

Checklist of Odonata of Sidi Bel Abbes, Northwest Algeria

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Abstract: The odonates of Algeria have been studied for more than a century and a half, but the Northwestern part of the country has historically received little attention. A recent study in central North Algeria reported a species new to the country, suggesting that new investigations in unexplored areas are necessary to fully understand the local odonatofauna. We studied assemblages of odonates in 23 sites in Sidi Bel Abbes (Northwest Algeria) by bimonthly recording adults across a 200 m-transect from May to August of 2019–2022. Our sampling yielded 29 species (13 damselflies and 16 dragonflies) belonging to 19 genera and seven families. We recorded a new locality for the regionally endangered *Coenagrion mercuriale*, expanding the western range limit of the species in Algeria. We documented the occurrence of *Selysiothemis nigra*, a species that has recently become more frequent in North Africa. *Ischnura pumilio* and *Onychogomphus forcipatus unguiculatus*, which are relatively rare in the region, were also recorded. The arid-dwelling *Trithemis kirbyi* and the Mediterranean endemic *Orthetrum nitidinerve* were quite common in the study area. This study fills an important gap of knowledge in our understanding of odonate geographic distribution in North Africa.

Keywords: dragonflies; North Africa; rare species; endemic



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1. Introduction

The odonates of Algeria have received research attention for more than a century and a half [1–3]. Odonatological studies in this country have peaked during the last decade [4–9], including species newly reported in the region (e.g., *Pyrrhosoma nymphula* [10]), and many new localities to species of conservation concern (e.g., *Calopteryx exul* [7,11,12], *Urothemis edwardsii*, [13,14], and *Lindenia tetraphylla*, [15]). These recent observations suggest that more species and populations of rare species are likely to be recorded in unexplored areas. Thus, new studies are needed to better understand the geographic distribution of species and the diversity of odonates in North Africa.

There is a total of 64 species of odonates currently known in Algeria (24 Zygoptera and 40 Anisoptera) [10,16]. There have been a large number of studies in the Northeastern part of the country, particularly in the Seybouse region and National Park of El Kala [4,13,17,18]. More recently, some studies have explored the odonate assemblages of watersheds in the central North regions of the country [6,7,19,20]. However, the Northwestern part of the country is still relatively unexplored. This region is particularly interesting because it is near the geographic range of relict populations of Palearctic (*Orthetrum brunneum*) and Afrotropical (*Pseudagrion sublacteum*) species as well as endemics (*Onychogomphus boudoti*) that could potentially exist in Western Algerian wetlands [21–23]. In addition, the North African endemic *Gomphus lucasii* is suggested to have its extreme western limit near the border between Algeria and Morocco, where it is replaced by the congeneric *G. simillimus* [24]. Investigating the wetlands of Northwestern Algeria is an opportunity to confirm the absence or presence of these species and pinpoint the longitudinal range margin of local odonates.

In this study, we investigated the odonate assemblages in Sidi Bel Abbas, a North-western Algerian province that has not been studied before. During the flight season of 2019–2022, we explored 23 sites that are widely distributed across the province and encompass different habitat types (lotic and lentic) in an effort to increase the knowledge of the geographic distribution of odonates in Algeria.

2. Materials and Methods

The climate of the study area (Sidi Bel Abbas, Northwest Algeria) is Mediterranean with a hot and dry summer and a cool and wet winter. Based on Köppen climate classification Csa [25], Sidi Bel Abbas has a hot-summer Mediterranean climate. The average annual temperature in the area is 15 °C (7–22 °C), whereas the annual precipitation is 410 mm. The province is 75 km away from the Mediterranean Sea. Agriculture consisting of wheat, barley, and grape is widespread in the province, especially near wetlands. We sampled 23 sites across Sidi Bel Abbas (Figure 1), of which 9 were lentic and 14 were lotic (Table 1; Figure 2). The lotic sites included rivers (N = 5) and streams (N = 9), whereas the lentic sites included ponds (N = 7) and dams (N = 2).

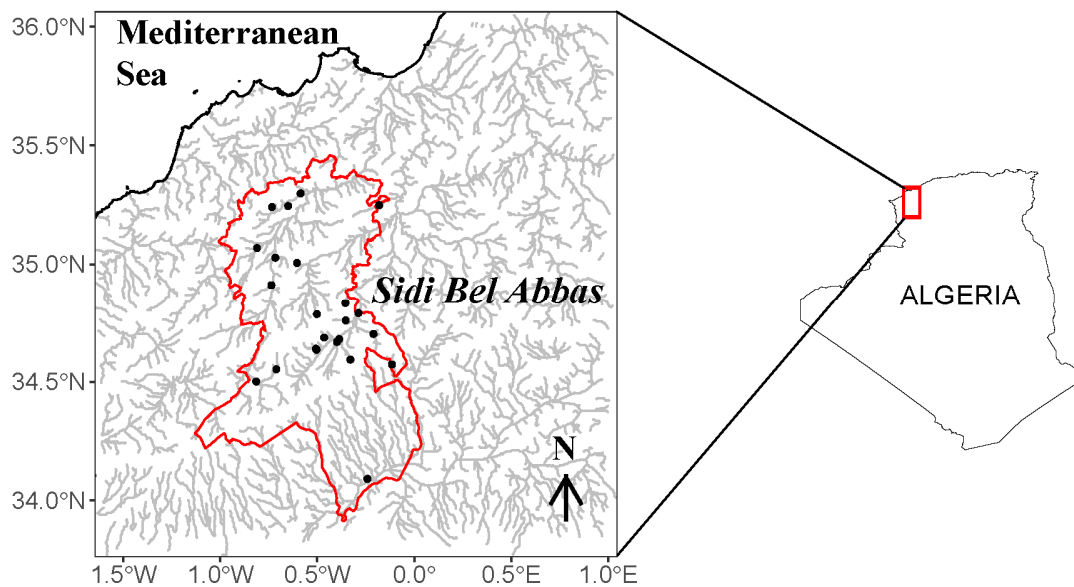


Figure 1. Study sites in Sidi Bel Abbas, Northwest Algeria.



Figure 2. Habitat types surveyed in this study. (a) pond (Site 3); (b) stream (Site 6); and (c) river (Site 18).

Table 1. Geographic location, altitude, and habitat characteristics of study sites.

Site	Code	Latitude (°)	Longitude (°)	Altitude (m)	Lentic/Lotic	Habitat Type
Lac de Sidi Mohamed Benali	S1	35.245048	−0.65025	458	Lentic	Pond
Barrage Sarno	S2	35.298252	−0.58609	417	Lentic	Dam
Retenue collinaire d'Oued Sebaa	S3	34.553155	−0.711152	1183	Lentic	Pond
Retenue Taoudmout	S4	34.573420	−0.11457	1152	Lentic	Pond
Retenue Tessala	S5	35.24049	−0.733454	500	Lentic	Pond
Source Khacheba	S6	34.593752	−0.329115	1160	Lotic	Stream
Source Tazemoura	S7	34.786333	−0.501930	921	Lotic	Stream
Retenue Sfisef	S8	35.248460	−0.18047	485	Lentic	Pond
Oued Ain Bent Soltane	S9	34.68041	−0.387070	911	Lotic	River
Source Sidi Yahia	S10	34.635759	−0.504054	1079	Lotic	Stream
Source Sidi Yahia 2	S11	34.639784	−0.506616	1067	Lotic	Stream
Source Pont Noir	S12	34.791100	−0.288126	768	Lotic	Stream
Source Djeffafa	S13	34.759732	−0.353169	896	Lotic	Stream
Oued Toundmi (Ain Bent Soltane)	S14	34.668143	−0.39836	933	Lotic	River
Source Zid Elmoumen	S15	34.83418	−0.354758	843	Lotic	Stream
Barrage Tabia	S16	35.027513	−0.716042	591	Lentic	Dam
Retenue collinaire Lamtar	S17	35.068178	−0.810801	580	Lentic	Pond
Oued Mekkeria region Sidi Ali Benyoub	S18	34.911643	−0.736484	704	Lotic	River
Source Ferme Chaib Marhoum	S19	34.090414	−0.241607	997	Lotic	Stream
Oued de Ras Elma–Karzouta	S20	34.501216	−0.815072	1089	Lotic	River
Source Ain Dradza	S21	34.68702	−0.464455	1100	Lotic	Stream
Retenue Ferme Hdjira	S22	35.005486	−0.604810	663	Lentic	Pond
Oued Tafessour	S23	34.702278	−0.210002	1000	Lotic	River

Our study took place from May to August of 2019–2022. Our visits were carried out in the morning (09:00–11:00) and late afternoon (16:00–18:00), periods when dragonflies are active in the region. We visited each site twice per month, recording the adults across a transect of 200 m along the banks of each site. To avoid damaging individuals, adults were generally photographed on-site without capture. Usually, pictures were sufficient to identify the adults to the species level. In cases where identification was challenging, we captured the adults with a hand net, took pictures of important morphological traits, and then released them in the same capture location. Since this study focused on the occurrence rather than the abundance of species, our sampling was adequate to determine species richness and the assemblage composition of odonates.

3. Results and Discussion

We recorded a total of 29 species (13 Zygoptera and 16 Anisoptera), belonging to 19 genera and seven families (Table 2; Figure 3). This represents 45% of all species that occur in Algeria (54% of zygopterans and 40% of anisopterans). Libellulidae was the dominant family among Anisoptera, with 11 species, whereas Coenagrionidae was the dominant family among Zygoptera, with eight species. This is often the case for North African studies, e.g., [5,7], and it is due to the high diversity of these taxonomic groups and the large geographic distribution of species belonging to these groups [24]. *Orthetrum* was the most represented genus among Anisoptera with five species, representing 83% of all *Orthetrum* species reported in Algeria [16].



Figure 3. Pictures of some odonate species found in this study. (a) *Coenagrion mercuriale*; (b) *Orthetrum nitidinerve* (Mediterranean endemic); and (c) *Trithemis kirbyi*.

Table 2. Checklist with frequency and altitudinal range of odonate species recorded in this study.

Suborder	Family	Species	Sites	Freq	Alt_Range (m)
Zygoptera	Calopterygidae	<i>Calopteryx haemorrhoidalis</i>	S11, S12, S13, and S7	4	768–1067
Zygoptera	Coenagrionidae	<i>Ceriagrion tenellum</i>	S3, S7	2	921–1183
Zygoptera	Coenagrionidae	<i>Coenagrion caerulescens</i>	S10, S11, S12, S13, S14, S17, S23, S4, and S6	9	580–1160
Zygoptera	Coenagrionidae	<i>Coenagrion mercuriale</i>	S21	1	1100–1100
Zygoptera	Coenagrionidae	<i>Enallagma deserti</i>	S3, S4	2	1152–1183
Zygoptera	Coenagrionidae	<i>Erythromma lindenii</i>	S12, S14, S17, S18, S21, S23, S3, S4, and S6	9	580–1183
Zygoptera	Coenagrionidae	<i>Erythromma viridulum</i>	S4	1	1152–1152
Zygoptera	Coenagrionidae	<i>Ischnura graellsii</i>	S1, S12, S13, S14, S18, S23, S3, and S4	8	458–1183
Zygoptera	Coenagrionidae	<i>Ischnura pumilio</i>	S23, S4	2	1000–1152
Zygoptera	Lestidae	<i>Chalcolestes viridis</i>	S12	1	768–768
Zygoptera	Lestidae	<i>Lestes barbarus</i>	S3	1	1183–1183
Zygoptera	Lestidae	<i>Sympecma fusca</i>	S22	1	663–663
Zygoptera	Platycnemididae	<i>Platycnemis subdilatata</i>	S14, S18	2	704–933
Anisoptera	Aeshnidae	<i>Anax imperator</i>	S1, S18, S2, S22, S3, S4, S6, and S7	8	417–1183
Anisoptera	Aeshnidae	<i>Anax parthenope</i>	S1, S4	2	458–1152
Anisoptera	Aeshnidae	<i>Hemianax ephippiger</i>	S4	1	1152–1152
Anisoptera	Gomphidae	<i>Onychogomphus costae</i>	S12	1	768–768
Anisoptera	Gomphidae	<i>Onychogomphus forcipatus unguiculatus</i>	S12	1	768–768
Anisoptera	Libellulidae	<i>Brachythemis impartita</i>	S1, S17, S2, S5	4	417–580
Anisoptera	Libellulidae	<i>Crocothemis erythraea</i>	S1, S12, S14, S15, S18, S19, S2, S23, S4, S6, and S8	11	417–1160
Anisoptera	Libellulidae	<i>Orthetrum cancellatum</i>	S3	1	1183–1183
Anisoptera	Libellulidae	<i>Orthetrum chrysostigma</i>	S4	1	1152–1152
Anisoptera	Libellulidae	<i>Orthetrum coerulescens</i>	S12, S5	2	500–768
Anisoptera	Libellulidae	<i>Orthetrum nitidinerve</i>	S10, S11, S12, S14, S17, S18, S19, S21, S23, S6, and S9	11	580–1160
Anisoptera	Libellulidae	<i>Orthetrum trinacria</i>	S1	1	458–458
Anisoptera	Libellulidae	<i>Selysiothemis nigra</i>	S2	1	417–417
Anisoptera	Libellulidae	<i>Sympetrum fonscolombii</i>	S1, S12, S13, S17, S18, S19, S2, S20, S23, S3, S4, S6, S7, and S8	14	417–1183
Anisoptera	Libellulidae	<i>Trithemis annulata</i>	S1, S12, S13, and S5	4	458–896
Anisoptera	Libellulidae	<i>Trithemis kirbyi</i>	S12, S13, S15, S18, S20, S23, S6, S7, S8, and S9	10	485–1160

Freq: frequency; Alt_range: altitudinal range.

Across the 23 sites, local species richness varied between one and 13 species (Table S1). The frequency of species (the number of sites where a species was observed) varied from one site (e.g., *Onychogomphus costae*, *Selysiotthemis nigra*) to 14 sites (*Sympetrum fonscolombii*) (Table 2). The frequency of species across sites was partly similar to what has been reported in other studies in North Africa [9], but there are some marked differences in some species. Concordant with other studies, some species were widespread (*Anax imperator*, *Crocothemis erythraea*, *S. fonscolombii*, *Coenagrion caerulescens*, *Erythromma lindenii*, and *Ischnura graellsii*). These species are not only generalists that tolerate human disturbance, habitat fragmentation, and pollution, but they also have long flight seasons [24]. *Orthetrum nitidinerve*, a Mediterranean endemic, seems relatively widespread in the area, occurring in 11 sites (48% of all sites). This frequency is comparable to that recorded in the Seybouse watershed in Northeast Algeria [4], but higher than that recorded in studies carried out in Chott Melghir basin [9] and the sub-basin of Haute Mina [20]. Some species such as *O. costae*, *Orthetrum cancellatum*, *O. chrysostigma*, *Chalcolestes viridis*, *Sympecma fusca*, and *Platycnemis subdilatata* were relatively rare in this study but are typically widespread in the Northeast [4] and elsewhere in the region. However, *T. kirbyi*, which was recorded in 10 sites in this study, has usually been reported in only a few sites in other studies [5,6,20]. This species is typically more frequent in arid areas but seems to have expanded its range to the North, perhaps due to climate change [26,27]. *T. kirbyi* was recorded in only three sites in the sub-basin of Haute Mina [20], three sites in Bejaia region [6], four sites in the Seybouse watershed [4], and seven sites in Chott Melghir basin [9].

The new locality for *C. mercuriale*, which is listed as near-threatened globally but endangered locally, is noteworthy because it expands the geographic distribution of this locally endangered species, which has a sporadic distribution in North Africa [22]. The site where the species was found was upstream, near its water source and far from human disturbance. The low frequency of the species was probably due to its sensitivity to water pollution. The highest concentration of localities for *C. mercuriale* in Algeria is in the Seybouse watershed [4]. Preliminary studies in the Seybouse watershed recorded only two sites for the species [5], but more sampling efforts yielded 12 sites [4]. Hence, increasing the sampling efforts in Sidi Bel Abbes, especially in streams and springs with high water quality, might reveal new populations of *C. mercuriale*. This type of lotic habitat is relatively common in our region.

Both *I. pumilio* and *O. forcipatus unguiculatus* have patchy distributions in Algeria [24] and are relatively rare in the East, where they were recorded in a few localities [4]. Our records expand the range limit of the species in western Algeria. Both species seem to live in small populations in the region, exhibiting numbers that are far lower than their often-sympatric congeners, *I. graellsii* and *O. costae*.

The two North African endemic species *G. lucasii* and *C. exul*, which have been recorded in several new localities in the east and center [11,12,17], have not been recorded in our study. These two species often share the same lotic habitat both as larvae and adults [4]. While their absence could be due to non-detection (e.g., the short flight season of *G. lucasii* makes it less likely to observe with low sampling frequency [28]), both species could genuinely be absent due to drought, habitat fragmentation, and pollution [29].

Selysiotthemis nigra was first discovered in the coast of Algeria in August 2013 on the banks of Lac Mezaïa in Béjaïa (Northern Algeria) [30] and more recently in the Kabylia region [6]. The species was recorded in Morocco more than a decade ago near the Sahara edge [31]. In our study, we found a single individual of the species in a single locality. This record expands the longitudinal range limit of the species in the country. However, unlike in lac Mezaïa where several individuals as well as breeding pairs were observed, our observed individual was probably vagrant, and no reproductive population has been established in the area yet. Nonetheless, the increase in the number of records in North Africa and Europe during the last two decades might be due to a range expansion.

Some relatively common species such as *L. virens* and *T. arteriosa* have not been reported in this study, but they might have been missed during our sampling due to the

absence of sampling of relatively small shallow ponds, which represent a preferred habitat for these species in North Africa. Our sampling was limited to the spring and summer; thus, it did not include the autumnal species such as *Aeshna mixta*, *S. striolatum*, and *S. meridionale*, which should exist in the area based on their widespread distribution elsewhere in the Mediterranean part of the country. Finally, four species that occur in Morocco (*G. simillimus*, *O. boudoti*, *O. brunneum*, and *P. sublacteum*) were not recorded in our study. More studies in provinces at the Moroccan border (e.g., Tlemcen and Saïda) are needed to determine their presence or absence in the Algeria.

Regarding the altitudes where the species were recorded (Table 2), our observations fall within the known altitudinal range of odonates in North Africa. For instance, *C. mercuriale* was recorded at 1100 m, which is higher than all the localities recorded in the Seybouse watershed in Northeast Algeria, but the species reaches 2100 m in Morocco [21]. *Onychogomphus forcipatus unguiculatus* is usually found in lowland rivers in Morocco and Algeria [32], which corresponds to the altitude where the species was found in this study (768 m). *Orthetrum nitidinerve* was found at altitudes spanning 580–1160 m in this study, but the species was recorded at 1900 m in Morocco [21]. An understanding of the altitudinal distribution of species is crucial to document altitudinal range dynamics due to climate change and other anthropogenic factors.

This study presents new records for dragonflies and damselflies in Algeria, helping us to better understand the geographic distribution of odonates in Northwestern Algeria, an area that has historically received limited research attention. We recorded the locally Endangered *C. mercuriale* and the locally rare *I. pumilio*, as well as new localities for locally rare species such as *Selysiothemis nigra* and *Trithemis kirbyi*. Our study highlights the need of new studies to fill the knowledge gaps about the geographic distribution of species in Algeria in particular and North Africa in general.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/hydrobiology1040025/s1>, Table S1: Species occurrence data in the study sites.

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