

DIVERSITY OF DRAGONFLIES AND DAMSELFLIES (Odonata) IN PRESPA NATIONAL PARK (ALBANIA)

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1. Introduction

Dragonflies (suborder Anisoptera) and damselflies (suborder Zygoptera) belong to the order Odonata, which is taxonomically isolated and very ancient. Dragonflies are characterized by large multifaceted eyes, two pairs of strong, transparent wings and an elongated colorful body. They are relatively large insects with impressive flight, while damselflies are smaller, slender and fly slowly and softly. The name dragonflies is usually used also for damselflies, the official Albanian name is Pelivezë. Odonata are predators at all levels of their life cycle. The larvae are aquatic in their vast majority and adult insects are terrestrial.

Odonata larvae live in water for some months to several years depending on the species. When the growing period is finished, the larva goes out from the water and moults. During emergence the individual change completely shape the body, wings, the abdomen expands and after the time needed to become sufficiently hard, they fly away as an adult individual (Riservato *et al.* 2009).

Male dragonflies patrol a territory and often meet females in the air and fly in tandem. Although they can be found far from water surface, during mating period, dragonflies always come back to the wetlands. Most of the Zygopteras' females and some Aeshinde species lay eggs into plants growing in or by the water, while others disperse their eggs on the water surface or on ground nearby.

The most important habitats for dragonflies are wetlands, which are characterized by their high biodiversity. However, these habitats are very vulnerable and are often altered by human activity. Many wetlands have disappeared and this trend will continue until ecological awareness increases (Benazzouz *et al.* 2009).

Dragonflies are a relatively small order of insects (Kalkman *et al.* 2008), but they are a well-known group (Corbet 1999) and many people appreciate their striking colours and acrobatic flights.

A total of 5952 extant species of Odonata have been described on the Earth (30 families, 652 genera), of which 2941 belong to the suborder Zygoptera, 3011 to the Anisoptera, and two in one genus to the Anisozygoptera, the total number is estimated to be close to 6000 species (Dijkstra *et al.* 2013).

According to the IUCN European Red List of Dragonflies, a total of 137 species and subspecies are assessed for Europe while eighteen of them are endemic to Europe. Dragonflies occur almost everywhere in Europe, but the highest species diversity is found in the southern half, with the highest numbers in parts of southern France, the foothills of the Alps and parts of the Balkan Peninsula (Kalkman *et al.* 2010).

Threatened dragonflies are found all over the Mediterranean region. However, some areas have a particularly high concentration of threatened species: the most notable are the southern Balkans, north-eastern Algeria and the Levant with the adjacent southern parts of Turkey. Fourteen percent of the species in the Mediterranean Basin are endemic, (9 of these are threatened and 5 Near Threatened). This highlights the responsibility that the Mediterranean countries have to protect the global populations of these species (Riservato *et al.* 2009).

Southern part of the Balkans is especially interesting for investigation of Odonata because both Boreal and Mediterranean species can be found in the same area. Prespa region is a biodiversity hot spot on the Balkan Peninsula, where the odonata fauna play an important role as a link between aquatic and terrestrial ecosystem.

1.1 Literature review (present knowledge)

Until the last ten years, the Odonata fauna of Albania was rather poorly studied. The previous research in Albania was discussed and contributed by Murányi (2007). Since then, several papers are done regarding faunistics and taxonomy (Murányi 2010, Olias *et al.* 2007) and some ecofaunistical aspects (e.g. Halimi *et al.* 2010). Only a few taxons are published for Prespa region in those papers (*Platycnemis pennipes nitidula*, *Erythromma viridulum* and *Coenagrion puella*). The data from Kitanova *et al.* (2013), related to Prespa region are included in this report as a results.

Having in consideration the list of odonata species reported in Karaman (1984), which refers to the Macedonian part of the Prespa Lake, it can be expected that 34 species can also be

found in the Albanian part. This paper includes only the habitats associated to the lake. List of species found by Karaman (1984) is attached in Annex 1.

The Prespa region has a rich Odonata fauna, including several important species. If the literature data from the surrounding of the Prespa Lake is included, 41 species can be expected for the region (not only wetland in the surroundings of Prespa Lake, but also whole watershed area of the lake, including reserves and other mountaineering wetlands). List attached in Annex 2.

Because there is an intention of nomination of the area as a biosphere reserve, which will include not only the Prespa region, but also the surrounding of the Ohrid Lake, the list of odonata species which can be found in the Prespa - Ohrid region are given to this report (Annex.2). This data relates to published data by Fileva (1954), Karaman 1969; 1984; Angelov et al. 1994; Peters & Hackethal 1986; Bedijanič et al. 2008; Boudot et al. 2009; Jović 2009; Jović & Mihajlova 2009; Zawal et al. 2010; and Murányi 2007. The data refer to Prespa Lake, Ohrid Lake, and the mountains of Galichica, Pelister and partly Jablanica. Published data from Greek part of Prespa region are not included in this list. (See table 2)

1.2 Conservation importance of the investigated group

Dragonflies and damselflies are of great importance. The aquatic nymphs and winged adults create an important link between aquatic and terrestrial ecosystems, and play a central role in the food chain of aquatic systems. As their larvae are aquatic, dragonflies can be used in making rapid assessments of water quality.

Because of their sensitivity to environmental change, dragonflies often serve as one of the most visible indicators of the health of the ecosystems they inhabit and the water quality in the wetland areas in which they breed. In addition, because they are predators, they have considerable potential for the biological control of mosquitoes which can transmit diseases to human beings (Moore 1997)

As adults, they typically eat mosquitoes, midges, and other small insects which make them valuable in controlling populations of pest insects. On the other hand they represent food to birds, frogs, spiders, fish, and even other large dragonflies. Thus, loss of dragonflies and damselflies could have a ripple effect on food webs.

Many ecological factors such as water pollution, flow, the amount and type of aquatic vegetation present, and the presence of fish and other aquatic predators affect their abundance and distribution.

Since most invertebrates are small and inconspicuous, their immense importance in nature is grossly underestimated. Therefore large conspicuous insects are of great importance in drawing attention to invertebrates and their conservation needs: what butterflies do as flagships for the terrestrial environment, dragonflies can do for the aquatic environment (Norman W. Moore 1997)

2. Methodology

Different freshwater localities in scope of the NP Prespa were visited for collecting material of the Odonata fauna. The specimens were captured using entomological net or hoop/water net (for larvae), sometimes only photographed, or the species were identified at the location. Some interesting species were collected and preserved in ethanol (70%) or kept dry in envelopes. Larvae material was kept in absolute ethanol (90%).

2.1 Sampling methods

This investigation of the Odonata is based primarily on adult specimens. Larval material was collected on the localities where it was possible to use hoop nets. The investigation strived to be seasonal, same localities were visited during spring summer and autumn for better understanding of the diversity of the species diversity.

2.2 Determination of species and their distribution areas

The identification of adult forms of species was done using Field Guide to the Dragonflies of Britain and Europe - Dijkstra & Lewington (2006). A Key to the Italian Odonata Larvae - Carchini (1983) was used for determination of larva material.

3. Investigated area

During the investigated period (May - September 2013), different freshwater localities were visited for collecting material. Mainly standing water habitats and their dragonfly fauna around the lake shore was target of investigation. But also several natural and artificial wetlands in mountain belt were taken in consideration. The data from the field trips in 2011 and 2012 done by the author and a small group of international Odonata experts are included in this report. List of localities is given below.

3.1 Localities

All of the surveyed localities are presented in Tab. 1.

Table 1. List of localities

LOC_No	AREA	LOCALITY	X_UTM	Y_UTM	Altitude	Data	HABITAT
GPN1	Great Prespa Lake	southern of vill. Tuminec (Tuminets = Kallamasi)	494891,77	4526768,81	844	24.05.20 13	Lake shore, limestone rocks with bushes (<i>Pruno webbii</i> ? <i>Juniperetum excelsae</i>)
GPN2	Great Prespa Lake	Zavir, Dolna Gorica (= Gorice e Vogel)	493741,39	4524547,20	854	24.05.20 13	Lake shore, limestone rocks with bushes
GPN3	Great Prespa Lake	Zavir, Dolna Gordica (= Gorice e Vogel)	493741,39	4524547,20	854	24.05.20 13	Lake shore with good developed reed belt and submerged aquatic vegetation
GPN4	Great Prespa Lake	Gorice e Vogel, Administration of the NP "Prespa"	493065,20	4525586,35	880	24.05.20 13	Dry area in degraded oak forest and individual threes from <i>Pinus nigra</i> .
GPN5	Great Prespa Lake	vill. Globochani (= Golomboch)	495248,70	4522916,90	852	24.05.20 13	Lake shore with reed belt and agricultural filed
GPL6	Great Prespa Lake	vill. Globochani (= Golomboch)	495597,51	4523082,48	844	24.05.20 13	Lake shore, limestone rocks with bushes
ZR7	Great Prespa Lake	Ralnik Swamp, near vill. Zrnovsko (= Zaroshke)	493281,32	4512195,95	847	24.05.20 13	Swampy area
ZR8	Great Prespa Lake	Ralnik Swamp, near vill. Zrnovsko (= Zaroshke)	493281,32	4512195,95	847	24.05.20 13	stony shore between the lake and the swamp
GAL9	Mount Galichica	NW from Gorice e Madhe	490950,05	4528247,08	971	24.05.20 13	Day pastures in degraded Oak forest
GAL10	Mount Galichica	Ceroska lokva	489308,24	4527984,33	1152	25.05.20 13	Artificial pond covered with <i>Typha</i>
GAL11	Mount Galichica	Pikina Voda	487692,00	4528304,28	1559	25.05.20 13	Xero- mesophyte limestone meadows with single bushes and trees within Fagetum
GAL13	Mount Galichica	Pikina voda	487531,17	4528380,54	1584	25.05.20 13	Meadow in the beech forest
GAL14	Mount Galichica	Mala Lokva	487373,19	4528054,51	1623	25.05.20 13	Artificial pond as a watering place for cattle
SPL15	Lake Prespa Minor	NW from vill. Treni	498897,90	4502390,36	859	25.05.20 13	Artificial canal with eutrophicated water covered with dense algae and hydrophytes aggregates
SPL16	Lake Prespa Minor	south of vill. Shuec	499856,99	4503721,89	848	26.05.20 13	NE of the Lake shore, <i>Buxus sempervirens</i> shrubland (highly degraded and modified <i>Querco-Carpinetum</i>)
SPL17	Lake Prespa Minor	south of vill. Shuec	499856,99	4503721,89	848	26.05.20 13	SW shore of the Small Prespa Lake with eutrophicated water invaded by dense reeds (<i>Typha</i> , <i>Phragmites</i>)
RCP18	Rakitsko (= Araf e Rakicke)	vill. Rakicke	498047,49	4508154,96	1094	25.05.20 13	Stream and flooded agricultural land
RCP19	Cerovsko	vill. Cerje	495229,33	4511094,01	1102	25.05.20 13	Artificial pond without vegetation
GPN20	Great Prespa Lake	southern of vill. Tuminec (Tuminets = Kallamasi)	495011,16	4526646,55	844	24.06.20 13	Lake shore, limestone rocks with bushes (<i>Pruno webbii</i> - <i>Juniperetum excelsae</i>)
GAL21	Mount	near Ceroska Lokva	491111,87	4528780,53	983	24.06.20 13	<i>Qercetum fraineto-cerris</i>

Galichica							
GAL22	Mount Galichica	Ceroska Lokva	489347,67	4527998,88	1156	24.06.20 13	Artificial pond overgrowth with Typha and other rooted floating-leaved plants
GAL23	Mount Galichica	Ceroska Lokva	489217,38	4528175,20	1154	25.06.20 13	Sheshi e Kenit, arteficial pond without vegetation
GPN24	Great Prespa Lake	southern of vill. Tuminec (Tuminets = Kallamasi)	494900,16	4526722,18	837	26.06.20 13	Lake shore, limestone rocks with bushes (Pruno webbii?Juniperetum excelsae)
GPN25	Great Prespa Lake	southern of vill. Tuminec (Tuminets = Kallamasi)	494891,77	4526768,81	844	26.06.20 13	Lake surface with aquatic vegetation
GPN26	Great Prespa Lake	Gorica e Vogelj, Administration of NP "Prespa" Albania	493323,93	4525665,54	865	11.07.20 12	Dry area in degraded oak forest and individual threes from Pinus nigra.
SPL27	Lake Prespa Minor	NW from v. Treni (Albania)	498898,75	4502391,47	858	11.07.20 12	Artificial canal (a small Dam)
SPL28	Lake Prespa Minor	south of v. Shuec	499778,60	4503641,29	847	11.07.20 12	Lake with eutrophicated water invaded by dense reeds (Typha and Phragmites) covers
OUT29	Out of NP Prespa	cloused to v. Vranisht (Albania)	495067,29	4501906,83	847	11.07.20 12	Irrigation Canal in agricultural fields
OUT30	Out of NP Prespa	River Davol, on the road between v.Changonj and v. Zemblak (Albania)	490920,67	4505391,82	830	11.07.20 12	River
ZR31	Great Prespa Lake	Pond north of v. Lajhtize	490826,33	4514534,71	899	12.07.20 12	Pond overgrowth with Typha from the NW side
ZR32	Great Prespa Lake	Ralnik area, east of vill. Znosko (= Zaroshke)	493474,28	4512727,63	852	11.07.20 12	Swamp Ralnik and lake coast
ZR33	Great Prespa Lake	vill. Pustec	492062,00	4515296,00	850	21.08.20 11	Open water surface with submersed vegetation
ZR34	Great Prespa Lake	SE of vill. Pustec, below vill. Djelas	493089,14	4515914,75	836	21.08.20 11	Cliff and stony shore lake
GPN35	Great Prespa Lake	Vill. Globocani (= Gollomboc)	495192,00	4522938,00	866	22.08.20 11	Agricultural fields connected with the lake
GPN36	Great Prespa Lake	Vill. Globocani (= Gollomboc)	495386,50	4522930,99	846	22.08.20 11	Read belt on the lake shore
GPN37	Great Prespa Lake	Clif SE of Vill. Globocani (= Gollomboc), srt	496475,00	4523099,00	842	22.08.20 11	Stony shore with bushes between the lake and the cliff
ZR38	Great Prespa Lake	Ralnik area, east of vill. Znosko (= Zaroshke)	493823,00	4513065,00	848	22.08.20 11	Swampy area
GAL39	Mount Galichica	Ceroska Lokva	489343,00	4528060,00	1152	23.08.20 11	Artificial pond overgrowth with Typha and Polygonum amphibium.
GAL40	Mount Galichica	Near Ceroska Lokva	489544,00	4528049,00	1139	23.08.20 11	Dray pasture surrounded with Oak forest
ZR41	Great Prespa Lake	Ralnik area, east of vill. Znosko (= Zaroshke)	492310,00	4512824,00	848	24.08.20 11	Lake shore, limestone rocks with bushes
GPN42	Great Prespa Lake	Vill. Globocani (= Gollomboc)	495192,00	4522938,00	866	24.08.20 11	Read belt on the lake shore
GPN43	Great Prespa Lake	Vill. Dolna Gorica (= Gorice e Vogel)	493108,98	4525656,31	878	24.08.20 11	Hilly pasture with individual trees
ZR44	Great Prespa Lake	Ralnik area, east of vill. Znosko (= Zaroshke)	493452,00	4512683,00	849	24.08.20 11	Swampy area
SPL45	Lake Prespa Minor	Lake shore near vill.Treni	498896,15	4502391,21	859	27.08.20 11	Lake with eutrophicated water and dense submersed vegetation)

3.2 Habitats

Wetlands habitat along the lake shore were observed: open water surface with submerged and floating plants, reed belt, lake shore with limestone rocks with bushes, stony shore lake, swampy area, agricultural field, artificial ponds, canals, watering places and a meadows in the beach forest in scope of the NP “Prespa”.

4. Results

4.1 Species diversity

Table 2. List of species

No.	SPECIES	LOCALITIES	COMMENTS
1	<i>Aeshna affinis</i> Vander Linden, 1820	GAL10, SPL15, GAL21, GAL22, GAL39	
2	<i>Aeshna isoceles</i> (Müller, 1767)	SPL17, GPN25	
3	<i>Anax imperator</i> Leach, 1815	GPN1, SPL15, SPL17, GPN25, SPL27, SPL28, ZR31, ZR32, ZR33, SPL45	
4	<i>Calopteryx splendens</i> (Harris, 1780)	SPL15, SPL15, SPL27, OUT29	
5	<i>Coenagrion ornatum</i> (Selys, 1850)	GPN2, GPN2, ZR7, SPL17, GAL22, GAL39	
6	<i>Coenagrion puella</i> (Linnaeus, 1758)	SPL17, OUT29	
7	<i>Coenagrion pulchellum</i> (Vander Linden, 1825)	SPL15	
8	<i>Coenagrion scitulum</i> (Rambur, 1824)	ZR7, ZR31	new for Albania
9	<i>Cordulia aenea</i> (Linnaeus, 1758)	ZR7, GAL13, ZR44	
10	<i>Crocothemis erythraea</i> (Brullé, 1832)	GPN5, GPN25, GPN26, SPL27, SPL28, ZR31, ZR33, SPL45	
11	<i>Enallagma cyathigerum</i> (Charpentier, 1840)	GPN1, GPN4, GPN5, GPN24, ZR32	
12	<i>Erythromma lindenii</i> (Selys, 1840)	ZR32	
13	<i>Erythromma najas</i> (Hansemann, 1823)	GPN1, GPL6, GPN20, GPN24	
14	<i>Erythromma viridulum</i> (Charpentier, 1840)	GPN2, GPN5, SPL27, OUT30, ZR31, ZR32, GPN35, GPN42	
15	<i>Ischnura elegans</i> (Vander Linden, 1820)	GPN1, GPN4, GPN5, ZR7, GAL10, SPL15, GAL22, GAL22, GPN25, SPL27, SPL28, OUT29, OUT30, ZR31, ZR32, GPN35, ZR41, GPN42, ZR44, SPL45	
16	<i>Lestes barbarus</i> (Fabricius, 1798)	ZR7, ZR31	
17	<i>Lestes virens</i> (Charpentier, 1825)	ZR7, ZR44	
18	<i>Libellula depressa</i> Linnaeus, 1758	GPN3, GAL10, GAL11, GAL12, GAL14, SPL17, RCP18, RCP19, GAL22, GAL23	
19	<i>Libellula quadrimaculata</i> Linnaeus, 1758	SPL16	
20	<i>Onychogomphus forcipatus</i> (Linnaeus, 1758)	GPN1, GPL6, ZR8, ZR31, ZR32, ZR33, ZR34, ZR38	
21	<i>Orthetrum brunneum</i> (Fonscolombe, 1837)	ZR31, GPN37, GPN1, GPN4, GPL6, ZR8, GAL9, SPL16,	
22	<i>Orthetrum cancellatum</i> (Linnaeus, 1758)	GAL21, GAL22, GPN24, OUT30, ZR31, ZR32, ZR33, ZR34, GPN36, GPN37, ZR38,	

		ZR44
23	<i>Orthetrum coerulescens</i> (Fabricius, 1798)	ZR31
24	<i>Platycnemis pennipes</i> (Pallas, 1771)	ZR32
25	<i>Sympetma fusca</i> (Vander Linden, 1820)	ZR31
26	<i>Sympetrum fonscolombii</i> (Selys, 1840)	GPN4, GAL9, GAL10, RCP19, GAL22, ZR31, GAL39, GAL40, ZR41, GPN42, GPN43
27	<i>Sympetrum sanguineum</i> (Müller, 1764)	SPL27, ZR31, ZR32, GPN42, SPL45
28	<i>Sympetrum striolatum</i> (Charpentier, 1840)	ZR7, ZR32
29	<i>Sympetrum vulgatum</i> (Linnaeus, 1758)	GPN3, GPN5, GPN24, SPL28

Even though there are well developed habitats it was remarked that some expected species were not found in the area and the population trend is decreasing.

Erythroma viridulum (Zygoptera) and *Orthetrum cancellatum* (Anisoptera) were noted as the most common tandems during the investigated period. While *Onychogomphus forcipatus* was the most common species, which usually perched on stony lake shore.

4.2 Important species

The distribution of the important dragonfly species is presented on Fig. 1. The greatest number of species was observed in the wetlands and shoreline between Kallamas and Gollomboc and Liqenas as well as in the mountain zone around Pikina Voda and Ceroska Lokva.

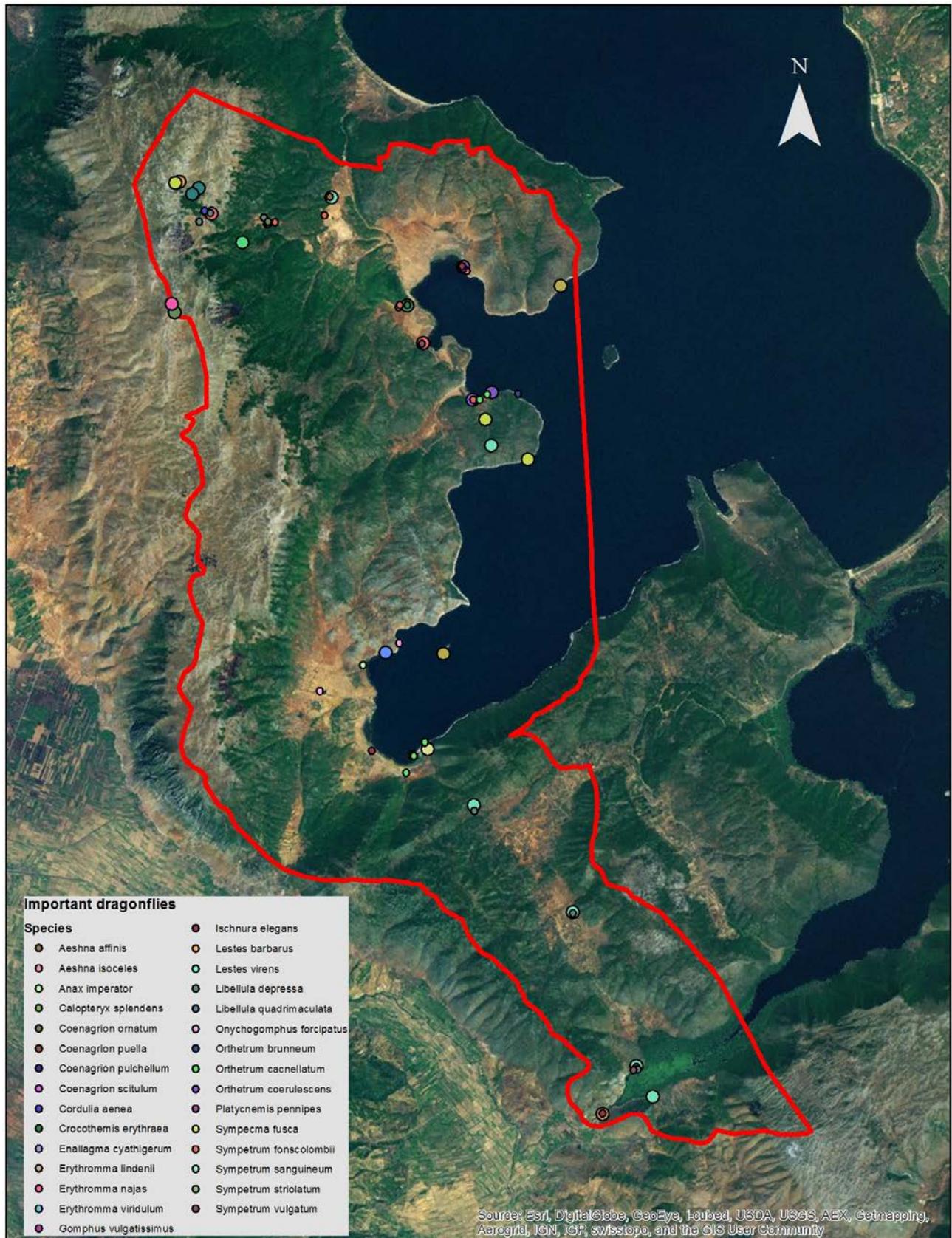


Figure 1. Important dragonfly species (Odonata) in Prespa National Park (Albania).

4.2.1 Global IUCN red list of species

According to European Red List (EUR RL) of Dragonflies, only *Coenagrion ornatum* is listed as near threatened, the same species is included as near threatened on the Mediterranean Red List (MED RL) together with *Coenagrion pulchellum*, *Erythromma najas*, *Cordulia aenea* and *Sympetrum vulgatum*. From the mentioned Dragonflies which are threatened, only *Coenagrion ornatum* is listed on Annex II of the EU Habitats Directive.

Table 3. Valorisation of dragonflies according to international and Albanian red lists.

SPEC	EU HD	EUR RL	MED RL	ALB RL
<i>Coenagrion ornatum</i>	App. II	NT	NT	NT?
<i>Coenagrion pulchellum</i>		LC	NT	
<i>Coenagrion scitulum</i>		LC	LC	new for Albania
<i>Erythromma najas</i>		LC	NT	
<i>Cordulia aenea</i>		LC	NT	
<i>Gomphus vulgatissimus</i>				NT
<i>Sympetrum vulgatum</i>		LC	NT	

Some other important species which are expected to be present in the region but are not registered during the investigating period are *Sympetrum depressiusculum* (EUR RL and - vulnerable), *Leucorrhinia pectoralis* listed on Annex II and IV on a Habitat Directive, *Lestes dryas* which is listed as near threatened in Albanian Red List.

4.2.2 Species of economic importance

Odonata are of little economic importance. Their main attraction for humans is aesthetic as they are beautifully colored and interesting for observation and photographing. In certain cases, the presence of odonates may be useful as an indicator of ecosystem quality as its mention above.

In some countries, such as Japan, Odonata is a popular subject of art and culture, and similar to butterflies and birds, it has been a topic of popular scientific interest. Dragonflies can be interesting toll for attracting tourist.

On the other side Odonata are beneficial to humans because as voracious aquatic predators they assist in the control of insect pests. There is lack of information about the species which are directly involved in control of insect pests.

4.2.3 Ecologically important species (keystone, umbrella, flagship species)

Dragonflies serve as umbrella species representing both aquatic and terrestrial assemblages. There are many advantages of using dragonflies as bioindicators. They react rapidly to a change in habitat quality by appearance/disappearance or by a change in abundance (Chovanec and Waringer, 2001).

4.3 Important localities for the investigated group

Swamp Ralnik, lake shore of Small Prespa Lake especially the area of village Shuec and lake shore of Great Prespa Lake with submerged, floating plants and part with good developed reed belt.

4.4 Important habitats for the investigated group

The diversity of wetland habitats in the region provide condition for presence of some important dragonfly's species listed on the IUCN Red List, EU Habitat Directive or other related Directives. Prespa Lakes and their surrounding still support a stable population of dragonflies with high diversity. Natural wetlands around the lake shore are the most important not just for larva but also for the adults. Changes in water flow or in aquatic vegetation are quite influential to the local faunal composition. The greatest numbers of species are found at sites that offer a wide variety of microhabitats.

The most important habitats in scope of the Prespa Park are reed belts, swampy areas and the parts with good developed submersing aquatic vegetation.

The microhabitats in scope of Swamp Ralnik still support great number of species. The habitats of Small Prespa Lake and the surrounded wetlands and shrubs are ideal for dragonflies, but we did not find a wide variety of species as we expected. The reason can be water pollution, eutrophication, increase of lake sediments passed through the channel and the densely overgrown reeds covering almost the entire lake at Albanian side.

Scrubs around the lake shore are important for some Zygoptera species as a shelter for adults. *Buxus sempervirens* shrublands and the depredated oak forest above the small prespa lake were the habitats where very large population of dragonflies were found (*Libellula qadrimaculata*, *Anax imperator* and some Zygoptera)

Forest clearance also removes the habitat in which adult insects shelter and catch their prey. Adults from *Cordulia aenea* was found only in the natural forest in the mountain belt. Larva material from the same species was found in the Swamp Ralnik and Small Prespa Lake,

it can be common around the lake shore, but probably due to predators and for food, adult passes in the higher parts beyond the water surface.

Some odonata species, especially from the family Gomphide are connected with rocky lake shore, this habitat is especially important for development of larva, but great period of the adult stage is also linked with the same habitat.

Some of the artificial wetlands are also important for dragonflies because they can be colonized easy, especially if they are unpolluted. The manmade pond near village Lin (=Lajhtize) supports great diversity of dragonfly species. *Coenagrion scitulum* was found there for the first time in Albania (Kitanova et al., 2013). The same species is found as a larva in swamp Ralnik.

4.5 Comparison with the fauna of adjacent areas

Comparison of the Odonata fauna from Macedonian and Albanian side of Great Prespa Lake show differences, particularly due to diversity of habitats (swamp microhabitats, wet meadows, reed belts combined with willow) of the Macedonian side of the Lake (around Stenje Ezerani, Perovo and Asamati) and presence of the Gordulegastriidae and Calopterygidae species which are connected with running waters (Brajchinska River, Kranska River). It is remarked that diversity of odonata declined in populations also in Macedonian side, some species are not confirmed in the last decade too, such as *Gomphus flavipes*. The reason of declining or loss of species is probably due to pesticide pollution or other agricultural activities as a main problem.

Swamp Ralnik from the Albanian side is the most similar habitat with swamp Stenje in Macedonian side where diversity of Odonata fauna is presented also with important species such as: *Leucorhinia pectoralis*, *Coenagrion ornatum*, *Brachytron pratense* e.t.c. However, in the area of Swamp Ralnik destruction of the habitats by the human activities is more visible, the natural vegetation is almost completely changed by overgrazing and mechanical changes. Differences in species diversity are visible between Ohrid and Prespa Lakes which is presented in the attached Annex. The wetlands around the lakes are very similar in species diversity, but because of the rivers and ponds in the mountain region there is a presence of species characteristic for those habitats. Typical species for the mountain ponds are: *Aeshna juncea* and *Aeshna cyanea*, while *Gomphus shniderii*, *Cordulegaster heros*, *Calopteryx virgo* and others are found in Steska River, Crn Drim. *Cordulegaster bidentata* is mostly presented in the mountaineering rivers in the high mountain belt.

5. Threats

Habitat destruction, degradation, pollution and mismanagement of water bodies are significant threats to the dragonflies. In recent years it has become clear that Climate

Change will turn out to be one of the most important threats to dragonflies in the Mediterranean. (Riserveto et al. 2009)

Wetlands in Prespa region provide essential services to local humans and economic development (water, food, materials) but in the same time most of them lost their natural conditions. Wetlands are degraded mainly by intensive agricultural practices, the potential issues may be pesticides and excessive nutrients from agricultural landscapes, siltation from soil and bank erosion, various water contaminants from human settlement and urban landscapes, construction, or tourism development in the last period. Almost all habitats important for dragonflies are surrounded by agricultural landscapes. All this resulted with habitat degradation:

- The swamps are under strong human pressure; at the same time those wetlands in the region are the most important for existence of many regional vulnerable species. The swamp Ralnik is obviously threatened by overgrazing. Due to a lack of suitable habitat condition such as vegetation, which provides ovipositing substrates, wind-shelter or a food source, the odonata diversity and the population may be declining.
- In both Great and Small Prespa Lakes the water is undergoing eutrophication process, which can be a reason for loss of some species. The reed belts (dominated by *Phragmites* and *Typha*) is still well developed in Great Prespa Lake, except some parts where urbanization is visible. The Small Prespa Lake is almost completely overgrown. Reed belts should be managed properly if the existing dragonfly's fauna is to be supported.

6. Measures for protection

The management of all water bodies for dragonflies largely consists of controlling native vegetation in the least damaging ways possible, and of controlling all forms of pollution. The first measure is usually easier to achieve than the second.

Managers of wetlands should have in mind that plants and animals which dragonflies depend on for shelter and food are the most important measures for their abundance and diversity. Cattle grazing especially in the area of Ralnik Swamp should be controlled and managed on a proper way. Dragonfly diversity declined as grazing intensity increased on overall wet meadow vegetation. Vegetation provides critical habitat for dragonflies during the aquatic (larval), terrestrial (adult), and emergence phases of their life cycle. Riparian vegetation provides adult dragonflies with perch platforms, cover from predators, habitat cues for oviposition sites, and shelters from wind, which may be particularly important in windy locations (Stewart & Samways 1998, Corbet 1999). It's important to keep the shallow water level in Ralnik Swamp. Managers can prevent, or at least reduce, damage caused by

human activities. Mechanical disturbance is visible in this area, reducing the surface of the swamp and the degradation of its natural shape and size, as well as natural characteristics of its bottom and vegetation.

Diversity and abundance of dragonflies also requires healthy aquatic ecosystem with indigenous vegetation to provide oxygen and clean the water but also helping them to hide, as well as for their transformation process from nymphs to adult fliers. Dragonfly larvae are vulnerable to predation by fish if these are kept in unnaturally large numbers. All this should take in account in managing habitats for dragonflies.

6.1 Habitats protection

Swamp Ralnik should be included in the zone for active management and to strive toward improvement of its natural features.

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8. Annexes

Table 3. List of species published for Macedonian side of Prespa Lake

List of species according Karaman (1984) (Prespa Lake, Macedonian side)	
Species	
1	<i>Platycnemis pennipes</i>
2	<i>Sympecma fusca</i>
3	<i>Coenagrion puella</i>
4	<i>Coenagrion pulchellum</i>
5	<i>Ischnura elegans</i>
6	<i>Ischnura pumilio</i>
7	<i>Lestes barbarus</i>
8	<i>Lestes virens</i>
9	<i>Erythromma lindenii</i>
10	<i>Erythromma najas</i>
11	<i>Enallagma cyathigerum</i>
12	<i>Erythromma viridulum</i>
13	<i>Aeshna isoceles</i>
14	<i>Aeshna affinis</i>
15	<i>Aeshna mixta</i>
16	<i>Brachytron pratense</i>
17	<i>Anax imperator</i>
18	<i>Anax parthenope</i>
19	<i>Gomphus vulgatissimus</i>
20	<i>Onychogomphus forcipatus</i>
21	<i>Cordulia aenea</i>
22	<i>Libellula depressa</i>
23	<i>Libellula quadrimaculata</i>
24	<i>Orthetrum albistylum</i>
25	<i>Orthetrum cancellatum</i>
26	<i>Crocothemis erythraea</i>
27	<i>Sympetrum meridionale</i>
28	<i>Sympetrum fonscolombii</i>
29	<i>Sympetrum vulgatum</i>
30	<i>Sympetrum depressiusculum</i>
31	<i>Sympetrum sanguineum</i>
32	<i>Sympetrum flaveolum</i>
33	<i>Sympetrum striolatum</i>
34	<i>Leucorrhinia pectoralis</i>

Table 4. List of Odonata species for Prespa and Ohrid region according to literature data.

Odonata species (Prespa - Ohrid region)	Odonata species (Prespa region and the surrounding)
1 <i>Calopteryx virgo</i>	1 <i>Calopteryx virgo</i>
2 <i>Calopteryx splendens</i>	2 <i>Calopteryx splendens</i>
3 <i>Platycnemis pennipes</i>	3 <i>Platycnemis pennipes</i>
4 <i>Lestes barbarus</i>	4 <i>Lestes barbarus</i>
5 <i>Lestes dryas</i>	5 <i>Lestes dryas</i>
6 <i>Lestes sponsa</i>	6 <i>Lestes virens</i>
7 <i>Lestes virens</i>	7 <i>Ischnura elegans</i>
8 <i>Ischnura elegans</i>	8 <i>Ischnura pumilio</i>
9 <i>Ischnura pumilio</i>	9 <i>Coenagrion pulchellum</i>
10 <i>Coenagrion pulchellum</i>	10 <i>Coenagrion puella</i>
11 <i>Coenagrion puella</i>	11 <i>Coenagrion scitulum</i>
12 <i>Coenagrion scitulum</i>	12 <i>Sympecma fusca</i>
13 <i>Sympecma fusca</i>	13 <i>Erythromma lindenii</i>
14 <i>Erythromma lindenii</i>	14 <i>Erythromma najas</i>
15 <i>Erythromma najas</i>	15 <i>Erythromma viridulum</i>
16 <i>Erythromma viridulum</i>	16 <i>Enallagma cyathigerum</i>
17 <i>Enallagma cyathigerum</i>	17 <i>Brachytron pratense</i>
18 <i>Pyrrhosoma nymphula</i>	18 <i>Aeshna isoceles</i>
19 <i>Brachytron pratense</i>	19 <i>Aeshna affinis</i>
20 <i>Aeshna isoceles</i>	20 <i>Aeshna mixta</i>
21 <i>Aeshna affinis</i>	21 <i>Anax imperator</i>
22 <i>Aeshna mixta</i>	22 <i>Anax parthenope</i>
23 <i>Aeshna juncea</i>	23 <i>Cordulia aenea</i>
24 <i>Aeshna cyanea</i>	24 <i>Cordulegaster heros</i>
25 <i>Anax imperator</i>	25 <i>Cordulegaster bidentata</i>
26 <i>Anax parthenope</i>	26 <i>Onychogomphus forcipatus</i>
27 <i>Cordulia aenea</i>	27 <i>Gomphus vulgatissimus</i>
28 <i>Cordulegaster heros</i>	28 <i>Gomphus schneiderii</i>
29 <i>Cordulegaster bidentata</i>	29 <i>Orthetrum albistylum</i>
30 <i>Onychogomphus forcipatus</i>	30 <i>Orthetrum cancellatum</i>
31 <i>Gomphus vulgatissimus</i>	31 <i>Libellula depressa</i>
32 <i>Gomphus schneiderii</i>	32 <i>Libellula quadrimaculata</i>
33 <i>Orthetrum brunneum</i>	33 <i>Crocothemis erythraea</i>
34 <i>Orthetrum coerulescens</i>	34 <i>Sympetrum meridionale</i>
35 <i>Orthetrum albistylum</i>	35 <i>Sympetrum fonscolombii</i>
36 <i>Orthetrum cancellatum</i>	36 <i>Sympetrum vulgatum</i>
37 <i>Libellula depressa</i>	37 <i>Sympetrum flaveolum</i>
38 <i>Libellula quadrimaculata</i>	38 <i>Sympetrum sanguineum</i>
39 <i>Libellula fulva</i>	39 <i>Sympetrum striolatum</i>

Odonata species (Prespa - Ohrid region)		Odonata species (Prespa region and the surrounding)	
40	<i>Crocothemis erythraea</i>	40	<i>Sympetrum depressiusculum</i>
41	<i>Sympetrum meridionale</i>	41	<i>Leucorrhinia pectoralis</i>
42	<i>Sympetrum fonscolombii</i>		
43	<i>Sympetrum vulgatum</i>		
44	<i>Sympetrum flaveolum</i>		
45	<i>Sympetrum sanguineum</i>		
46	<i>Sympetrum striolatum</i>		
47	<i>Sympetrum depressiusculum</i>		
48	<i>Leucorrhinia pectoralis</i>		
49	<i>Somatochlora flavomaculata</i>		