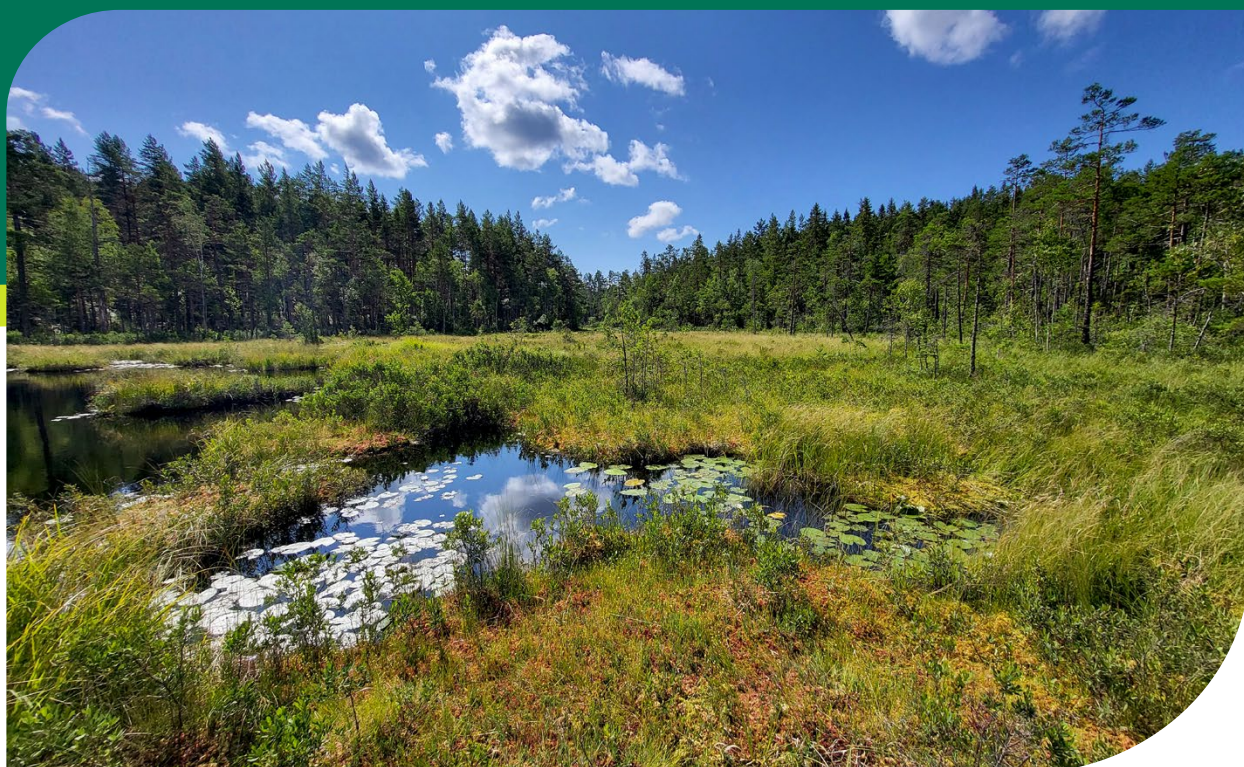


European Dragonflies: Moving from assessment to conservation planning

De Knijf, G., Billqvist, M., van Grunsven, R., Allen, D., Assandri, G., Bellotto, V., Bruslund, S., Bedjanič, M., Conze, K.-J., Díaz Martínez, C., Dolný, A., Ferreira, S., Garn, A., Goertzen, D., Holzinger, W., Houard, X., Hunger, H., Jeanmougin, M., Jović, M., Kalniņš, M., Karlsson, T., Kazila, E., Kitanova, D., Kulijer, D., Leus, K., Lohr, M., Maynou, X., Motte, G., Múrria, C., Olsen, K., Prunier, F., Sahlén, G., Schiel, F.-J., Šácha, D., Šigutová, H., Sparrow, D., Sparrow, R., Tańczuk, A., Tarkowski, A., Taylor, P., Trottet, A., Vilenica, M., Vinko, D. & Lees, C.

Appendix to the Status Assessment of European Dragonflies (Odonata) –
European Red List of Dragonflies 2024



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Contact point for individuals and organisations wanting to support the implementation of this preliminary plan: Dragonfly Conservation Europe (info@europeandragonflies.com).

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Cover photo credit: The peat bog Svartgölen in the region of Östergötland, Sweden is an excellent example of an oligotrophic habitat for dragonflies. It harbours populations of several threatened or Near threatened species such as *Coenagrion hastulatum* (VU), *Aeshna juncea* (EN), *Somatochlora metallica* (VU), *Leucorrhinia albifrons* (NT), *L. dubia* (VU) and *Sympetrum danae* (EN). © Magnus Billqvist.

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Acronyms & Abbreviations

A2P	Assess-to-Plan, a conservation planning process developed by the CPSG that integrates Red List assessment with action planning
AOO	Area of Occupancy, a key Red List metric. AOO is defined as the area within its 'extent of occurrence' which is occupied by a taxon, excluding cases of vagrancy
CPSG	IUCN SSC Conservation Planning Specialist Group
COST	Cooperation in Science and Technology (an EU funding initiative)
DCE	Dragonfly Conservation Europe
DRAGON-project	See: https://www.fondationbiodiversite.fr/en/the-frb-in-action/programs-and-projects/le-cesab/dragon/
EOO	Extent of Occurrence, another key Red List metric, is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy.
EC	The European Commission
EU PLEDGES	Pledges made by informal groups / organisations in a European Union Member State, to undertake green action
EU27	27 European Union Member States
EUNIS	European Nature Information System
FAIR	Findable, Accessible, Interoperable, Reusable (data) – promoted by EC
HD	Habitats Directive (CD, 1992). See: http://data.europa.eu/eli/dir/1992/43/2013-07-01
IAS	Invasive Alien Species
iNaturalist	Nature Application (App) for recording, mapping and sharing biodiversity observations
LIFE	L'Instrument Financier pour l'Environnement – European Union's funding instrument for the environment and climate action
Natura 2000	Network of protected areas covering Europe's most vulnerable threatened species and habitats
Odonatology	The study of dragonflies
PA	Protected Area
WFD	Water Framework Directive
WFD CIS 2015	This refers to guaranteeing the flows and water levels required to sustain the ecological function of the flora and fauna and habitat processes

Executive Summary

Introduction

In Europe, 146 species of dragonflies and damselflies have been recorded, of which 142 species have resident populations in Europe. These aquatic insects belonging to the order Odonata, and are collectively referred to as dragonflies throughout this document. Dragonflies are characterised by an aquatic larval stage that can last from few months to several years, and a terrestrial adult stage which usually lasts several weeks. They are perhaps the most charismatic,

striking and instantly recognisable taxon of all European aquatic invertebrates, which makes them appealing for the general public. Moreover, being sensitive to water quality and habitat degradation, dragonflies are valuable indicators of ecosystem health. These “Guardians of the Watershed” are present in nearly all European freshwater habitats, yet often fall through the cracks of conservation policies, plans and initiatives.

The planning approach

Between February 6 and March 5 2024, following the second assessment of European dragonflies for the IUCN European Red List (De Knijf *et al.*, 2024), 37 dragonfly experts from 23 European countries participated in five online conservation action-planning workshops. These workshops focused on 30 species categorised as threatened (Critically Endangered (CR), Endangered (EN), Vulnerable (VU)), and 19 species classified as Near Threatened (NT) within the European Union (EU). The project followed the “Assess-to-Plan” (A2P) methodology of the IUCN Species Survival Commission (SSC) Conservation Planning Specialist Group (CPSG). A2P is designed to build consensus among assessors and other experts on the priority actions needed to reverse declines in targeted species and to identify organisations that could implement these actions over the next 5-10 years.

The 30 target species, categorised as threatened in the EU predominantly occur in oligotrophic standing waters (peat bogs and heathland ponds) or in Mediterranean running waters. These dragonflies are primarily threatened by habitat alteration and destruction (e.g. eutrophication) and different aspects of climate change

(e.g. increasing water temperature, droughts). Climate change can cause the desiccation of the aquatic habitats of larvae, which is often exacerbated by the lowering of groundwater levels and the direct abstraction of surface water. The current legislation and a few conservation actions are already trying to improve the conservation of dragonflies, but these activities have proven to be insufficient to reverse the dragonfly decline. Furthermore, there is a negligible overlap between the species identified as threatened or Near Threatened in the European Red List and the species protected under the Annexes of the EU Habitats Directive (CD, 1992). Therefore, the species that need conservation efforts most urgently are not currently protected. Unfortunately, the rarest endemic species, most of which are threatened, are not protected at all and the destruction of their habitat continues. Therefore, a number of species would benefit from additional conservation efforts urgently – in this context, the recently approved EU Nature Restoration Regulation can help.

Priority actions recommended by workshop participants for the next 5-10 years fell into three broad categories (Figure 1):

- Actions aimed at increasing the capacity for effective conservation of dragonflies in Europe, such as improving monitoring schemes, creating accessible data platforms, expanding and coordinating a European network of specialists, and performing well-targeted statistical analyses.
- Actions describing urgent requirements for protecting, restoring and managing key habitats and populations to avert further declines and drive on-ground recovery.
- Actions aimed at improving the support to dragonfly conservation provided by European policy and planning mechanisms.

Audience

No single national agency or management authority can reverse the decline of European dragonflies alone; on the contrary, this requires collaborative and concerted efforts. This document therefore targets the diverse array of decision-makers, managers, practitioners and scientists required to implement the recommended actions, including: European and national government agencies and management authorities, especially water management and nature conservation boards and authorities; NGOs; policy makers (local, regional, national and international); developers and landscape

planners (and their ecologists); the scientific community and places of learning (universities, institutes, schools); the main land-user groups (agriculture, grasslands, forestry); Natura 2000 site managers; managers of public land and parks; nature conservation area management bodies; groups with similar conservation interests (e.g. groups aiming to conserve freshwater habitats for other invertebrate species); and local communities in areas where action is most needed. Relevant business sectors are also included, such as gravel and mining companies, and water utility companies.

Implementation

This preliminary plan is European Union in scope. Though much can be done at the European level to direct and incentivise conservation, most of the actions will need to be implemented at national, sub-national and local levels. These actions would benefit from dialogue and collaboration among the diverse stakeholder groups

working at these scales. National or sub-national planning workshops aimed at customising and operationalising this preliminary plan for the local context are essential to catalyse its uptake and progress. Figure 2 and Table 1 illustrates some key actions along with potential implementing and enabling agencies.

Figure 1: Summary of recommended goals and 5-10 year sub-goals



Table 1. Examples of habitat protection actions and restoration priorities, key implementers, and enabling agencies who can support the work

Examples of recommended actions	Implementing agencies	Enabling agencies
<ul style="list-style-type: none"> Safeguarding the populations of species that are Critically Endangered. 	<ul style="list-style-type: none"> National and local managers, including NGOs, of relevant sites and populations, in close cooperation with expert odonatologists. 	
<ul style="list-style-type: none"> Implementing effective actions for ensuring the ecological flow in streams and rivers in Europe, with highest national/regional priority, and locally in watersheds and streams with the occurrence of the threatened species of dragonflies, but also where other freshwater taxa (e.g. fishes) are present. 	<ul style="list-style-type: none"> National and regional nature conservation and water management agencies. National and local managers, including NGOs, of protected areas. 	<ul style="list-style-type: none"> EU, national & local policy makers national and regional nature conservation and water management agencies
<ul style="list-style-type: none"> Prohibiting abstraction of water during summer, including effective controls in all streams and rivers with the occurrence of threatened species. 	<ul style="list-style-type: none"> National and regional nature conservation and water management agencies. Local enforcement agencies. 	<ul style="list-style-type: none"> Universities & biodiversity conservation training institutes Research & biological data management organisations
<ul style="list-style-type: none"> Improving the hydrology of oligotrophic ecosystems by restoring groundwater levels. 	<ul style="list-style-type: none"> National and regional nature conservation and water management agencies. 	<ul style="list-style-type: none"> Education & advocacy organisations
<ul style="list-style-type: none"> Reducing eutrophication of standing waters, stemming mainly from nitrogen deposition from agriculture and water pollution. 	<ul style="list-style-type: none"> National and regional nature conservation and water management agencies. Farming sector. National and local managers, including NGOs, of protected areas. 	<ul style="list-style-type: none"> Conservation NGOs and dragonfly societies Funding agencies
<ul style="list-style-type: none"> Implementing climate-adapted management plans for small oligotrophic water bodies. 	<ul style="list-style-type: none"> National and local managers, including NGOs, of protected areas. 	

Introduction

Biology and ecology

Dragonflies belong to the insect order Odonata, which in Europe consists of two suborders, the true dragonflies (Anisoptera = dissimilar wings) and the damselflies (Zygoptera = uniform wings). Generally, the word “dragonflies” refers to both suborders. They are characterised by an aquatic larval stage, that can last several years and a terrestrial adult stage, which usually only lasts a few weeks.

Females can lay hundreds of eggs, with the method and placing of the eggs being species-dependent. Some species display exophytic oviposition, spreading eggs directly in the water or onto the sediment. Others protect the eggs from desiccation and predation by laying them into plants (endophytic oviposition) or pushing them into mud. When the eggs hatch, the first instar (pro-) larva emerges. It is very small and somewhat tadpole-like. After a few hours, or sometimes even minutes, the first of the skin moults occur. The larva is fully grown after between 6 and 17 skin moults. Depending on the species, this takes from just over two months to more than five years. Development is fastest in warm, shallow waters where some species can have more than one generation per year. The larvae are carnivorous and are among the top predators among the aquatic invertebrates, and as so reflecting the abundance at lower trophic levels, making them important in freshwater ecosystems.

Unlike butterflies and beetles, the dragonfly larva does not have a pupal phase. Instead, the fully grown larva makes a final moult above the water. When the larva has found a suitable

location, its skin splits and opens allowing it to squeeze out its head, midbody, legs and wings. When it has achieved sufficient physiological stability, it is time for the final step, when the rear body is pulled out of the larval skin which remains at the water edge as an exuvia.

When sexually mature, they seek out wetlands to mate. There, the males hold territories which vary in size from a few metres to long stretches along the water shores, depending on species, population size, number of males and the quality of the habitat. Within the territory, the males inspect other dragonflies that pass by and try to drive competitors away and find females to mate with. The number of individuals of the same species at a location varies across species. Those with strong territorial behaviour usually occur in fewer numbers.

Different species of dragonflies have different habitat requirements. Most species thrive in permanent and open water habitats with good water quality. Some species are more tolerant regarding water quality and cope better than others with, for example, lightly polluted waters, brackish conditions or wetlands that dry out. Generalists are found in a diverse array of aquatic ecosystems, while specialists are found only where their ecological needs are met and may disappear with even minor disturbances. The more heterogeneous habitats a landscape contains, the higher number of dragonfly species it can support. Hence, a rich dragonfly fauna is therefore a good indicator of a diverse biological landscape and environmental conditions.

Dragonflies in Europe

So far, 146 dragonfly species have been found in Europe. The list is based on Boudot and Kalkman (2015) and supplemented by recently published taxonomic revisions and the discovery of some additional species. Of these, 142 species are resident and were recently assessed to be included in the [European Red List](#) (De Knijf *et al.*, 2024). Nineteen species of dragonflies are endemic to Europe, that is, they are not found anywhere else in the world, and 13 of those species are restricted to the 27 European Union Member States (EU27). These endemic dragonflies merit attention in Europe's conservation policies, but only four out of the 19 are protected through the Habitats Directive (Kalkman *et al.*, 2018, De Knijf *et al.*, 2024). Moreover, according to this new European Red List, eight were assessed as threatened and an additional four as Near Threatened.

Through their beautiful colours and conspicuous behaviour, dragonflies are probably the most attractive of all freshwater invertebrates. As a result they are one of the better-known aquatic groups of species and insect orders. Dragonflies play an important role in ecosystems as they

can be both predators and prey, and are present in nearly all European freshwater habitats. Being one of the easiest groups to identify, no wonder then that dragonflies are growing in popularity in many countries. Many European citizens are nowadays watching, counting, and reporting dragonfly diversity and occurrences. This means that there is generally more faunistic data and information available than for most other invertebrates.

Dragonflies are excellent indicators of landscape use and its changes, and hence should be a focus of conservation efforts (Samways, 2024). However, they very often fall through the cracks of conservation policies, plans, and initiatives when they should to a much greater extent be regarded as valuable contributors to wider conservation efforts. Since they are conspicuous, widespread, and relatively easy to monitor, dragonflies should be considered as flagship or umbrella organisms for the biodiversity of both freshwater and the adjacent terrestrial habitats. They merit without any doubt the title of “guardians of the watershed”.



Coenagrion intermedium (EN) is endemic to the Greek island of Crete. Increased abstraction of water from streams and rivers for irrigation, pollution and the effects of climate change are the main threats. © Geert De Knijf.

Dragonflies are perhaps the most important indicator insect group for tracking the impacts of climate change on biodiversity. However, even in well-located, well-designed and managed protected areas, conservation objectives are not met if overall water and land use policies are inadequate. By treating dragonflies as the umbrella group, rivers, wetlands and freshwater biodiversity will benefit from dragonfly conservation

plans since dragonflies benefit other riparian and freshwater organisms. These plans should include specific actions to improve water use and management of the aquatic habitats and surrounding terrestrial habitats, throughout the range of the species included in them. An example on the national scale is already deployed in France with the national action plan for dragonflies (Houard *et al.*, 2020).

Scope and characteristics of the A2P species subset

Of the 142 species assessed, 29 (21.0%) extant species for which sufficient data are available are threatened (i.e., assessed as Critically Endangered, Endangered or Vulnerable) at the European scale, with two species (1.4%) assessed as Critically Endangered (CR), nine (6.3%) as Endangered (EN) and 18 (12.7%) as Vulnerable (VU). In addition, 17 species (12.0%) were assessed as Near Threatened (NT), with four species (2.8%) considered Data Deficient (DD). The situation for the 137 species present within the EU Member States is quite similar to that of Europe as a whole (Figure 2); 30 species (22.6%) are threatened (with none assessed as DD), of which two species (1.5%) are CR, ten (7.3%) EN and 18 (13.1%) VU. As for the Pan Europe region, a further 19 species (13.9%) were assessed as Near Threatened. A summary of the threatened and Near Threatened species at the European and the EU27 levels is given in Appendix 1. The highest number of threatened species are found in a broad belt approximately from southern France to southern Scandinavia and the Baltic states (Figure 3; De Knijf *et al.*, 2024).

Most dragonfly species are found in eutrophic waters, while the group confined to temporary waters contains the lowest number of species. Most threatened dragonfly species are either found in southern streams and rivers or in

oligotrophic waters. The other habitat groups have only a few threatened species. The main habitat types occupied by threatened species are presented in Figure 4.

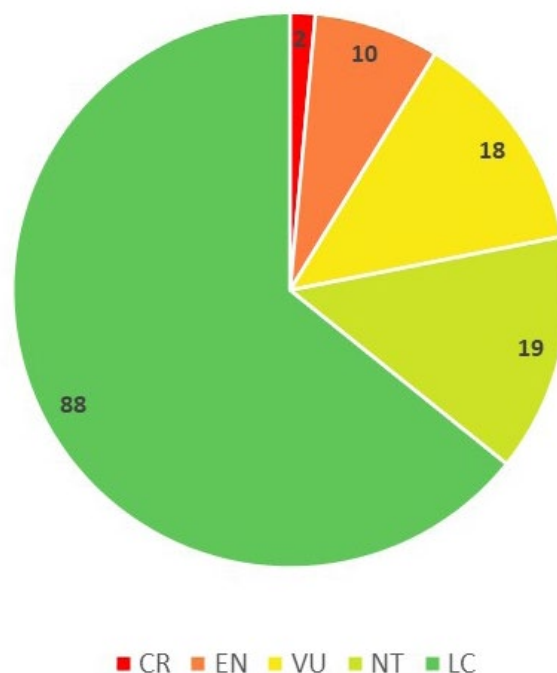


Figure 2. The Red List status of dragonflies in the EU 27 Member States. Numbers indicate the number of species in each Red List Category. Not Applicable (NA) species are excluded.

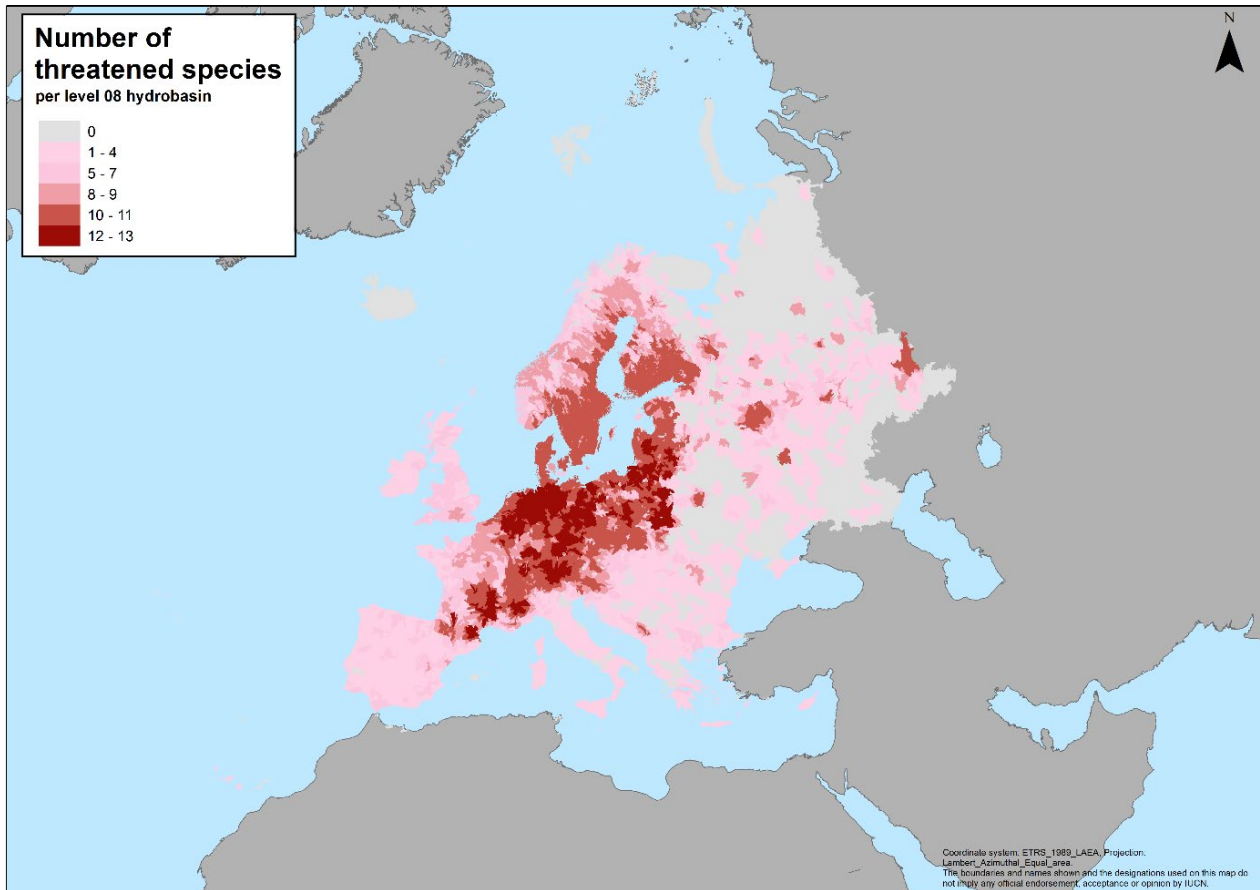


Figure 3. Threatened dragonfly species richness in Europe presented per HydroBASIN based on the data for the period 2000-2020. Not Applicable (NA) species are excluded. Near Threatened (NT) species are not included in this map.

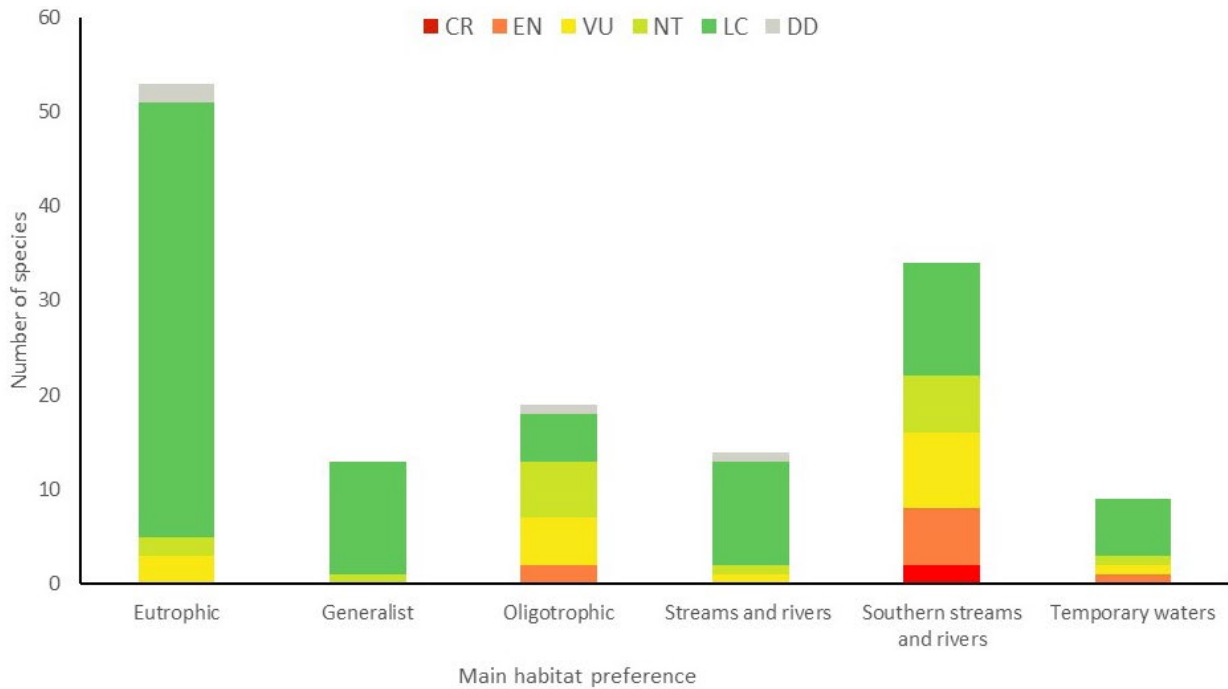


Figure 4. Red List categories of all dragonfly species in the different aquatic habitat types in Europe.

The dragonfly A2P workshops

The A2P project was a partnership between the IUCN SSC Conservation Planning and Dragonfly Specialist Groups, Dragonfly Conservation Europe (DCE), the IUCN European Regional Office in Brussels, some national or regional governmental entities, dragonfly societies active in Europe, and institutions covering odonatology. The planning discussions involved 37 participants from 23 countries and took place over five, two-hour online sessions.

To increase the efficiency of these discussions, experts were consulted beforehand to find ways of grouping species that could be treated as a single conservation target. These groupings generally comprise: species occurring in the same kinds of habitats or areas and which are therefore subject to similar pressures; species at risk from the same high profile threat (for

example water abstraction from streams, eutrophication of small water bodies); or species requiring a type of conservation intervention practised by a specific community of actors (for example, *ex situ* management support). For the dragonfly A2P discussions, the following three working groups were formed, based on such groupings. Over five online sessions, these working groups described the main threats causing declines or preventing recovery of their target species and the obstacles to taking effective conservation action. They discussed the actions that most urgently need to be taken over the next 5-10 years, focusing on what might be most achievable, and arranged these actions into major themes. The results of these discussions and the goals and conservation actions recommended are described in the following pages.

Group 1. Species of (predominantly) Mediterranean streams and rivers

The first group (Group 1) included species confined to streams and rivers in the Mediterranean. Nearly all threatened (CR, EN, VU) species of streams and rivers in Europe are confined to southern Europe. Those considered here include a group of species confined to southwestern Europe (Iberia, France and some of them are also present in Italy) with mostly wide distributions, and another group confined to southeastern Europe (Greece, Bulgaria, Cyprus) many of which have a small range (e.g. the two endemics of Crete). Though of high conservation concern, most have no legal protection.

Target species (CR, EN, VU): *Anax immaculifrons*, *Boyeria cretensis*, *Ceriagrion georgifreyi*, *Coenagrion caerulescens*, *Coenagrion castellani*, *Coenagrion intermedium*,

Coenagrion mercuriale, *Cordulegaster helladica*, *Cordulegaster insignis*, *Cordulegaster picta*, *Somatochlora borisi*, *Ischnura intermedia*, *Macromia splendens*, *Onychogomphus cazuma*, *Orthetrum nitidinerve*, *Pyrrosoma elisabethae*, *Zygonyx torridus*.

Target species (NT): *Gomphus graslinii*, *Gomphus simillimus*, *Onychogomphus costae*, *Oxygastra curtisii*, *Platycnemis acutipennis*.

Working group members: Geert De Knijf, Cecilia Díaz Martínez, Cesc Múrria, David Sparrow, Despina Kitanova, Eleana Kazila, Florent Prunier, Giacomo Assandri, Marina Vilenica, Martin Jeanmougin, Mathias Lohr, Rosalyn Sparrow, Sónia Ferreira, Xavier Houard, Xavier Maynou.



Pyrrhosoma elisabethae (CR) is restricted to Greece and southern Albania and prefers streams with cold unpolluted water. © Geert De Knijf.

Group 2. Species of nutrient poor (oligotrophic) habitats in the lowlands

Species of nutrient-poor habitats which are, or were, widespread in the European lowlands, from the UK and Belgium, across the Netherlands, northern Germany and Poland as far as the Baltic States. These species also occur at higher altitudes (higher in mountain areas) and latitudes (further north). However, threats (e.g. intensive agriculture and nitrogen deposition) and their impact are not the same for them there. Consequently some of the actions and conservation measures needed are different. Several species in this group are also included in Group 3 as they occur in northern parts of Europe and at higher altitudes, but are becoming rare in the lowland parts of West and Central Europe.

Target species (CR, EN, VU): (*Aeshna grandis*), *Aeshna juncea*, *Coenagrion hastulatum*, *Coenagrion lunulatum*, *Leucorrhinia dubia*, *Leucorrhinia rubicunda*, (*Somatochlora metallica*), *Sympetrum danae*.

Target species (NT): *Lestes sponsa*, *Leucorrhinia albifrons*, *Nehalennia speciosa*.

Working group members: Roy van Grunsven, Agnieszka Tańczuk, Aleš Dolný, Diana Goertzen, Grégory Motte, Hana Šigutová, Kent Olsen, Klaus-Jürgen Conze, Pam Taylor.

¹ *Aeshna grandis* and *Somatochlora metallica* also occur in the north or in mountain ranges, but in slightly different habitats so they do not fit well in this group. Accordingly, we do not focus on them here so they are in brackets. *Coenagrion hastulatum* is included in both Group 2 and Group 3 because it is becoming rare in the lowlands but is still more common in the north and at high altitudes.

Group 3. Species of nutrient poor (oligotrophic) habitats in the north or in mountain ranges

Species of nutrient-poor habitats more or less confined to Scandinavia and to several mountain ranges in Central and Eastern Europe, and the Balkans. They are rare or even absent from the European lowlands (e.g. *Aeshna caerulea*, *Somatochlora alpestris*).

Target species (CR, EN, VU): *Aeshna grandis*, *Coenagrion hastulatum*, *Coenagrion hylas*, *Somatochlora metallica*.

Target species also present in the lowlands (CR, EN, VU): *Aeshna juncea*, *Leucorrhinia dubia*, *Leucorrhinia rubicunda*, *Sympetrum danae*.

Target species (NT): *Aeshna caerulea*, *Aeshna crenata* (NT in EU27), *Aeshna subarctica*, *Nehalenniaspeciosa* (NT in EU27), *Somatochlora alpestris*, *Somatochlora sahlbergi*.

Working group members: Magnus Billqvist, Damjan Vinko, Dejan Kulijer, Dušan Šácha, Franz-Josef Schiel, Göran Sahlén, Holger Hunger, Matjaž Bedjanič, Miloš Jović, Tommy Karlsson, Werner Holzinger.



Somatochlora sahlbergi (NT) has the northernmost breeding range of any dragonfly species, only occurring in areas with permafrost north of 67°. Habitat degradation projected to occur resulting from climate change could push it to a threatened category in the near future. More fieldwork is needed to increase the knowledge of this species. © Magnus Billqvist.

GOAL 1. To have a European network of experts providing knowledge, tools and expertise to support effective dragonfly conservation

1.1 Summary

There are gaps in our understanding of dragonfly population trends and the pressures and conditions causing them, especially in regions with few data. Within the EU, the data-poor regions are primarily the southeast, *i.e.* the Balkan countries together with Greece. This region also harbours many threatened species. Over the

next 5-10 years we must increase the volume and utility of information being collected not only in these regions but Europe-wide through expansion and harmonisation of monitoring, and through mobilisation of existing and new data, supported by an expanded and better coordinated network of dragonfly specialists.

1.2 Challenges and opportunities

Monitoring

- Monitoring is the basis of conservation. We need to know how the different species are doing to target conservation measures. There is a need for balance between detailed local monitoring efforts and large-scale, repeatable monitoring. We need to have a good overview of trends at local, national and European scales and therefore what kind of monitoring is required. It is likely that a combination of different approaches is needed with widespread low intensity monitoring to understand how the more common species are doing, with targeted monitoring of the rarest species where a substantial subset of the populations is monitored.
- For large-scale calculation of dragonfly monitoring trends, methods such as occupancy modelling allow us to calculate trends in distribution from opportunistic data. To assess changes in population size more standardised monitoring is necessary.
- The classical method to calculate trends in abundance is through standardised transects, so-called Pollard Walks. These are however very inflexible and demand a lot of effort. Novel methods where the effort is standardised, such as 15 minutes counts might be a good alternative. The use of smartphones with GPS makes the recording of sampling location and time effortless. These methods could be a good framework to develop national and European-wide monitoring schemes.
- Trend calculations always depend on long time series and therefore we would need 10

years before we have good data with these novel methods – in the meantime we must use opportunistic data. The models using opportunistic data rely on complete lists, allowing for the assumption that species that were not recorded were not seen. These data are more useful than just recording the rare species.

- Data are currently being collected in a variety of ways; this can be optimised by educating people about the value of complete lists and repeated visits. We can educate people in the use of statistical models to mine information on distribution trends.
- For some species it is essential to have more quantitative data on abundance to see trends.
- There is an urgent need to organise local monitoring surveys of threatened dragonflies populations, including local stakeholders, for some of the endangered species.
- As monitoring is a crucial element of conservation actions, for both cost-efficient and outcome-efficient measures, funding should be secured at European and national levels.

An information platform

- In many countries, there are dragonfly societies or groups that have data and access to internet platforms containing data on dragonflies. It would be beneficial if one or a few experts per country would be national focal points to validate the data and to streamline the information.
- In order to be able to undertake analyses on a larger scale, such as the European Red List, a Europe-wide database should be developed to aggregate and make available in a uniform format the data from individual countries. This would also facilitate the analysis of national trends for countries where societies are not able to do that by themselves. Whether this will be as open data or FAIR data has to be decided.

- To reach these goals, international collaboration and funding are needed to build and maintain a database.

Information on threatened species

- More information is needed for several threatened species, especially for those with small ranges. This includes information on ecology, actual distribution, trends, local threats, actions needed, conservation measurements, etc.
- For the more widespread species, information on their actual distribution and population trends is needed.
- European-wide awareness campaigns (e.g. “dragonfly of the year”) can contribute to species conservation, especially if well organised and professionally supported (e.g. social media campaigns, influencers involvement).

Dragonflies as indicators

- Threatened dragonfly species are habitat specialists or sensitive to habitat deterioration so they can be used as indicators of the habitat quality and the health of freshwater ecosystems, and the negative trends affecting it.
- Dragonflies can be excellent indicators of the health of habitats and of the impacts of pressures such as climate change, but they are under-used and under-represented. Birds are often used as indicators for larger wetlands (e.g. Black Grouse, Golden Plover etc.) and these may not be sufficient to signal good conditions for dragonflies and other small and/or aquatic fauna. Small waterbodies, on which a substantial part of aquatic biodiversity relies, are poorly covered by the current indicators and therefore receive little conservation efforts. This is also the case for many of the threatened and Near Threatened dragonfly species discussed here. It is generally necessary to use

several organism groups as indicators as they have different habitat requirements.

- Improved access to standardised dragonfly monitoring protocols and to the wider European network of trained dragonfly experts, could help promote the wider adoption of dragonflies as indicator species.
- Dragonflies are valuable indicators for other biodiversity assets. But such an indicator system needs to be developed, which would enable observations to be translated into quantified assessments of habitats and pressures. The DRAGON project in France (Jeanmougin *et al.*, 2023), involving a postdoc and network, is aiming to do this – learning from the grassland butterfly project which is embedded in a wider biodiversity conservation framework. Input from the wider odonatological network is essential for this. An EU-wide dragonfly monitoring protocol and indicator should be developed and adopted by the EU, similar to the European grassland butterfly indicator and the pollinator species monitoring (EUPoMS).
- Besides their role as indicators of wetland ecosystem health, dragonflies can function as icons. Dragonflies are conspicuous, easily recognized and among the top predators in invertebrate communities, showing the strength of food pyramids. So, virtually any freshwater habitat type can have its own dragonfly ‘mascot’.
- IUCN can assist by disseminating the importance of Red lists and the value of dragonflies as indicator species. This needs to be demonstrated in scientific papers and would support potential funding.
- Dragonflies are sometimes used as indicators in large conservation projects for water bodies and this provides opportunities for

improved understanding of what does and what does not work for them.

Specialist capacity

- Until 2024, there was no European organisation for conservation of dragonflies as is the case for birds and butterflies (e.g. BirdLife International, Butterfly Conservation Europe). The recently established Dragonfly Conservation Europe (DCE) will be a useful platform for expanding and connecting the European network of dragonfly experts and promoting dragonfly conservation.
- Nurturing volunteers through funded programmes and well-targeted Citizen Science initiatives could also be helpful. Capacity building through in-country training will be important over the next 5-10 years and priority countries for this include among others Greece, Albania, Bulgaria and Romania.
- Few people develop a deeper involvement in the study of dragonflies. There is a need to stimulate education and training of more expert odonatologists and to strengthen collaboration between them. In some countries there may be very few experts. This makes it difficult to ensure regular contact and information exchange with authorities so that dragonflies are adequately considered and protected.
- The distribution of people with taxonomic and ecological expertise on dragonflies is not even across the region, with the highest numbers in the north and northwest of Europe and fewer experts in the east and southeast. Encouraging new students in these areas can be a good approach.
- A system of financial support for building the network should be developed.

1.3 Recommendations

The following 5-10 year sub-goals and actions were recommended by workshop participants (Table 2). Frontline implementing agencies for these actions are: **Dragonfly Conservation Europe (DCE); National Dragonfly Societies;**

nature advocacy organisations. Key enabling agencies (i.e. who can provide financial or other support) are: **European Commission, national and international conservation agencies, international foundations.**

Table 2. Sub-goals and recommended priority actions for filling the gaps in information, tools and expertise related to dragonflies, over the next 5-10 years.

1.3.1 Installation, development and improvement of European-wide monitoring of dragonflies	
Recommended actions	
1.3.1.1	Harmonise monitoring approaches and monitoring efforts across different regions. Advocate for compatible Europe-wide as well as national monitoring programmes.
1.3.1.2	Promote data collection and optimise use of opportunistically collected data through resources/talks/articles about: <ul style="list-style-type: none"> • how the most useful data can be recorded (complete lists, replications etc.); • the use of statistical models to extract information on distribution; • what kind of datasets are more valuable than others, e.g. for use with statistical models that support evaluation of distribution trends, by the expert network.
1.3.1.3	Advocate for regional groups to collect data that local experts, if necessary, can help with interpretation and validation of the data.
1.3.2 An established data sharing platform	
Recommended actions	
1.3.2.1	Agree on the specifications for a dedicated platform with curated access for specific purposes.
1.3.2.2	Explore options for acquiring data from other platforms.
1.3.2.3	Create a standardized data form how to collect data, especially monitoring data.
1.3.3 Improved knowledge of threatened species population trends and their drivers	
Recommended actions	
1.3.3.1	Organise monitoring surveys of threatened dragonfly populations.
1.3.3.2	Undertake a review and analysis of experiences from different restoration projects from different countries. What has been found when dragonflies were used as indicators.
1.3.3.3	Raise awareness through influencers and campaigns (e.g. dragonfly of the year).
1.3.4 Dragonfly indicators developed	
Recommended actions	
1.3.4.1	Promote dragonflies as indicators of rewetting of wetlands, human impact through changes in the boundary zone water/land, the effects of climate change, and more.

1.3.4.2	Develop one or more indicators for dragonflies. Some (trend in abundance and the other trend in distribution) are included in the set of European Biodiversity Indicators as proposed by the EUROPABON consortium. This should be adopted as an EU biodiversity indicator.
1.3.4.3	Selecting a smaller number of species that we know well as indicators of specific environments or threats, such as those associated with oligotrophic habitats or with streams and rivers.
1.3.4.4	Promote the indicator value of dragonflies through popularised scientific and other publications.

1.3.5 An expanded, more evenly distributed European network of dragonfly experts

Recommended actions

1.3.5.1	<p>Establish a European dragonfly organisation to connect and mobilise specialists across the region to maintain contact and exchanges with key authorities, with the aims to:</p> <ul style="list-style-type: none"> • launch Dragonfly Conservation Europe (DCE) at the European Congress on Odonatology in Seville 2024; • promote regular contact and information exchange between dragonfly experts and relevant authorities; • consider establishing national focal points (experts); • secure funding.
1.3.5.2	Level-up dragonfly expertise across Europe by organising workshops and field training both in species identification and monitoring.
1.3.5.3	Promote cross-border opportunities. COST actions might be an opportunity for strengthened pan-European collaboration.



Sympetrum flaveolum (EN) used to be relatively common in Europe with regular "invasion years" when it was very abundant over large parts of Europe. It has disappeared from a large part of its former range and invasions have practically stopped. © Geert De Knijf.

GOAL 2. To have adequate protection, restoration and management of priority habitats and populations of threatened dragonflies

2.1 Introduction

Recovering threatened dragonfly species and preventing others from becoming threatened will require urgent, direct protection, management and restoration of key habitats over the next 5-10 years. Key habitats for threatened species include streams and rivers in southern Europe and smaller oligotrophic water bodies further north. Where there is no water there are no dragonflies. Restoring and maintaining water levels is critically important to both of these systems. In addition, taking action to keep

nutrients out of oligotrophic systems, managing wetland-adjacent habitat to support climate resilience and good quality aquatic environments, and transitioning to more biodiversity-sensitive methods of managing streams and wetlands, will be needed. This in turn will require concerted and sustained action by many agencies to ensure that frontline implementers are equipped with good guidance and clear incentives for effective conservation management.

2.2 Challenges and opportunities

Species of (predominantly) Mediterranean streams and rivers

Many threatened dragonflies in the Mediterranean are confined to rivulets, streams and rivers. Stresses are especially severe on the larval habitats (that is, on the aquatic part of the life-cycle) and are mostly linked with the quantity of water or even the desiccation of streams and rivers. The reasons for this are the increased abstraction of surface water, mostly for agricultural use (irrigation), lowering of the groundwater table (often through illegal wells), water pollution and increased droughts and long periods of very hot weather due to climate change. This has even severely increased over the last years.

Besides the aquatic habitat, the terrestrial habitat suffers from habitat degradation such as removing the riparian vegetation. Several species are affected by deterioration or even cutting of the forest belt adjacent to streams and rivers, but over-trampling of the herbaceous vegetation by cattle is also a problem. Traditional agriculture practices are increasingly abandoned and replaced by more intensive forms. Not only large but also small dams are a challenge across the Mediterranean. In the Balkans, where many new dams are planned, this will worsen the situation for several species. The impact of Invasive Alien Species (IAS) is currently a regional problem for some threatened species, but might become a severe threat in the future.



The Rio Guardiara is a Mediterranean river with populations of several threatened and Near Threatened species such as *Boyeria irene* (NT), *Gomphus graslinii* (NT), *Macromia splendens* (VU), *Oxygastra curtisii* (NT) and *Zygonyx torridus* (VU). © Roy van Grunsven.

Species of nutrient poor (oligotrophic) standing waterbodies in the lowlands

The major challenge to threatened species here is the interaction of eutrophication with climate change resulting in loss of water from the habitat and sites drying up in summer. Due to less precipitation coupled with more evaporation, harmful nutrients and other pollutants become increasingly concentrated, even if a bog does not become completely dry. Extreme rainfall events on these very dry lands result in run-offs carrying nutrients and also sediments with negative effects. Climate change further increases vegetation succession, especially in drought periods, which can accelerate the establishment of trees where water bodies previously existed. Abstraction of groundwater contributes to this and has the strongest impacts when it is already dry and hot, whereby the buffering influence of the presence of groundwater in the system is lost. In addition, due to increasing

water temperature, bogs become suitable for more thermophilic species, which may outcompete more cold-adapted oligotrophic species ultimately leading to complete shifts in species communities. Abstraction of surface water and lowering of groundwater tables, through e.g. drainage, around the wetlands changes the hydrology and thereby the ecology and the ecosystem functioning of wetlands. Many wetlands are now surrounded by dry agricultural landscapes. Nitrogen deposition results in acidification and eutrophication leading to changes in vegetation, indirectly affecting the larval habitat, and there is also the influence of phosphate and nitrogen through surface and groundwater run-off from agriculture. The impact of IAS, especially crayfish, is currently limited but could become problematic. It should be noted that in general the addition of beavers has a positive effect on creating dragonfly habitats, as their activity results in rewetting areas. In exceptional cases conflicts with conservation goals for individual species might be of concern.

Obstacles to addressing these challenges include insufficient legal protection, intensification of agriculture, lack of climate adapted management plans and the limited translation of management plans into actions whose impacts

can be measured. In some areas, there is a resistance to deepening pools in bogs, as this is sometimes incorrectly perceived as increasing greenhouse gas emissions or as interfering with natural processes.

2015



2019



Beuven (the Netherlands) is a large shallow oligotrophic lake that used to have populations of *Coenagrion hastulatum* (VU), *Symptetrum danae* (EN) and *Leucorrhinia rubicunda* (VU). The drought in 2018-2019 resulted in the loss of the sedge vegetation and the populations of all three species seem to have disappeared from it. Top situation in 2015 (© Tim Termaat), lower in 2019 (© Roy van Grunsven). © Roy van Grunsven.

Species of nutrient poor (oligotrophic) standing waterbodies in the north or in mountain areas

Major challenges to threatened species here are afforestation and natural vegetation succession. With more nutrients and lower water levels, there is an accelerated and ongoing afforestation which is occurring on a large scale. The main problem, at least in Scandinavia is that forestry is very intense, with clear cuts dotting the landscape, thus resulting in leakage of nutrients and sediments into all forest waters. Trenching of bogs to acquire more land for forestry, as well

as old trenches that drain the bogs long after peat extraction has been abandoned, is turning the former open mires to forests. When water levels are lowered it paves the way for the establishment of trees and shrubs, which in turn is increased by nitrogen deposition and climate change. The trees and shrubs that establish themselves also absorb water, which dries out the soil further and accelerates the afforestation. These nutrient poor habitats are to a lesser degree also impacted by negative influences from agriculture such as eutrophication, nutrient inputs, drainage, and lowering of the ground water table.



Bog complex in the vicinity of Pirttivuopio, about 50 km north of the Arctic Circle in Sweden, holds species such as *Coenagrion hastulatum* (VU), *Aeshna caerulea* (NT), *A. juncea* (EN), *A. subarctica* (NT), *Somatochlora alpestris* (NT), *S. metallica* (VU), *S. sahlbergi* (NT), *Leucorrhinia dubia* (VU) and *L. rubicunda* (VU). © Magnus Billqvist.

2.3 Recommendations

The following 5-10 year sub-goals and actions were recommended by workshop participants (Table 3). Frontline implementing agencies for these actions are: **National and regional nature conservation and water management agencies; land managers; Dragonfly Conservation Europe (DCE); national dragonfly societies; nature advocacy organisations; farming and**

forestry sectors; protected area managers; recreational users (tourism organisations, aquatic recreation groups). Key enabling agencies (i.e. who can provide financial or other support) are: **European Commission; national and regional nature conservation and water management agencies.**

Table 3. Sub-goals and recommended priority actions for protecting, restoring and managing habitats and local populations of threatened dragonflies over the next 5-10 years.

2.3.1 Ecological flow rates and proper management of European rivers and streams, and adjacent terrestrial habitat	
Recommended actions	
2.3.1.1	Secure Ecological Flow (e-flow) in all streams and rivers where any of the threatened species occurs (NT in EU27). This means guaranteeing the flows and water levels required to sustain the ecological function of the flora and fauna and habitat processes.
2.3.1.2	Prohibit water abstraction from streams where threatened dragonflies occur, in particular directly from springs.
2.3.1.3	Strongly avoid lowering the groundwater table.
2.3.1.4	Prohibit building new dams and remove dams in areas where threatened species occur.
2.3.1.5	Prohibit gravel extraction in streams and rivers where threatened species are present.
2.3.1.6	Maintain or restore forest and other riparian vegetation, and avoid over-trampling by livestock.
2.3.1.7	Nature-friendly maintenance of streams and ditches. Timely, section-by-section mowing of the riparian vegetation and no interventions in the river bed that have not been agreed with experts.
2.3.2 In priority oligotrophic water bodies, hydrology is maintained or restored, and nutrients and other risks are excluded	
Recommended actions	
2.3.2.1	Restore hydrology in peat bogs and mires stabilising water levels over time. Plug drainage ditches not in use to re-wet habitats.
2.3.2.2	Strongly reduce input of nutrients through air and from adjacent farmland, and in the north of Europe also from clear cutting of forests. Close drains and ditches that lead nutrient-rich water to, or draw water from, habitats.
2.3.2.3	Restore and create small oligotrophic water bodies. Create e.g. appropriate habitats in <i>Sphagnum</i> peat bogs within restoration projects. This might include (partially) removing of scrub and trees in formerly open mires and bogs. But specific care is needed to local conditions, as scrub is also an important refugia during very warm days (see also 2.3.4.1). Include dragonfly specialist in the planning and monitoring phase.

2.3.2.4 Adjust peat extraction methods to favour subsequent restoration and adapt how pools are created and maintained during peat excavation.

2.3.2.5 At some sites it might be adequate to reduce water loss through soil by sheet piling.

2.3.2.6 Manage or create buffer zones (e.g. open to semi-open habitat with younger pine, willow and birch, stands of older forest or areas with more or less wet marshland with low vegetation) to maintain water levels and reduce the amount of incoming nutrients.

2.3.2.7 Minimise presence of fish, especially IAS in oligotrophic habitats.

2.3.3 Protected areas conserving threatened species effectively with species-specific planning and action for the most urgent cases

Recommended actions

2.3.3.1 Include key dragonfly habitats in new or existing protected areas.

2.3.3.2 Incorporate dragonfly conservation needs into management plans.

2.3.4 Dragonfly-inclusive, climate adaptive approaches to planning and management of water bodies and their surrounds

Recommended actions

2.3.4.1 Implement climate adaptive management, especially in West and Central Europe where oligotrophic habitats heat up too much during warm springs and summers (e.g. maintain presence of scrub and low trees near the open water to cool local temperatures and provide refuges for oligotrophic species).

2.3.4.2 Explore and where feasible pursue re-creation of wetlands in areas previously hosting nutrient-poor bogs or heathlands but more recently cultivated with poor results (often due to soil erosion, drought and floods). E.g. [Ghost Pond project](#), Norfolk, UK.

2.3.4.3 Look outside protected areas to investigate the possibilities of creating or re-creating adequate habitats that link isolated key areas.

2.3.5 Awareness and education

Recommended actions

2.3.5.1 Raise awareness among water management agencies, farmers, industry hydropower companies about water abstraction, ecological flows, etc.

2.3.5.2 Ensure inclusion of dragonfly specialists in planning the management of water bodies and the surrounding areas.

2.3.5.3 Connect with groups restoring water bodies for other species to ensure that dragonfly needs are met (e.g. when restoring habitats for birds or for vegetation, it is important not to remove all dragonfly habitat at once).

2.3.5.4 Inform local people, tourists and other user-groups about the vulnerability and importance of Europe's streams, rivers, ponds and wetlands (especially in areas heavily impacted such as Mediterranean rivers that are intensively used).

2.3.5.5 Promote greater awareness about water scarcity and good practices of domestic use (also use within the tourism industry).

2.3.5.6 Targeted as well as broad information campaigns about the consequences of releasing alien invasive species, especially fish and crayfish.

Ensure guidance is developed, translated, and promoted to relevant stakeholders on the following:

- 2.3.5.7
- restoration and management of dragonfly habitats (especially those important to threatened species);
 - water management regimes.
-



Part of the site at Svabesholm, Scania, Sweden, which hosts dragonflies species such as *Lestes sponsa* (NT), *Coenagrion armatum* (NT in EU), *C. hastulatum* (VU), *C. lunulatum* (VU), *Aeshna grandis* (VU), *A. juncea* (EN), *Leucorrhinia rubicunda* (VU), *Sympetrum vulgatum* (VU) and occasionally *Sympetrum danae* (EN) and *S. flaveolum* (EN). © Magnus Billqvist.

GOAL 3. To have effective policy and planning support for dragonflies at European, national and local levels

3.1 Introduction

Many of the drivers threatening dragonflies are known, can be monitored and to some extent mitigated. Of the species occurring in standing water bodies, nearly all prefer small waterbodies, a type of habitat that is not covered by the European Water Framework Directive (WFD). In these habitats they are often the only taxonomic group for which data are available. Some of these habitats are protected under the EU Habitats Directive (HD), but we see an increasing disconnect between conservation of the floral elements of these habitats and that of the associated fauna. As the HD is strongly focused on habitat types, and these are based

on vegetation cover, the goals for managing or restoring them do not always include effective protection for the fauna present. Of the handful of river and wetland conservation policies, the WFD alone should be able to ensure good conservation status of freshwater ecosystems in Europe. However, in June 2021, although 26% of the EU's land area was protected, exceeding Aichi Target 11, the effectiveness of protected areas for conserving or restoring biodiversity in rivers, lakes, and wetlands was more limited (51% positive outcomes of 75 case studies; Acreman *et al.*, 2020), and freshwater biodiversity is still declining.

3.2 Summary

- Current EU laws, especially the Habitats Directive, policies and regulations provide a framework for biodiversity conservation that many species and their habitats can benefit from.
- In addition, many policy and planning initiatives critical to successful dragonfly conservation will be best addressed at the national or regional level, with specific protections delivered through the agencies responsible for on-ground site protection.
- Better implementation and enforcement of existing laws (e.g. European regulation on minimum ecological flow or e-flow) as well as some well-targeted changes to policy, would improve the prospects for threatened dragonflies and prevent more species from becoming threatened in the near future.

3.3 Challenges and opportunities

Better protection of dragonflies and their habitats

- The **European Habitats Directive** (for EU countries) and the **Bern Convention** (for countries within and outside the EU), focus on 17 and 14 species of dragonflies, respectively.
- In the **European Habitats Directive (HD)**, a total of 16 European dragonflies are explicitly listed in the Annexes. This number is in practice 17, as *Coenagrion castellani* was recently split off from *C. mercuriale* as a *bona fide* species. According to the HD regulations, these new species are implicitly also considered as protected through this Directive. Eight are listed in Annexes II as well as IV, four only in Annexes II and only five in Annexes IV. The Annexes are crucial as species listed generally receive higher levels of monitoring and protection, at least within the EU Natura 2000 network. Annex IV species are especially important since they require Member States to set up and implement a strict protection regime.
- However, threats and status of species are constantly changing, and the Annexes of the Habitats Directive show a bias towards Western and Central European species and in some cases, at least for dragonflies, could be outdated. At the moment it is not possible to add new species to the Annexes, so other avenues need to be found to elevate protection and monitoring for threatened dragonfly species, such as the implementation of the EU Nature Restoration Regulation.
- The EU Nature Restoration Regulation (EU, 2024) opens many opportunities for restoring small water bodies, proper stream and river management and adequate species protection plans. Member States are

required to meet targets for restoring wetlands, rivers, lakes, and small water bodies, representing important habitat types for dragonflies (for instance including oligotrophic waters). Moreover, in their National Restoration Plans, Member States need to plan for the proper management of streams and river and their connectivity, and rewet a portion of the peatlands currently used for agriculture. This Regulation provide another opportunity, as Member States need to improve on 2 out of 3 provided biodiversity indicators for agriculture, including high-biodiversity landscape features that list streams, small wetlands, and small ponds which would benefit the conservation of dragonfly species and their habitats.

- Another tool is the RAMSAR convention, where there is the possibility to propose sites to be protected because of the presence of threatened dragonflies, so that they can receive the necessary protection and management.

Funding mechanisms for protection and management of threatened species

- For the species mentioned on the Annexes of the HD, there is funding available through European projects such as LIFE.
- EU Funding for threatened species (European Red List species) must be better expanded, stimulated and be made more publicly known.
- IUCN Red List threatened species should be included as eligible target species for conservation and research projects funded by EU (e.g. LIFE, HORIZON, Biodiversa+, InterReg projects) and national funds.



Waste dump (plastics) and high input of nutrients leads to algae bloom and decrease of oxygen saturation in the Eurotas River, Peloponnese, Greece. © Geert De Knijf.

European regulation on minimum water flow (e-flow)

- E-flow or ecological flow (a European regulation) is the minimum level of water that should be available in streams and rivers so that they can still fulfil their ecological role and processes. This will naturally be stream dependent.
- Ecological flow should ensure that water abstraction from streams and rivers is limited so that a minimum flow will always exist. At the sites where any of the threatened species occurs stricter regulations should be applied and water abstraction should be prohibited during spring and summer. This is especially important in several countries in the Mediterranean such as Cyprus, Greece, Italy and Spain. Enforcement of this regulation at the local scale might be necessary.

- EC should not provide funding for any new dam construction, but should rather provide funding for dam removal.
- Gravel extraction from streams and rivers should be well regulated and prohibited where threatened species are present.
- The new EU Restoration Regulation will be particularly important for the restoration of rivers.

The **Water Framework Directive** (WFD) and associated national laws and regulations focus on rivers and on natural lakes. Small water bodies are especially important for many dragonflies and for aquatic biodiversity in general, but these are not incorporated in this Directive.



Small dams on a nearly completely dry river in the Peloponnese, Greece. © Geert De Knijf.

European Red List adoption at national levels with associated protections and planning

- IUCN Red List categories have been assigned and recently updated for dragonflies at a European scale. It is important that these new designations are recognised in national protection and management plans.
- Additionally, countries/regions need to focus on their threatened species even if they are not threatened at the European level.
- Red listing continues to be an important tool for understanding the status of dragonflies and, potentially, for increasing their protection and conservation, both at regional and national levels.
- There is a large discrepancy between European countries in regard to red lists. Some countries have outdated lists or none at all, others may have lists focused on specific taxonomic groups (e.g. dragonflies). There are also large national differences

in how the lists are drawn up and how the analyses and assessments were performed. In addition, the red lists are implemented in various ways or not at all in the day-to-day conservation work from the grassroots up.

- Exchanging expertise, advice, and information on developing national red lists using the knowledge and experience of dragonfly societies and experts would help increase the value and use of this tool.

Adequate implementation and enforcement of existing laws and regulations

Although several European laws and regulations exist, implementation and enforcement at the local level is often neglected. A good example of this is the enforcement of the European regulation on ecological flow, which can be poor where it conflicts with agriculture priorities (e.g. greenhouses in the Mediterranean region need enormous amounts of water).

3.4 Recommendations

The following 5-10 year sub-goals and actions were recommended by workshop participants (Table 4). Frontline implementing agencies for these actions are: **European Union, national and local policy makers, planners and regulators; IUCN SSC Dragonfly Specialist Group and Dragonfly Conservation Europe (DCE) ; European and national environment agencies; Natura 2000 site managers; industry and developers working around freshwater habitats;**

water management agencies; education organisations (schools, universities; field centres); national and local government and non-government authorities responsible for managing water bodies and their surrounds; biodiversity planning and implementation bodies; non-governmental campaigning and advocacy organisations; entomological organisations; museums.

Table 4. Sub-goals and recommended priority actions for improving policy and planning support to dragonflies at European, national and local levels over the next 5-10 years.

3.4.1 Current protection under the EU Habitats Directive	
Recommended actions	
3.4.1.1	Enforce protection for species and their habitats included in the EU HD Annexes at the national and local level.
3.4.1.2	Promote the inclusion of restoration measures for key dragonfly habitat types in Member States' National Restoration Plans, also highlighting their importance as indicators of biodiversity in both freshwater and the adjacent terrestrial habitats
3.4.1.3	Work out an overview of which dragonfly species can act as a typical species for inland surface waters and for mires, bogs and fens. This is foreseen in the HD as a part of structures and functions under the habitat description, but is not worked out. This can be a proper way to incorporate dragonflies more in effective management plans and protection.
3.4.2 Funding mechanisms for protection and management of threatened species	
3.4.2.1	Inclusion of IUCN Red List threatened species as eligible target species for conservation and research projects funded by EU (e.g. LIFE, HORIZON, Biodiversa+, InterReg projects) and national funds.
3.4.2.2	Integrate dragonfly conservation measures into current and future EU projects aimed at restoration of wetlands.
3.4.3 Toward natural flowing of streams and rivers	
Recommended actions	
3.4.3.1	Implement the European regulation on ecological water flow at national and local level.
3.4.3.2	Advise Member States on removing artificial barriers to surface water connectivity and restoring natural functioning of floodplains in their National Restoration Plans, focussing on key areas, habitats, and conditions for dragonflies.
3.4.3.3	Regulate water abstraction from streams and rivers. Prohibit extraction directly from the source.

3.4.3.4 Regulate gravel extraction from rivers and streams and prohibit where threatened species occur.

3.4.3.5 Implement European and national laws at the local scale, especially illegal water abstraction from streams and ground water.

3.4.4 Mitigated risks from dams

Recommended actions

3.4.4.1 Stop financial support from the European Commission to build dams.

3.4.4.2 Provide funding from the European Commission for dam removal on rivers where threatened species occur.

3.4.5 European Red List adoption at national levels with associated protections and planning

Recommended actions

3.4.5.1 Adopt European Red List at national level with associated management plans and monitoring.

3.4.5.2 Promote national Red Lists and associated national protections, adding national priorities besides the European ones. To keep them up-to-date, a Red List should be reassessed every 10 years.

3.4.5.3 Exchange information on developing national red lists with the help of IUCN and Dragonfly Conservation Europe (DCE).

3.4.6 Adequate implementation and enforcement of existing laws and regulations

Recommended actions

3.4.6.1 Enforce existing European and national legislation, with focus on protection of habitats of threatened species and stimulation of research and monitoring.

3.4.6.2 Relevant expert could explore ways to provide support to Member States to ensure they develop ambitious National Restoration Plans until 2026 and their implementation thereafter, focusing on monitoring, restoring, and improving conditions for dragonfly species in Europe.

3.4.6.3 Regulate water abstraction at 'fine levels'. Control abstraction near important sites.

3.4.6.4 Improve pollution controls through effective enforcement (including effective implementation of the Water Framework Directive and the EU Nitrates Directive).

3.4.6.5 Promote Nature Based Solutions and rewetting of river valleys.

3.4.6.6 Make sure IAS legislation is updated to accommodate emerging risks (e.g. to prevent trade or transport of invasive crayfish and fish).

3.4.7 Improve management planning for priority areas with threatened dragonflies

Recommended actions

3.4.7.1 Include dragonfly specialists in conservation planning for site management.

3.4.7.2 Evaluate and monitor implementation of management plans.

3.4.7.3 Increase stakeholder-inclusive participatory planning for priority areas with threatened dragonflies.

3.4.8 Awareness and education

Recommended actions

3.4.8.1	Promote Dragonflies as “Guardians of the Watershed” enabling a better understanding of biodiversity, a healthy environment and human well-being.
3.4.8.2	Prioritise awareness training for dragonfly conservation in countries where threatened species occur (e.g. in the Mediterranean region).
3.4.8.3	Include dragonflies as environmental and climate change indicators at national and European levels.



The Weerribben, the Netherlands, is a fen ecosystem with large populations of *Aeshna viridis* (NT), *Sympetrum danae* (EN), *Sympetrum depressiusculum* (VU) and *Sympetrum vulgatum* (VU). © Roy van Grunsven.

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Appendix 1. Threatened and Near Threatened dragonfly species at the European and EU27 levels

Family	Species	Common name	Europe	EU27
Coenagrionidae	<i>Ceragrion georgifreyi</i>	Turkish Red Damsel	CR	CR
Coenagrionidae	<i>Pyrrhosoma elisabethae</i>	Greek Red Damsel	CR*	CR
Aeshnidae	<i>Aeshna juncea</i>	Moorland Hawker	EN	EN
Aeshnidae	<i>Boyeria cretensis</i>	Cretan Spectre	EN*	EN*
Coenagrionidae	<i>Coenagrion caerulescens</i>	Mediterranean Bluet	EN	EN
Coenagrionidae	<i>Coenagrion intermedium</i>	Cretan Bluet	EN*	EN*
Coenagrionidae	<i>Ischnura intermedia</i>	Dumont's Bluetail	EN	EN
Gomphidae	<i>Onychogomphus cazuma</i>	Cazuma Pincertail	EN*	EN*
Libellulidae	<i>Orthetrum nitidinode</i>	Yellow-veined Skimmer	EN	EN
Libellulidae	<i>Sympetrum danae</i>	Black Darter	EN	EN
Libellulidae	<i>Sympetrum flaveolum</i>	Yellow-winged Darter	EN	EN
Coenagrionidae	<i>Coenagrion hylas</i>	Siberian Bluet	VU	EN
Aeshnidae	<i>Aeshna grandis</i>	Brown Hawker	VU	VU
Aeshnidae	<i>Anax immaculifrons</i>	Magnificent Emperor	VU	VU
Coenagrionidae	<i>Coenagrion castellani</i>	Italian Bluet	VU*	VU*
Coenagrionidae	<i>Coenagrion hastulatum</i>	Spearhead Bluet	VU	VU
Coenagrionidae	<i>Coenagrion lunulatum</i>	Crescent Bluet	VU	VU
Coenagrionidae	<i>Coenagrion mercuriale</i>	Mercury Bluet	VU	VU
Cordulegastridae	<i>Cordulegaster helladica</i>	Greek Goldenring	VU*	VU*
Cordulegastridae	<i>Cordulegaster insignis</i>	Blue-eyed Goldenring	VU	VU
Cordulegastridae	<i>Cordulegaster picta</i>	Turkish Goldenring	VU	VU
Corduliidae	<i>Somatochlora borisi</i>	Bulgarian Emerald	VU*	VU
Corduliidae	<i>Somatochlora metallica</i>	Brilliant Emerald	VU	VU
Libellulidae	<i>Leucorrhinia dubia</i>	Small Whiteface	VU	VU
Libellulidae	<i>Leucorrhinia rubicunda</i>	Ruby Whiteface	VU	VU

Libellulidae	<i>Sympetrum depressiusculum</i>	Spotted Darter	VU	VU
Libellulidae	<i>Sympetrum vulgatum</i>	Vagrant Darter	VU	VU
Libellulidae	<i>Zygonyx torridus</i>	Ringed Cascader	VU	VU
Macromiidae	<i>Macromia splendens</i>	Splendid Cruiser	VU*	VU*
Lestidae	<i>Lestes macrostigma</i>	Dark Spreadwing	NT	VU
Aeshnidae	<i>Aeshna caerulea</i>	Azure Hawker	NT	NT
Aeshnidae	<i>Aeshna subarctica</i>	Bog Hawker	NT	NT
Aeshnidae	<i>Aeshna viridis</i>	Green Hawker	NT	NT
Aeshnidae	<i>Boyeria irene</i>	Western Spectre	NT	NT
Coenagrionidae	<i>Ischnura graellsii</i>	Iberian Bluetail	NT	NT
Corduliidae	<i>Somatochlora alpestris</i>	Alpine Emerald	NT	NT
Corduliidae	<i>Somatochlora sahlbergi</i>	Treeline Emerald	NT	NT
Gomphidae	<i>Gomphus graslinii</i>	Pronged Clubtail	NT*	NT*
Gomphidae	<i>Gomphus pulchellus</i>	Western Clubtail	NT*	NT*
Gomphidae	<i>Gomphus simillimus</i>	Yellow Clubtail	NT*	NT*
Gomphidae	<i>Onychogomphus costae</i>	Faded Pincertail	NT	NT
Lestidae	<i>Lestes sponsa</i>	Common Spreadwing	NT	NT
Libellulidae	<i>Leucorrhinia albifrons</i>	Dark Whiteface	NT	NT
Libellulidae	<i>Sympetrum pedemontanum</i>	Banded Darter	NT	NT
Platycnemidae	<i>Platycnemis acutipennis</i>	Orange Featherleg	NT*	NT*
Synthemistidae	<i>Oxygastra curtisii</i>	Orange-spotted Emerald	NT	NT
Aeshnidae	<i>Aeshna crenata</i>	Siberian Hawker	LC	NT
Coenagrionidae	<i>Coenagrion armatum</i>	Dark Bluet	LC	NT
Coenagrionidae	<i>Nehalennia speciosa</i>	Sedgling	LC	NT

Threatened or Near Threatened dragonfly species in Europe. Species endemic to Europe or EU27 are marked with an asterisk (*) (De Knijf et al., 2024).

Appendix 2. Details of project participants

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European Dragonflies:

Moving from assessment to conservation planning

