

Mediterranean Freshwater Key Biodiversity Areas: a new standard to highlight important sites for conservation of threatened dragonflies

Violeta Barrios¹, Elisa Alcázar¹, Ari Kivelä¹, Geert De Knijf^{2,3}, Catherine Numa¹

¹IUCN Centre for Mediterranean Cooperation, Malaga, Spain

²Research Institute for Nature and Forest, Brussels, Belgium

³Co-chair IUCN/SSC Dragonfly Specialist Group

Violeta Barrios [violeta.barrios@iucn.org]

Abstract

This article presents sites identified as Freshwater Key Biodiversity Areas (KBAs) in the Mediterranean Hotspot which are important for threatened Odonata species. The article also introduces the recently launched IUCN Global Standard for the identification of KBAs and how it can be applied as a conservation tool for freshwater species.

Keywords: Odonata, Freshwater Key Biodiversity Area, Conservation, Mediterranean Basin Hotspot

The IUCN Centre for Mediterranean Cooperation, together with key experts and partners from the region, identified the freshwater KBAs for the Mediterranean basin (Darwall et al., 2014, Maíz-Tomé et al., *in press*). Odonata species, together with freshwater plants, molluscs and freshwater fishes, were used as a key group to identify the freshwater KBAs.

Freshwater KBAs are freshwater ecosystems that contribute significantly to the global persistence of freshwater biodiversity. The global standard for identification of KBAs was validated in 2016 by the International Union for Conservation of Nature (IUCN). The standard supports and harmonizes identification of important biodiversity sites. It also helps to identify sites that are neglected in existing approaches or policy making, e.g. small or temporary freshwater bodies that are important for the freshwater biodiversity. The IUCN KBA criteria (Table 1) are based on species' vulnerability and irreplaceability and their purpose is not to include every species or ecosystem within a KBA, but rather to locate and highlight sites that make significant contributions to the global persistence of biodiversity. This means that mainly species with a threatened category at the global level (i.e. Critically Endangered, Endangered or Vulnerable) according to IUCN Red List of Threatened Species will be considered but also those with a restricted range.

Table 1. Overview of the KBA Criteria. More details on each sub-criterion and thresholds are available from IUCN 2016.

KBA Criteria and sub-criteria
A. THREATENED BIODIVERSITY
A1. Threatened species
A2. Threatened ecosystem types
B. GEOGRAPHICALLY RESTRICTED BIODIVERSITY
B. Individual geographically restricted species
B2. Co-occurring geographically restricted species
B3. Geographically restricted assemblages
B4. Geographically restricted ecosystem types
C. ECOLOGICAL INTEGRITY
D. BIOLOGICAL PROCESSES
D1. Demographic aggregations
D3. Recruitment sources
E. IRREPLACEABILITY THROUGH QUANTITATIVE ANALYSIS

The identification of a site as a KBA is unrelated to its legal status, however, they can be invaluable for informing conservation planning and priority-setting. For example, KBAs can support the strategic expansion of protected-area networks toward achievement of the Aichi Biodiversity Targets (in particular Target 11 and 12), as established by the Convention on Biological Diversity (IUCN 2016).

Mediterranean freshwater KBAs and Odonata

Out of the 387 KBA for freshwater taxa identified in the Mediterranean region, 79 host Odonata species (Figure 1) which are all threatened with extinction according to IUCN Red List of Threatened Species (except for *Cordulegaster princeps*, listed as Near Threatened). Most of these sites important for dragonflies and damselflies are found in the eastern part of the Mediterranean or Morocco.

The Mediterranean hosts 165 Odonata species, of which 32 species are considered threatened with extinction and 10 of the latter are endemic to the area (Riservato et al., 2009). This is the case of the Critically Endangered Greek Red Damsel, *Pyrhosoma elisabethae*, which occurs in seven freshwater KBAs and of the Endangered Greek Goldenring (*Cordulegaster helladica*) which is present in ten freshwater KBAs. Additionally, the North African endemic Glittering Demoiselle (*Calopteryx exul*, listed as Endangered) is the Odonata species which occurs in more freshwater KBAs (20) and the Splendid Cruiser (*Macromia splendens*, Vulnerable) occurs in 15 freshwater KBAs of western Mediterranean. Table 2 at the end presents the Mediterranean freshwater KBAs where Odonata species are present.

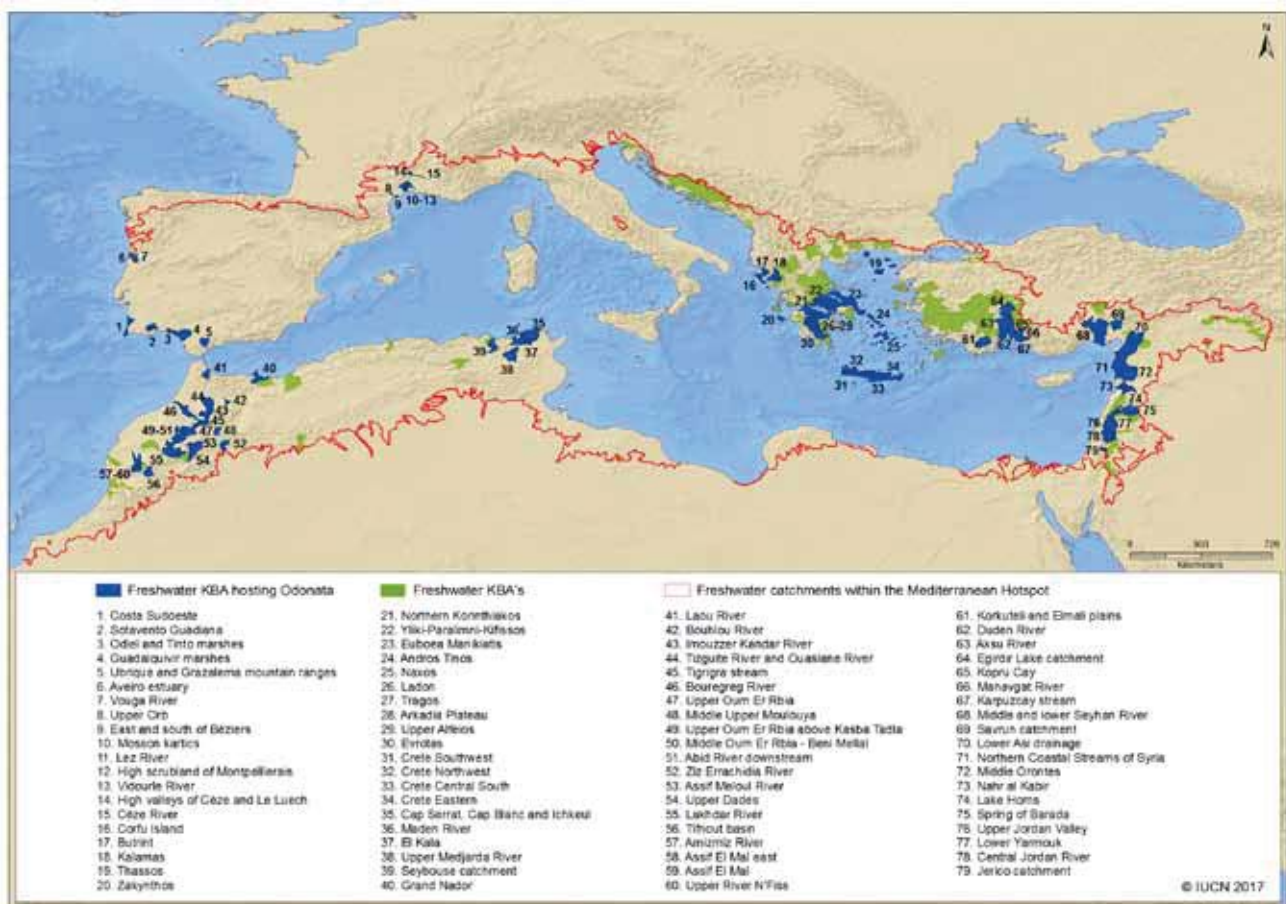


Figure 1. Mediterranean freshwater KBAs important for threatened Odonata species.

Main threats and conservation actions

In the Mediterranean region, Odonata are mainly threatened by increasing demand for drinking water, agricultural irrigation measures, hydrological alterations following construction of dams, over-abstraction of surface and ground waters, water pollution, land development, and invasive species (Boudot et al., 2009).

Out of the 79 freshwater KBAs hosting key Odonata species, 75.95% overlap with existing protected areas (based on an analysis done with Protected Planet material, UNEP-WCMC & IUCN, 2017). However, the effectiveness of protected areas for freshwater biodiversity is often questioned for many reasons including a lack of consideration of freshwater needs when designing and declaring protected areas, fewer resources devoted to freshwater conservation management than to other actions, and poor understanding of complex management problems beyond the limits of the protected area (Hermoso et al., 2016).

As a step further, currently four river basins (Litani river, Sebou river, Douro river and Vjosa river) in the

Mediterranean region, all of them encompassing freshwater KBAs, have been selected as they typify the range of threats for the region. These areas will act as pilot sites to act upon and to demonstrate tangible conservation actions which offer the potential for solutions that could be replicated regionally.

An increased attention to reducing the threats to freshwater in areas under protection, as well as designation and management of additional areas, are needed to safeguard freshwater flows, and support biodiversity conservation and the provision of freshwater ecosystem services (Harrison et al., 2016). The identification of KBAs targeting sites already known to be important for freshwater biodiversity can be a first step in this regard.

Table 2. Summary of freshwater KBAs important for Odonata species in the Mediterranean region. Mediterranean endemic species are highlighted with an asterisk (*).

Species	IUCN Red List Category	Freshwater KBA name	Country	No. in Fig. 1
<i>Boyeria cretensis*</i>	Endangered (EN)	Crete Central South	Greece	33
		Crete Eastern	Greece	34
		Crete Northwest	Greece	32
		Crete Southwest	Greece	31
<i>Brachythemis fuscopalliata</i>	Vulnerable (VU)	Aksu River	Turkey	63
		Duden River	Turkey	62
		Lower Asi drainage	Turkey, Syria	70
		Northern Coastal Streams of Syria	Syria	71
<i>Calopteryx exul*</i>	Endangered (EN)	Abid River downstream	Morocco	51
		Assif Meloul River	Morocco	53
		Bouhlou River	Morocco	42
		Bouregreg River	Morocco	46
		El Kala	Algeria, Tunisia	37
		Grand Nador	Morocco, Spain	40
		Imouzzer Kandar River	Morocco	43
		Lakhdar River	Morocco	55
		Laou River	Morocco	41
		Maden River	Tunisia	36
		Middle Oum Er Rbia - Benia Mellal	Morocco	50
		Middle Upper Moulouya	Morocco	48
		Seybouse catchment	Algeria	39
		Tigrigra stream	Morocco	45
		Tizguite River and Ouaslane River	Morocco	44
		Upper Dades	Morocco	54
		Upper Medjarda River	Algeria	38
Upper Oum Er Bbia above Kasba Tadla	Morocco	49		
Upper Oum Er Rbia	Morocco	47		
Ziz Errachidia River	Morocco	52		

Species	IUCN Red List Category	Freshwater KBA name	Country	No. in Fig. 1
<i>Calopteryx hyalina</i> *	Endangered (EN)	Lake Homs	Lebanon, Syria	74
		Middle Orontes	Syria	72
		Nahr al Kabir	Lebanon, Syria	73
		Spring of Barada	Lebanon, Syria	75
<i>Calopteryx syriaca</i> *	Endangered (EN)	Central Jordan River	Lebanon, Syria	78
		Jerico catchment	Palestine	79
		Lower Yarmouk	Jordan, Syria	77
		Upper Jordan Valley	Jordan, Lebanon, Syria	76
<i>Ceriagrion georgifreyi</i> *	Vulnerable (VU)	Corfu Island	Greece	16
		Thassos	Greece	19
		Zakynthos	Greece	20
<i>Coenagrion intermedium</i> *	Vulnerable (VU)	Crete Central South	Greece	33
		Crete Eastern	Greece	34
		Crete Northwest	Greece	32
		Crete Southwest	Greece	31
<i>Cordulegaster helladica</i> *	Endangered (EN)	Andros Tinos	Greece	24
		Arkadia Plateau	Greece	28
		Euboea Manikiatis	Greece	23
		Evrotas	Greece	30
		Ladon	Greece	26
		Naxos	Greece	25
		Northern Korinthiakos	Greece	21
		Tragos	Greece	27
		Upper Alfeios	Greece	29
		Yliki-Paralimni-Kifissos	Greece	22
<i>Cordulegaster princeps</i> *	Near Threatened (NT)	Abid River downstream	Morocco	51
		Amizmiz River	Morocco	57
		Assif El Mal	Morocco	59
		Assif El Mal east	Morocco	58
		Assif Meloul River	Morocco	53
		Bouhlou River	Morocco	42
		Imouzzer Kandar River	Morocco	43
		Lakhdar River	Morocco	55
		Middle Upper Moulouya	Morocco	48
		Tifnout Basin	Morocco	56
		Tigrigra stream	Morocco	45
		Upper Dades	Morocco	54
		Upper Oum Er Rbia	Morocco	47
Upper River N'Fiss	Morocco	60		

Species	IUCN Red List Category	Freshwater KBA name	Country	No. in Fig. 1
<i>Gomphus lucasii</i> *	Vulnerable (VU)	Cap Serrat, Cap Blanc and Ichkeul	Tunisia	35
		El Kala	Algeria, Tunisia	37
		Maden River	Tunisia	36
		Seybouse catchment	Algeria	39
		Upper Medjarda River	Algeria, Tunisia	38
<i>Macromia splendens</i>	Vulnerable (VU)	Aveiro estuary	Portugal	6
		Céze River	France	15
		Costa Sudoeste	Portugal	1
		East and south of Béziers	France	9
		Guadalquivir marshes	Spain	4
		High scrubland of Montpellierais	France	12
		High valleys of Céze and Le Luech	France	14
		Lez River	France	11
		Mosson karstics	France	10
		Odiel and Tinto marshes	Spain	3
		Sotavento Guadiana	Portugal	2
		Ubrique and Grazalema mountain ranges	Spain	5
		Upper Orb	France	8
		Vidourle River	France	13
Vouga River	Portugal	7		
<i>Onychogomphus assimilis</i>	Vulnerable (VU)	Aksu River	Turkey	63
		Duden River	Turkey	62
		Egirdir Lake catchment	Turkey	64
		Karpuzcay stream	Turkey	67
		Kopru Cay	Turkey	65
		Korkuteli and Elmali plains	Turkey	61
		Manavgat River	Turkey	66
Middle and lower Seyhan River	Turkey	68		
<i>Onychogomphus macrodon</i> *	Endangered (EN)	Central Jordan River	Lebanon, Syria	78
		Lower Asi drainage	Syria, Turkey	70
		Savrun catchment	Turkey	69

Species	IUCN Red List Category	Freshwater KBA name	Country	No. in Fig. 1
<i>Pyrrhosoma elisabethae</i> *	Critically Endangered (CR)	Arkadia Plateau	Greece	28
		Butrint	Albania	17
		Corfu Island	Greece	16
		Kalamas	Greece	18
		Ladon	Greece	26
		Tragos	Greece	27
		Upper Alfeois	Greece	29

Acknowledgements

We would like to thank Dejan Kulijer and Boudjéma Samraoui for sharing their extensive knowledge on the occurrence of dragonflies of the Balkans and of North Africa respectively and for their contribution in the designation and evaluation of KBAs in the Mediterranean.

References

- Boudot, J.P., Kalkman, V.J., Azpilicueta Amorín, M., Bogdanović, Cordero Rivera, T.A., Degabriele, G., Dommanget, J.L., Ferreira, S., Garrigós, B., Jović, M., Kotarac, M., Lopau, W., Marinov, M., Mihoković, N., Riservato, E., Samraoui, B. and Schneider, W., 2009. Atlas of the Odonata of the Mediterranean and North Africa. Libellula Supplement 9, 256 pp.
- Darwall, W., Carrizo, S., Numa, C., Barrios, V., Freyhof, J. and Smith, K., 2014. *Freshwater Key Biodiversity Areas in the Mediterranean Basin Hotspot: Informing species conservation and development planning in freshwater ecosystems*. Cambridge, UK and Malaga, Spain: IUCN. x + 86pp. Available at: [<https://www.iucn.org/content/key-biodiversity-areas-mediterranean-basin-hotspot>].
- Harrison, I. J., Green, P. A., Farrell, T. A., Juffe-Bignoli, D., Sáenz, L., and Vörösmarty, C. J., 2016. Protected areas and freshwater provisioning: a global assessment of freshwater provision, threats and management strategies to support human water security. *Aquatic Conserv: Mar. Freshw. Ecosyst.*, 26: 103–120. [doi: 10.1002/aqc.2652].
- Hermoso, V., Abell, R., Linke, S., and Boon, P., 2016. The role of protected areas for freshwater biodiversity conservation: challenges and opportunities in a rapidly changing world. *Aquatic Conserv: Mar. Freshw. Ecosyst.*, 26: 3–11. [doi: 10.1002/aqc.2681].
- IUCN, 2016. A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0. First edition. Gland, Switzerland: IUCN. Available at: [<https://portals.iucn.org/library/node/46259>].
- Maíz-Tomé, L., Darwall, W., Smith, K.G., Numa, C., Barrios, V. (in press). *Freshwater Key Biodiversity Areas in the North Western Mediterranean. Informing species conservation and development planning in freshwater ecosystems*. IUCN, Cambridge, UK and Malaga, Spain.
- Riservato, E., Boudot, J.P., Ferreira, S., Jović, M., Kalkman, V.J., Schneider, W., Samraoui, B., Cuttelod, A., 2009. The Status and Distribution of Dragonflies of the Mediterranean Basin. Gland, Switzerland and Malaga, Spain: IUCN. vii + 33 pp. Available at: [https://www.iucn.org/downloads/mediterranean_dragonflies_en_web.pdf].
- UNEP-WCMC & IUCN, 2017. Protected Planet: The World Database on Protected Areas (WDPA). Downloaded June 2017, Cambridge, UK: UNEP-WCMC and IUCN. Available at: [www.protectedplanet.net].