

Tarbiat Modares University Press  
Entomological Society of Iran**Research Article**  
Biodiversity<https://doi.org/10.52547/jibs.9.1.155>

ISSN: 2423-8112

<https://zoobank.org/urn:lsid:zoobank.org:0A0F944D-B78F-40DD-A648-16C89C50D303>

## Diversity of Odonates (Odonata, Anisoptera & Zygoptera) in the Theniet El Had National Park-North West of Algeria

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**ABSTRACT.** The aim of this study is to make an inventory of the fauna of the Odonata in Theniet El Had National Park, which helps managers to make appropriate decisions for the conservation of these species. The site is entirely forested (*Cedrus* and *Quercus* species) with numerous intra-forest natural environments (clearings, grasslands, rocky habitats, springs, pools and ponds, etc.), this mosaic of habitats harbours a remarkable wealth of fauna and flora. Our study focused on the natural and artificial temporary forest ponds, scattered throughout the park, which are of biological and ecological interest for a very wide range of insects, most notably the hemimetabola. These are characterised by a larval stage that is quite different from the adult stage in terms of habitat and lifestyle, namely odonates, where the larvae are aquatic whereas the adults have an aerial life. The inventory of odonates was carried out through monthly surveys of 8 water bodies (7 forest ponds and one hill reservoir) during one year, from March 2017 to February 2018. This preliminary inventory allowed us to inspect 240 individuals of odonates belonging to 18 species i.e. 11 genera and 5 families. The species recorded at the end of this study are the subject of a cartographic representation showing their distribution at the local scale (in the park) and at the national scale.

**Key words:** Conservation, Damselflies, Dragonflies, Forest, National Park, Biodiversity

**Received:**

01 October, 2022

**Accepted:**

28 December, 2022

**Published:**

01 January, 2023

**Subject Editor:**

Mohsen Kiany

**Citation:** Mairif, M., Bendifallah, L., Doumandji, S. (2023) Diversity of Odonates (Odonata, Anisoptera & Zygoptera) in the Theniet El Had National Park-North West of Algeria. *Journal of Insect Biodiversity and Systematics*, 9 (1), 155–182.

### INTRODUCTION

Owing to their larval development that relies on aquatic environments, adult terrestrial life, and typical behaviours, odonates are one of the most remarkable symbols of wetland biodiversity (Bailleux et al., 2017). They are very sensitive to thermal variations (Grand, 2009) and vulnerable to the alteration and destruction of their habitats (Bailleux et al., 2017). This gives them the quality of bio-descriptors. Moreover, their population dynamics are a biological indicator of the richness of aquatic environments and their sanitary state and water quality (Schmidt, 1985; Castella, 1987; Dommanget, 1989; Moore,

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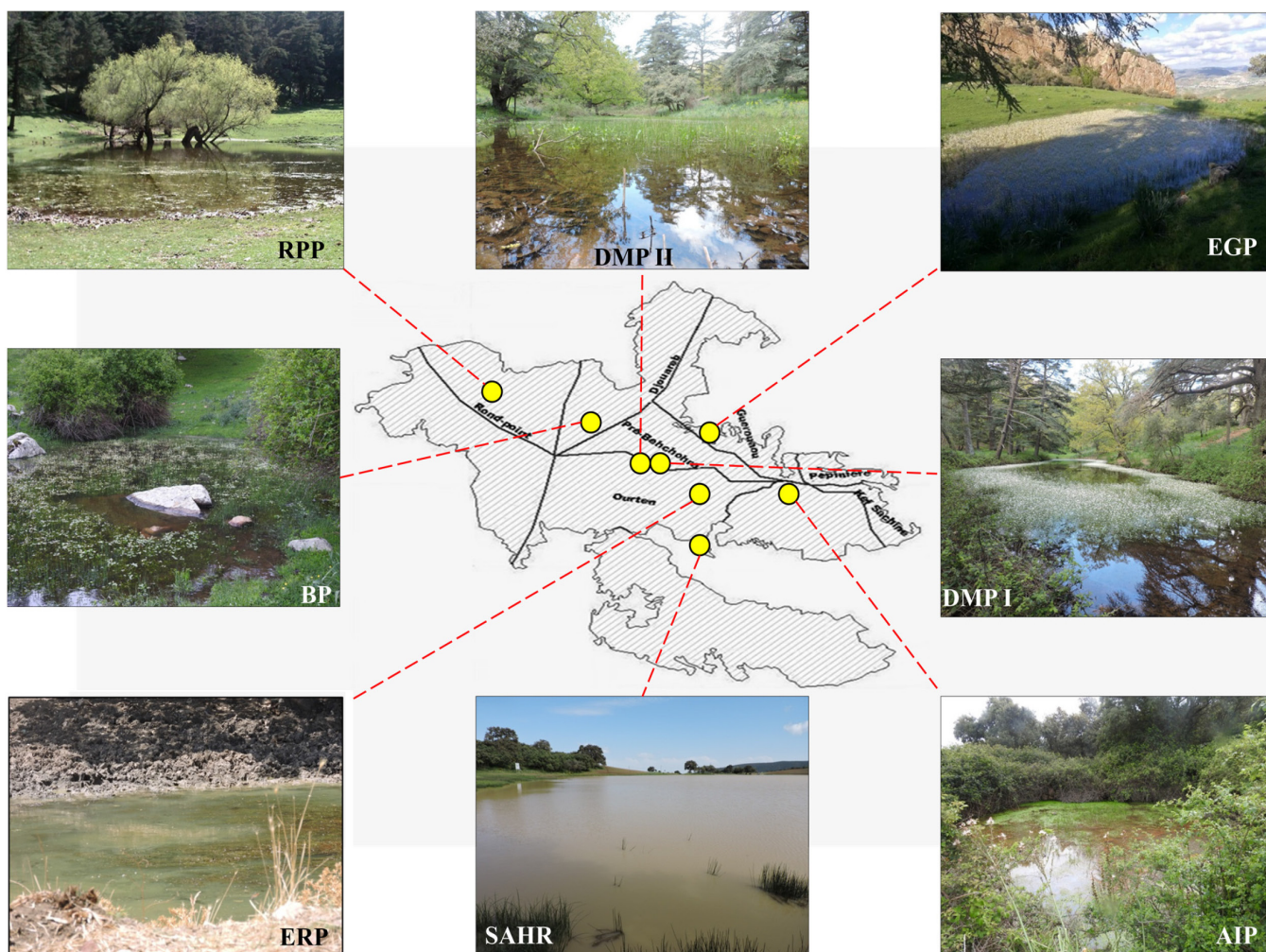
1997; Corbet, 1999; Chovanec & Waringer, 2001; Dijkstra & Lempert, 2003; Oertli et al., 2005; Cotrel & Rouillier, 2007; Indermuhele et al., 2008; Craig et al., 2008; Martín & Maynou, 2016). They colonise both stagnant and running water; each habitat type has its own odonatological assemblage (Bailleux et al., 2017). On a global scale, the species diversity of odonates is estimated at 6361 species (Paulson et al., 2022). The Mediterranean region is home to 165 species, with a particularly high rate of endemism, where about one in seven odonate species is endemic (Riservato et al., 2009). Approximately 92 species and subspecies are found in North Africa, of which Algeria hosts 70% of the total species richness of the North African region, namely 64 taxa (Boudot, 2010).

Odonatological research in Algeria dates back to the 18th century (Sélys, 1849). More than fifty works deal with the Odonata of Algeria (Boudot, 2010). The most recent ones have been carried out in the period from 1978 to 2021 (Dumont, 1978; 2007; Samraoui et al., 1992, 1993, 1998; 2010; Samraoui & Menai, 1999; Samraoui & Corbet, 2000a, 2000b; Khelifa et al., 2011; Benchalel & Samraoui, 2012; Kabouche, 2013; Khelifa et al., 2013; Samraoui & Alfarhan, 2015; Bouchelouch et al., 2015; Zebsa et al., 2015; Guebailia et al., 2016; Khelifa et al. 2016; Hafiane et al., 2016; Benchalel et al., 2017; Yalles Satha & Samraoui, 2017; Djemai & Bounaceur, 2017; Khelifa, 2017; Dumont, 2017; Khelifa & Zebsa, 2018; Senouci & Bounaceur, 2018; Sellam-Bouattoura et al., 2018; Demnati et al., 2019; Chelli & Moulai, 2019; Senouci & Bounaceur, 2021). The northwest of Algeria has not been the subject of exhaustive work, with the exception of a few punctual attempts (Kabouche, 2013; Senouci & Bounaceur, 2018; Senouci & Bounaceur, 2021). In Theniet El Had National Park, this group of insects has not been studied. Our study represents the first odonatological exploration in the Theniet El Had National Park (THNP). We propose to (1) establish a preliminary list of the existing species in this protected area, (2) to know their Spatio-temporal distribution and (3) their phenologies in order to give an inventory that will help the managers of the national park to take the appropriate decisions to protect this entomological group.

## MATERIAL AND METHODS

**Presentation of the study area.** The fieldwork took place in a protected area well known for its ecological importance and diversity, which is the National Park of Théniet El-Had, the first natural area protected in Algeria, on August 03, 1923, by the French colonial government. It is located in the North-West of Algeria in Tissemsilt, a few kilometres from the eponymous town of Théniet El Had in the heart of the Tellian Atlas, 185 km south-west of the capital Algiers, and 150 km from the Mediterranean coast. On 23 July 1983 and by a presidential decree, a large part of the cedar state forest was re-declared a national park, with a total area of 3424.5 ha, its highest point reaching 1787 m (Ras El Braret). It extends over the northern part of the Ouarsenis through ridges and slopes forming numerous Kefs oriented in all directions, resulting in an extremely uneven relief with various exposures dominated by three main branches (North, South and West) (Mairif, 2019). Its bioclimatic stage ranges from sub-humid to humid. The cedar (*Cedrus atlantica* M) forest in this park is unique in western Algeria. It is also one of the rare places in the Mediterranean region where the cork oak (*Quercus suber* L.) grows at an altitude of over 1600 m. It is home to a plethora of animal and plant species, many of which are endemic to Algeria, as well as unique landscapes and natural sites (Bessah, 2005). The national park is characterised by a highly branched hydro-system with the often temporary flow, it is very often strongly incised and ends in a dense gully interspersed with a certain number of pools and temporary ponds. 83 temporary water bodies have been identified in the national park across all cantons and slopes (Kouar, 2016).

**Methodology and choice of study sites.** Given the importance of the number of water bodies in the national park and their heterogeneous distribution in space, eight (8) of the most accessible areas were chosen in order to have the most representative geographical coverage possible (Fig. 1), taking into account the importance in volume, duration and state of submersion. The water bodies were georeferenced by Garmin GPSMAP® 64 (Garmin Ltd, Switzerland). Table 1 summarises the stationary characteristics of the eight sites.



**Figure 1.** Geographical location of the study site, (Abbreviations: **RPP**= Rond-point pond; **DMP I** = Djadj el ma pond I; **EGP** = El gerouaou pond; **BP** = Berdez pond; **DMP II** = Djadj el ma pond II; **ERP** = El radjradja pond; **ATP** = Ain touilla pond; **SAHR** = Sidi abdoune hill reservoir).

**Table 1.** List and characteristics of the sites studied in Theniet El Had National Park.

Site Code	Site name	Township	Latitude	Longitude	Altitude	Area
RPP	Pond of Rond-point	Rond-point	35°52'12"	1°56'48"	1463 m	2 048 m <sup>2</sup>
DMP I	Pond of Djadj El Ma supérieur	Ouartén	35°51'22"	1°58'40"	1505 m	1006 m <sup>2</sup>
DMP II	Pond of Djadj El Ma inférieur	Ouartén	35°51'21"	1°58'43"	1497 m	993 m <sup>2</sup>
EGP	Pond of El Guerouaou	Guerouaou	35°52'06"	1°58'17"	1392 m	978 m <sup>2</sup>
BP	Pond of Berdez	Djouareb	35°52'04"	1°57'38"	1524 m	450 m <sup>2</sup>
ERP	Pond of El Radjradja	Sidi Abdoune	35°50'58"	1°59'04"	1379 m	936 m <sup>2</sup>
ATP	Pond of Ain Touilla	pépinière	35°50'35"	2°00'29"	1370 m	437 m <sup>2</sup>
SAHR	Hill reservoir of Sidi abdoune	Sidi Abdoune	35°50'25"	1°59'10"	1287 m	23 716 m <sup>2</sup>

Field data collection was carried out by means of a field sheet and on the basis of regular monthly surveys, between March 2017 and February 2018. Sampling was carried out exclusively on adult odonates,

with one hour of observation dedicated for each site, on sunny days, from 10:00 a.m. to 3:00 p.m. because it is the peak of activity for dragonflies, surveying a strip of 200 m around the water bodies under study. For common species, identification is mainly carried out by sight, from a distance, with photographic evidence, using a Nikon P900® camera with 84× zooms. The most difficult individuals to identify are captured with an entomological net and kept in boxes labelled with the date, place and time of capture, for subsequent determinations under the magnifying glass, carried out by Prof. Doumandji Salaheddine from the laboratory of the department of agricultural and forest zoology of the Ecole Nationale Supérieure d'Agronomie d'Alger. Anisopterans have a powerful flight (Boudot et al., 2017) that can reach a speed of 34.1 km/h (Woodall, 1995), which makes them difficult to capture in flight; on the other hand, Zygopterans are easier to capture, as they fly more slowly (Corbet, 1962). In order to make our study more reliable, the species designated in this study are the subject of a cartographic representation of distribution at the local scale (in the national park) and at the national scale (Appendix 1), based on the new administrative division, according to which the number of provinces has increased from 48 to 58 and through the exploitation of the maximum available published data. A species listed in a province means that the species has been recorded in at least one locality in its territory. The species distribution maps were prepared by the free software Qgis 3.22.13. In the designations of localities, the words "Galeta and Garaet", "Mounts" and "Ouaad" are abbreviated to 'G', 'M' and 'O' respectively. The results obtained are analysed by a statistical study through the application of Ascending Hierarchical Classification (AHC) and principal component analysis (PCA) and another index study of composition and structure, by using Minitab 16.

**Ecological indices of composition.** Firstly the total richness ( $S$ ), "is the number of species present in an ecosystem" (Ramade, 1984). It was used to determine the numerical importance of the species present in the national park. Secondly, absolute abundance ( $N$ ) is the total number of individuals caught of a species or group of species.

**Ecological indices of structure.** The ecological indices of structure used are the *Shannon diversity index*  $H'$  and the *equitability index*  $E$ . The diversity of a stand  $H'$  is calculated by the following formula:  $H' = -\sum Q_i \log_2 Q_i$ , where:  $H'$  = Shannon diversity index expressed in bits.  $Q_i = n_i/N$  which is the probability of encountering species  $i$ . ( $n_i$  number of individuals of species  $i$ , and  $N$ : total number of individuals of all species present).  $\log_2 x: \ln x/0.69$  ( $\ln x$  is the neperian logarithm of  $x$ ). According to Daget (1976), this index provides much more information on how individuals are distributed among the various species. The greater the  $H'$  index, the more diverse a community will be. *Equirrepartition index (equitability)* ( $E$ ) used to characterise diversity, equi-repartition is very important. It allows for the comparison of two stands with different species richness. According to Blondel (1979), equitability is the ratio of the observed diversity ( $H'$ ) to the maximum diversity ( $H'_{max}$ );  $E = H'/H'_{max}$ ;  $E$ : Equitability index;  $H'$ : Shannon diversity index expresses one bit unit.  $H'_{max}$ : Maximum diversity, given by  $H'_{max} = \log_2 S$  (bits).  $S$ : Total richness expressed in number of species.  $E$ : varies between 0 and 1, tending towards 0 when almost all the numbers correspond to a single species of stand and equal to 1 when all the species have the same abundance.

## RESULTS

**Species composition.** At the end of this study, a total of 18 identified species of odonates were found in all the water flats surveyed in the Theniet El Had National Park (Table 2). All the species catalogued in this study are sufficiently documented in the existing odonatological literature. The Anisoptera are represented by two (2) families: the Aeshnidae consisting of three (3) genera and three (3) species, and the Libellulidae with four (4) genera and eleven (11) species. The Zygoptera are represented by three (3) families: the Coenagrionidae with two (2) genera and two (2) species, the Lestidae and Calopterygidae with one (1) genus and one (1) species for each.

**Table 2.** Odonates in the national park and their distribution. + species present, - species absent.

Species/Sites	RPP	DMP I	DMP II	EGP	BP	ERP	ATP	SAHR
<b>ZYGOPTERA</b>								
<i>Calopteryx haemorrhoidalis</i> (Van Der Linden, 1825)	+	-	-	-	-	-	+	+
<i>Chalcolestes viridis</i> (Vander Linden, 1825)	+	-	-	-	-	-	-	-
<i>Erythromma lindenii</i> (Sélys, 1840)	+	+	+	-	-	-	+	+
<i>Ischnura pumilio</i> (Charpentier, 1825)	-	-	-	-	-	-	+	+
<b>ANISOPTERA</b>								
<i>Aeshna mixta</i> (Latreille, 1805)	-	+	-	+	+	+	+	+
<i>Anax parthenope</i> (Sélys, 1839)	+	+	-	-	+	+	-	+
<i>Anax ephippiger</i> (Burmeister, 1839)	+	+	+	+	+	+	-	+
<i>Orthetrum cancellatum</i> (Linnaeus, 1758)	-	-	-	-	-	+	+	+
<i>Orthetrum chrysostigma</i> (Burmeister, 1839)	+	+	+	-	-	-	+	+
<i>Orthetrum coerulescens</i> (Schneider, 1845)	+	+	+	+	-	+	+	+
<i>Orthetrum nitidinerøe</i> (Sélys, 1841)	-	-	-	-	-	-	-	+
<i>Crocothemis erythraea</i> (Brullé, 1832)	-	-	-	-	-	+	-	+
<i>Sympetrum fonscolombii</i> (Sélys, 1840)	+	+	+	+	-	+	+	+
<i>Sympetrum meridionale</i> (Sélys, 1841)	+	+	+	-	+	-	-	+
<i>Sympetrum sinaiticum</i> (Dumont, 1977)	-	-	-	+	-	-	-	-
<i>Sympetrum striolatum</i> (Charpentier, 1840)	+	+	+	+	+	+	+	+
<i>Trithemis annulata</i> (Palisot de Beauvois, 1807)	+	-	-	-	-	+	+	+
<i>Trithemis kirbyi</i> (Sélys, 1891)	-	-	-	-	-	-	-	+

**Taxonomic hierarchy**

**Class Insecta Linnaeus, 1785**

**Order Odonata Fabricius, 1793**

**Suborder Zygoptera Sélys, 1854**

**Calopterygidae Sélys, 1850**

**Genus *Calopteryx* Leach, 1815**

***Calopteryx haemorrhoidalis* (Van Der Linden, 1825) (Fig. 2A)**

In the N.P.T.E.H, the species is found in three sites (Fig. 2B) with a total number of 05 individuals: **RPP**, 15.V.2017, 1♂ 1♀; **ATP**, 15.V.2017, 1♂; **SAHR**, 15.V.2017, 1♂ 1♀.

**Lestidae Calvert, 1901**

**Lestinae Calvert, 1901**

**Genus *Chalcolestes* Kennedy, 1920**

***Chalcolestes viridis* (Vander Linden, 1825) (Fig. 2D)**

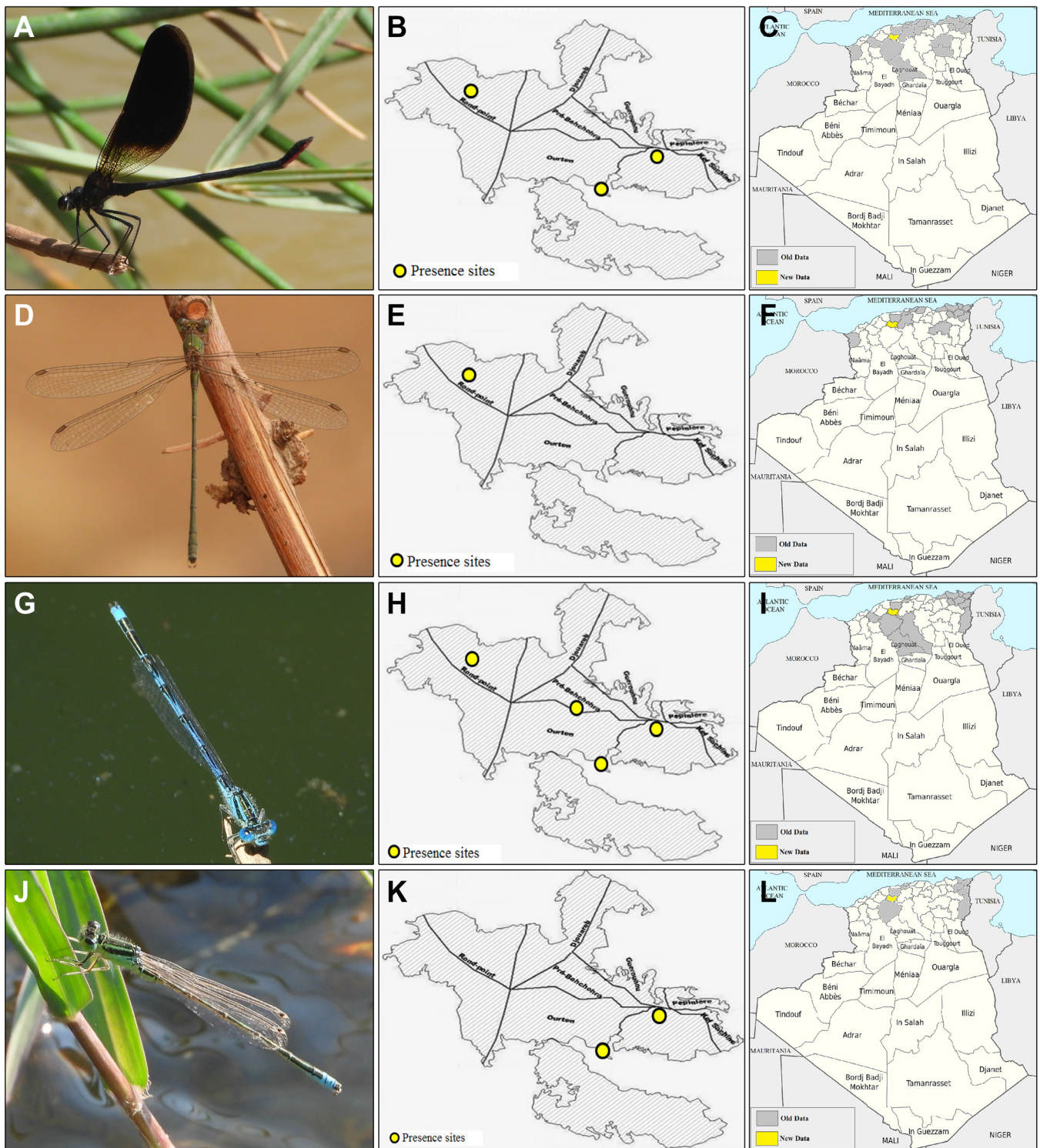
The species has been found in the National Park on several occasions in one site (Fig. 2E): **RPP**, 15.VI.2017, 1♂; 15.VII.2017, 1♂; 15.VIII.2017, 1♂ 1♀; 16.IX.2017, 3♂ 2♀; 15.X.2017, 2♂; 20.XI.2017, 1♂.

**Coenagrionidae Kirby, 1890**

**Genus *Ischnura* Charpentier, 1840**

***Ischnura pumilio* (Charpentier, 1825) (Fig. 2G)**

It is found in the park in two sites, located on the southern slope: **SAHR**, 16.IX.2017, 1♂ 1♀; **ATP**, 15.X.2017, 1♂ (Fig. 2H).



**Figure 2.** The general habitus, regional distribution and national distribution of the Odonata species in Theniet El Had National Park. **A-C.** *Calopteryx haemorrhoidalis* (Published data: 23, Number of locations: 39, Observation Provinces: 03, 05, 06, 07, 09, 10, 13, 14, 15, 16, 18, 21, 23, 24, 25, 26, 29, 35, 36, 41, 44); **D-F.** *Chalcolestes viridis* (Published data: 18, Number of locations: 39, Observation provinces: 05, 09, 13, 15, 18, 21, 23, 24, 25, 26, 35, 36, 41, 44); **G-I.** *Erythromma lindenii* (Published data: 18, Number of locations: 43, Observation provinces: 03, 09, 12, 14, 16, 17, 18, 21, 23, 24, 25, 28, 29, 36, 41, 44); **J-L.** *Ischnura pumilio* (Published data: 08, Number of locations: 13, Observation departments: 09, 12, 14, 16, 23, 24, 36, 41, 44).

**Coenagrioninae Kirby, 1890****Genus *Erythromma* Charpentier, 1840*****Erythromma lindenii* (Sélys, 1840) (Fig. 2J)**

The species is found in four sites, three sites on the southern slope and one site on the northern slope (Fig. 2K): **RPP**, 15.IV.2017, 1♂; **SAHR**, 15.IV.2017, 1♀; 15.VI.2017, 1♂; 15.X.2017, 1♂; **DMP I**, 15.V.2017, 1♀; **ATP**, 15.V.2017, 1♂ 1♀; 15.X.2017, 1♀.

**Suborder Anisoptera Sélys, 1854****Aeshnidae Rambur, 1842****Aeshninae Rambur, 1842****Genus *Aeshna* Fabricius, 1775*****Aeshna mixta* Latreille, 1805 (Fig. 3A)**

The species is abundant and can be found in six sites, one site on the northern slope and five sites on the southern slope (Fig. 3B): **BP**, 15.VI.2017, 1♂; 15.VII.2017, 1♂ 1♀; 15.VIII.2017, 1♂; 16.IX.2017, 1♂; 20.XI.2017, 1♂; 20.XII.2017, 1♂; **EGP**, 15.VI.2017, 1♀; 15.X.2017, 1♂; 20.XI.2017, 1♂; **ATP**, 15.VIII.2017, 1♂; 16.IX.2017, 1♂ 1♀; 20.XI.2017, 1♂; **RSA**, 20.XII.2017, 1♀; **DMP I**, 15.X.2017, 1♂; **ERP**, 15.X.2017, 1♂.

**Genus *Anax* Leach, 1815*****Anax parthenope* (Sélys, 1839) (Fig. 3D)**

This species is encountered in five sites, three sites on the southern slope and two sites on the northern slope (Fig. 3E): **BP**, 15.IV.2017, 1♂; **ERP**, 15.V.2017, 1♂; 15.VI.2017, 1♀; 15.VII.2017, 1♂; 15.X.2017, 1♀; 16.IX.2017, 1♂ 1♀; **RPP**, 15.VIII.2017, 1♂; 16.IX.2017, 1♀; **RSA**, 15.VIII.2017, 1♀; 16.IX.2017, 1♂ 2♀♀; **DMP I**, 16.IX.2017, 1♀.

***Anax ephippiger* (Burmeister, 1839) (Fig. 3G)**

The Species is found in seven sites, four sites on the southern slope and three sites on the northern slope (Fig. 3H): **BP**, 15.IV.2017, 1♂; 15.V.2017, 1♂; 15.VIII.2017, 1♂; 16.IX.2017, 1♂; 15.X.2017, 1♂; **ERP**, 15.IV.2017, 1♂; 15.V.2017, 1♀; 15.VIII.2017, 1♂; 16.IX.2017, 1♂; **RPP**, 15.V.2017, 1♀; 16.IX.2017, 1♂; **RSA**, 15.IV.2017, 1♂; 15.VIII.2017, 1♂; 16.IX.2017, 1♂ 1♀; 15.X.2017, 1♂; **MDMII**, 15.V.2017, 1♀; 16.IX.2017, 1♂; **DMPI**, 15.VIII.2017, 1♀; 16.IX.2017, 1♂; **EGP**, 15.VIII.2017, 1♂; 15.X.2017, 1♂.

**Libellulidae Rambur, 1842****Libellulinae Rambur, 1842****Genus *Orthetrum* Newman, 1833*****Orthetrum cancellatum* (Linnaeus, 1758) (Fig. 3J)**

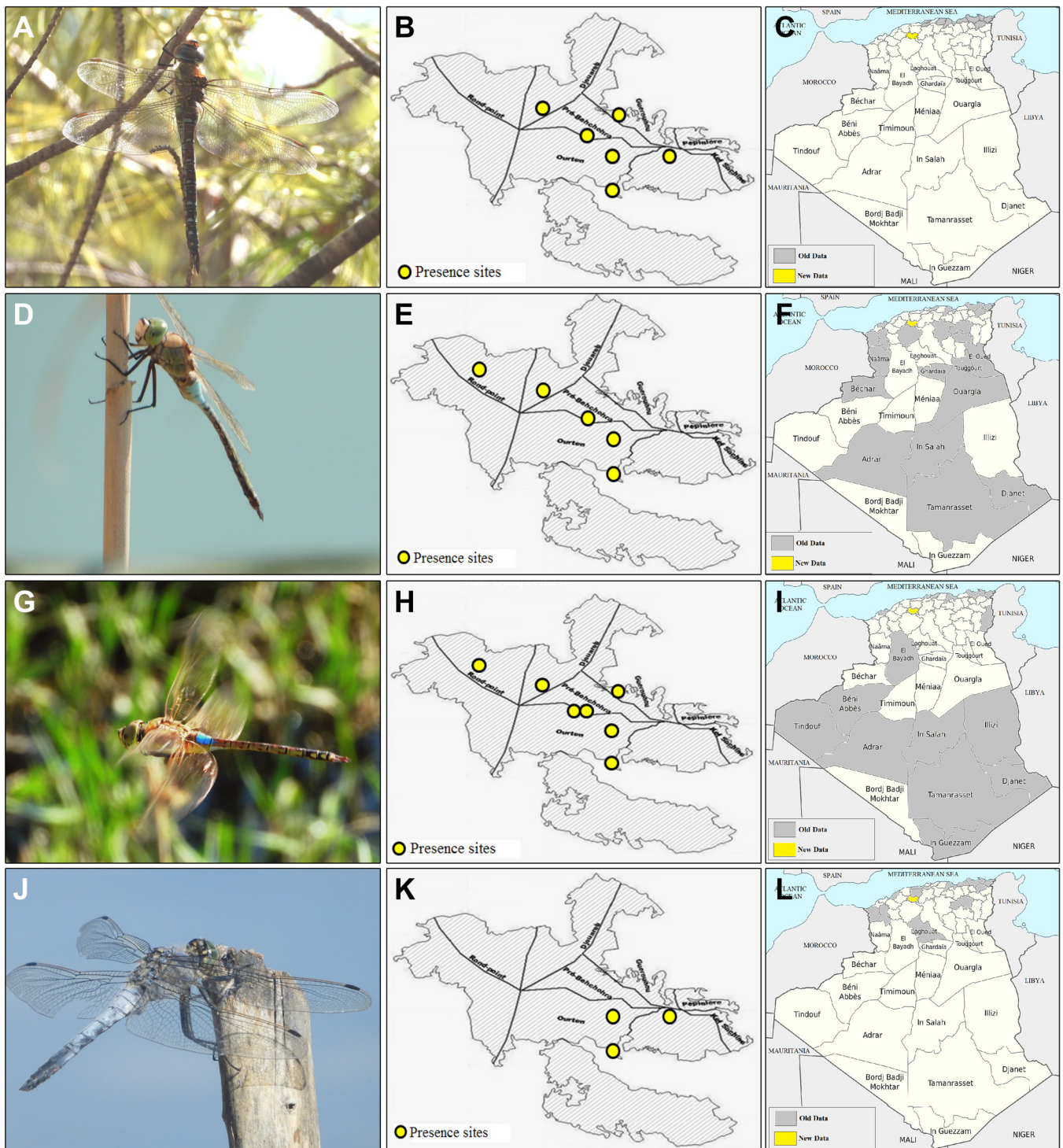
The Species is found in three sites on the southern side of the national park (Fig. 3K): **RSA**, 15.IV.2017, 1♂; 15.V.2017, 1♂; 15.VI.2017, 1♂ 1♀; **ERP**, 15.VI.2017, 1♀; **ATP**, 15.VIII.2017, 1♂.

***Orthetrum chrysostigma* (Burmeister, 1839) (Fig. 4A)**

This *Orthetrum* is widely distributed in the park, and is found in five sites, four sites in the southern slope and one site in the northern slope (Fig. 4B): **RSA**, 15.IV.2017, 1♀; 15.VI.2017, 1♂; 15.VII.2017, 1♂; 15.VIII.2017, 1♀; 15.X.2017, 1♂; **RPP**, 15.V.2017, 1♂; 15.VI.2017, 1♂; 15.VIII.2017, 1♀; 16.IX.2017, 1♂; **MDM1**, 15.VI.2017, 1♀; **MDM2**, 15.VI.2017, 1♂; 15.VII.2017, 1♀; 15.X.2017, 1♂; **ATP**, 15.X.2017, 1♂.

***Orthetrum coerulescens anceps* (Schneider, 1845) (Fig. 4D)**

This species is very abundant in the national park; it is found in seven sites, five sites in the southern slope and two sites in the northern slope (Fig. 4E): **MDM1**, 15.V.2017, 1♂; 15.VII.2017, 1♀; 15.VIII.2017, 1♀;



**Figure 3.** The general habitus, regional distribution and national distribution of the Odonata species in Theniet El Had National Park. **A–C.** *Aeshna mixta* (Published data: 15, Number of locations: 23, Observation provinces: 06, 09, 15, 16, 18, 21, 23, 24, 36, 38); **D–F.** *Anax parthenope* (Published data: 19, Number of locations: 52, Observation provinces: 01, 05, 06, 07, 08, 11, 13, 14, 21, 22, 23, 24, 28, 30, 31, 35, 36, 39, 45, 46, 47, 53, 55, 56); **G–I.** *Anax ephippiger* (Published data: 15, Number of locations: 36, Observation provinces: 01, 06, 11, 12, 16, 21, 23, 31, 32, 33, 35, 36, 37, 52, 53, 54, 56); **J–L.** *Orthetrum cancellatum* (Published data: 12, Number of locations: 32, Observation departments: 03, 05, 06, 09, 13, 18, 21, 22, 23, 24, 27, 36, 42, 44).



16.IX.2017, 1♂; **MDM2**, 15.V.2017, 1♂ 1♀; 15.VI.2017, 2♂♂; 16.IX.2017, 1♂; **EGP**, 15.V.2017, 1♂; 15.VI.2017, 1♂; **RPP**, 15.VI.2017, 1♂ 1♀; 15.VII.2017, 1♀; **ATP**, 15.VI.2017, 1♂ 1♀; 15.X.2017, 1♂; **RSA**, 15.VI.2017, 1♀; 15.VII.2017, 1♂ 1♀; 15.VIII.2017, 2♂♂; **ERP**, 15.VII.2017, 1♂; 15.VIII.2017, 1♀.

#### *Orthetrum nitidinerve* (Sélys, 1841) (Fig. 4G)

This species is very rare in the park. During our study, it was found in a single site on the southern slope (1287 m altitude) with two individuals observed in mid-September (Fig. 4H): **RSA**, 16.IX.2017, 2♂♂.

### Sympetrinae Tillyard, 1917

#### Genus *Crocothemis* Brauer, 1868

##### *Crocothemis erythraea* (Brullé, 1832) (Fig. 4J)

This species was found in two sites on the southern slope with three individuals observed during the whole period of study (Fig. 4K): **RSA**, 15.V.2017, 1♂; 15.VI.2017, 1♀; **ERP**, 15.VI.2017, 1♂.

#### Genus *Sympetrum* Newman, 1833

##### *Sympetrum fonscolombii* (Sélys, 1840) (Fig. 5A)

This species is very abundant in the national park, found in all sites except the Berdez pond which is the highest water body in the national park (Fig. 5B): **MDM1**, 15.IV.2017, 1♂; **MDM2**, 15.IV.2017, 1♂; **EGP**, 16.IX.2017, 1♀; **RPP**, 15.IV.2017, 1♂; 15.VI.2017, 2♂♂ 1♀; 15.X.2017, 1♂ 1♀; **ATP**, 16.IX.2017, 1♂; **RSA**, 15.III.2017, 1♂; 15.VI.2017, 2♀♀; 15.VII.2017, 1♂; 15.VIII.2017, 1♂; 16.IX.2017, 1♂ 1♀; 15.X.2017, 1♂; **ERP**, 15.III.2017, 1♂; 15.IV.2017, 1♂ 1♀; 15.V.2017, 1♀.

##### *Sympetrum meridionale* (Sélys, 1841) (Fig. 5D)

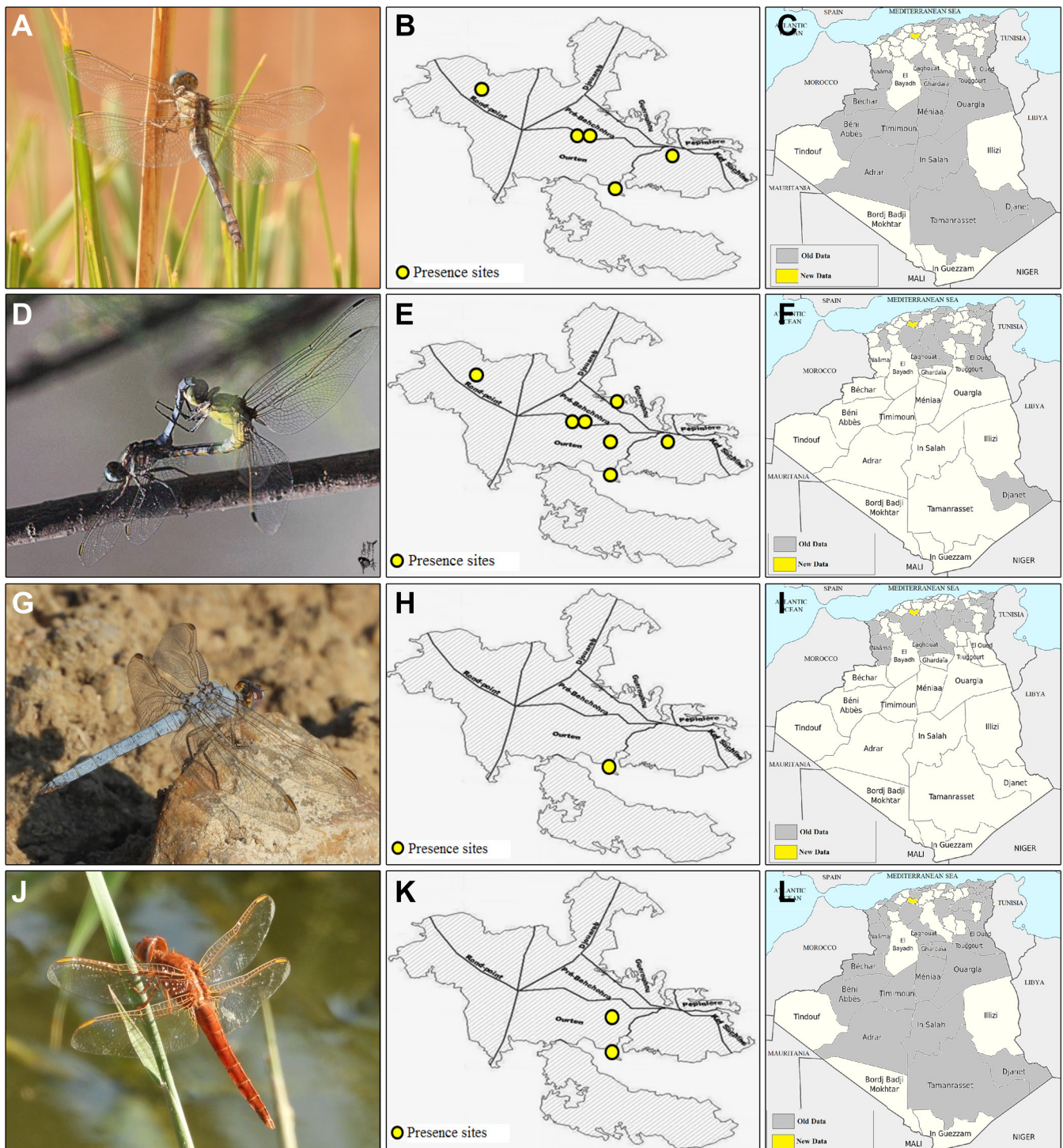
In the park, the species is recorded in five sites, two sites on the northern slope and three sites on the southern slope (Fig. 5E): **MDM1**, 15.VI.2017, 1♀; **MDM2**, 15.VIII.2017, 1♂; 16.IX.2017, 1♀; **BP**, 15.VI.2017, 1♀; **RPP**, 15.VIII.2017, 1♀; **RSA**, 15.VI.2017, 1♂; 15.VIII.2017, 1♀.

##### *Sympetrum sinaiticum* Dumont, 1977 (Fig. 5G)

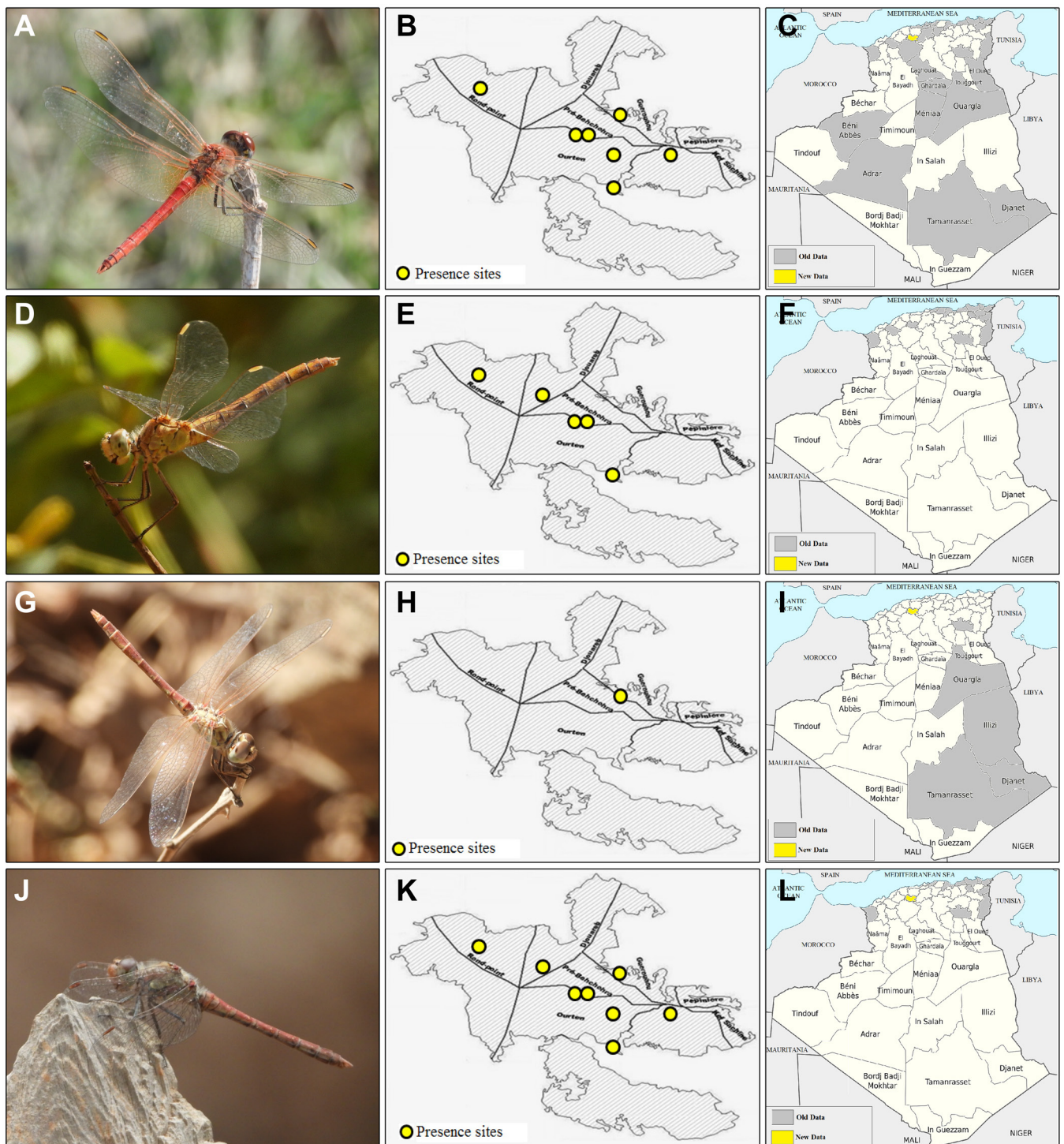
The observation of this *Sympetrum* in the park is the first attempt for a tellian area. The available data (Le Roi, 1915; Dumont, 1978; Samraoui & Menaï, 1999; Demnati et al., 2019) show that its distribution is Saharan and pre-Saharan. It supports the arid and semi-arid climate, but this time it is found in a sub-humid to humid bioclimatic stage, especially since the observation took place on the northern slope of the park, where an immature male was observed perched on a dry branch of dog rose (*Rosa canina*) far from the El Guerouaou Pond, at an altitude of about (1400 m) (Fig. 5H): **REG**, 15.VIII.2017, 1♂. This observation represents the closest point to the Mediterranean coast and the first record of the species in the central-western part of the Tell, on the Ouarsenis mountain range.

##### *Sympetrum striolatum* (Charpentier, 1840) (Fig. 5J)

This *Sympetrum* is the most abundant species in the park, colonising all the water bodies: **BP**, 15.III.2017, 1♂; 15.V.2017, 1♂; 16.IX.2017, 2♂♂; 15.V.2017, 1♂; **EGP**, 15.III.2017, 1♂; 15.IV.2017, 1♂ 1♀; 15.V.2017, 1♂; 15.VI.2017, 1♂ 3♀♀; 15.VII.2017, 1♂ 1♀; 15.VIII.2017, 2♀♀; 16.IX.2017, 2♂♂ 2♀♀; 15.X.2017, 1♀; 20.XI.2017, 1♂; 20.XII.2017, 1♂; **RPP**, 15.V.2017, 1♀; 15.VI.2017, 1♀; 15.VII.2017, 1♂; 15.VIII.2017, 1♂ 1♀; 15.X.2017, 1♂; **MDM1**, 15.V.2017, 1♂ 1♀; 15.VI.2017, 2♀♀; 15.VII.2017, 1♂; 15.VIII.2017, 1♂; 15.X.2017, 1♂; **MDM2**, 15.VI.2017, 1♀; 20.XI.2017, 1♂; **ERP**, 15.VI.2017, 1♂; 20.XI.2017, 1♀; **ATP**, 15.V.2017, 1♂; 16.IX.2017, 1♂; **RSA**, 15.V.2017, 3♂♂ 2♀♀; 15.VI.2017, 1♂; 15.X.2017, 1♀; 20.XI.2017, 1♂ 1♀; 20.XII.2017, 1♂ (Fig. 5K).



**Figure 4.** The general habitus, regional distribution and national distribution of the Odonata species in Theniet El Had National Park. **A–C.** *Orthetrum chrysostigma* (Published data: 27, Number of locations: 79, Observation provinces: 01, 03, 06, 07, 08, 09, 10, 11, 12, 15, 16, 18, 21, 23, 24, 27, 28, 30, 31, 35, 36, 39, 42, 45, 46, 47, 49, 52, 53, 56, 58); **D–F.** *Orthetrum coerulescens* (Published data: 17, Number of locations: 33, Observation provinces: 03, 06, 07, 09, 10, 12, 14, 15, 16, 17, 21, 22, 23, 24, 25, 28, 31, 36, 39, 41, 44, 55, 56); **G–I.** *Orthetrum nitidinerve* (Published data: 17, Number of locations: 36, Observation provinces: 03, 05, 07, 09, 12, 13, 14, 17, 19, 23, 24, 25, 28, 29, 31, 36, 38, 41, 45, 46); **J–L.** *Crocothemis erythraea* (Published data: 31, Number of locations: 96, Observation departments: 01, 03, 04, 05, 06, 07, 08, 09, 11, 12, 13, 14, 16, 18, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 35, 36, 39, 41, 42, 44, 45, 46, 47, 49, 52, 53, 55, 56, 58).



**Figure 5.** The general habitus, regional distribution and national distribution of the Odonata species in Theniet El Had National Park. **A–C.** *Sympetrum fonscolombii* (Published data: 24, Number of locations: 45, Observation provinces: 01, 03, 06, 07, 09, 10, 11, 12, 13, 14, 16, 18, 21, 23, 24, 26, 29, 30, 35, 36, 39, 42, 47, 52, 56, 58); **D–F.** *Sympetrum meridionale* (Published data: 18, Number of locations: 31, Observation provinces: 06, 07, 12, 13, 15, 18, 21, 23, 24, 25, 29, 35, 36, 38, 41); **G–I.** *Sympetrum sinaiticum* (Published data: 05, Number of locations: 14, Observation provinces: 07, 11, 30, 33, 56); **J–L.** *Sympetrum striolatum* (Published data: 18, Number of locations: 31, Observation departments: 06, 07, 12, 13, 18, 21, 23, 24, 25, 35, 36, 38, 41).

## Trithemistinae Tillyard, 1917

### Genus *Trithemis* Brauer, 1868

#### *Trithemis annulata* (Palisot de Beauvois, 1807) (Fig. 6A)

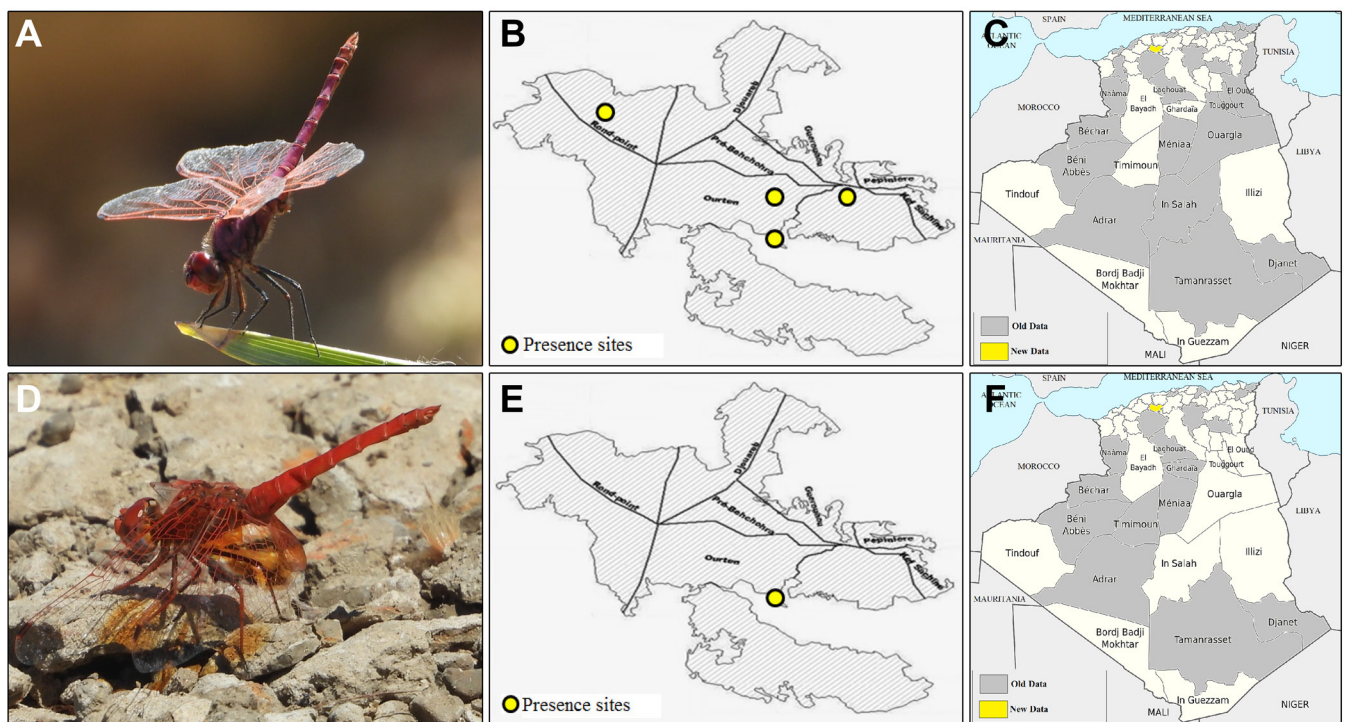
This trithemis is recorded in four sites in the park, three sites in the southern slope and one site in the northern slope (Fig. 6B): **RPP**, 15.VI.2017, 1♀; **ERP**, 15.V.2017, 2♂♂ 1♀; 15.VI.2017, 2♂♂; 16.IX.2017, 1♂; **ATP**, 15.VII.2017, 1♂; **RSA**, 15.V.2017, 1♂1♀; 15.VI.2017, 3♂♂ 2♀♀; 15.VII.2017, 1♀; 15.VIII.2017, 2♂♂ 1♀.

#### *Trithemis kirbyi* (Sélys, 1891) (Fig. 6D)

In general, this species is expanding rapidly (Bailleux et al., 2017), but it shows a very restricted distribution in the national park. It is found in low numbers (03 individuals) in the only forest reservoir on the southern slope (Fig. 6E), which represents the lowest water body (1287 m) in the study area, observations are detailed as follows: **RSA**, 15.V.2017, 1♂; 15.VI.2017, 1♂ 1♀.

**Flight phenology of odonates** (Fig. 7). The flight period of odonates was very variable according to the species, it is generally less than one year, the flight periods indicated in Fig. 7 correspond to the observations recorded in the national park during the study period, in comparison with the reference flight periods for Algeria taken from the synthesis of Samraoui and Menaï (1999). Concerning the species occasionally present in the national park, we note for *Calopteryx haemorrhoidalis*, a very short flight period (one month) compared to six months of reference. This is probably due to the increase in temperature where most of the watercourses stop flowing. For *Sympetrum sinaiticum* and despite its short flight period (one month), we recorded a perfect synchronisation of its flight period with the reference period. As for *Trithemis kirbyi*, it presents a remarkable precocity of the emergence of two months compared to the reference period, where we could observe the first individual in May. The appearance of *Orthetrum nitidinerve* in our study area is late, where we encountered two individuals in September, while the reference period spans two months (July and August). The same is true for *Ischnura pumilio*, which was recorded with a one-month delay in its predicted emergence period. For the species potentially or moderately present in the park, the variations of the flight period compared to the reference period is practically insignificant for the majority of the species which remain with some exceptions; we note for *Anax parthenope*, *Orthetrum coerulescens* a total similarity of emergence with the reference periods. For *Orthetrum cancellatum*, *Orthetrum chrysostigma*, *Sympetrum fonscolombii* and *Sympetrum striolatum*, the onset of their emergence is identical to that of the reference periods, but with a flight delay of one to two months compared to the references, whereas *Aeshna mixta*, *Anax ephippiger*, *Trithemis annulata* and *Erythromma lindenii* emerged one month later than expected. *Erythromma lindenii* has a flight period with gaps in between; this is due to the lack of observations of this zygopteran. *Chalcolestes viridis* shows a remarkable delay in the emergence of three months with four months of flight delay. For *Crocothemis erythraea* and *Sympetrum meridionale*, the flight variations compared to the reference are significant (2/9 months and 3/7 months respectively). It is worth mentioning that during our study, *Sympetrum striolatum* shows the longest flight period (10 months) while *Sympetrum sinaiticum*, *Orthetrum nitidinerve* and *Calopteryx haemorrhoidalis* show the shortest flight period (one month). The two months of January and February were without any odonate observations.

**Chorological study of the odonates of Theniet El Had National Park** (Fig. 8). In this section, we study the bio-geographical origins of the odonatological procession of the national park from the synthesis of (Jacquemin & Boudot, 1999, Boudot & Kalkman, 2015). The 18 species of odonates recorded in the Theniet El Had National Park belong to two different chorological groups, a dominating group of Palaearctic origin with 61%, it includes a set of species present in the old world and becoming rare or disappearing in the intertropical zone. 46% of the Palaearctic group are species with their centre of gravity in the Mediterranean basin, They form the Mediterranean odonatological subgroup (Fig. 9) to which *Erythromma lindenii* belongs, which has a holo-Mediterranean extension with an Atlantic expansion, plus *Anax parthenope* and *Sympetrum meridionale* as holo-Mediterranean species with an eastern expansion that extends well into the East.



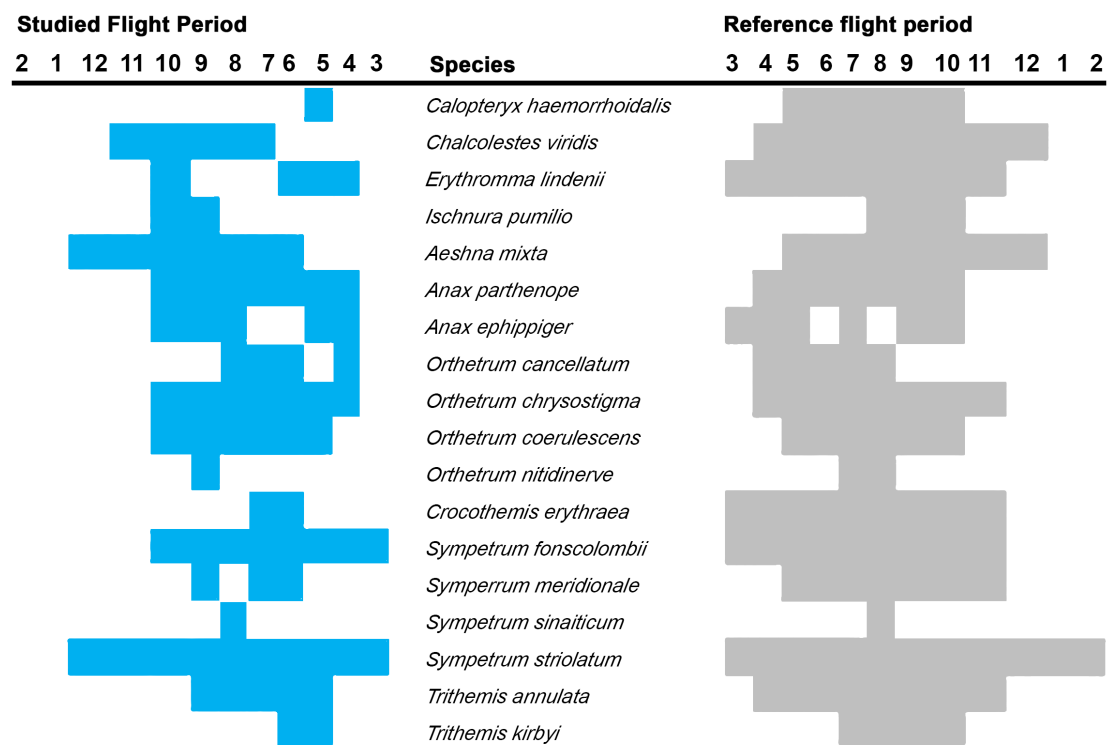
**Figure 6.** The general habitus, regional distribution and national distribution of the Odonata species in Theniet El Had National Park. **A–C.** *Tritemis annulata* (Published data: 19, Number of locations: 51, Observation provinces: 01, 03, 06, 07, 08, 09, 11, 12, 14, 18, 21, 22, 23, 24, 27, 28, 30, 31, 36, 39, 42, 45, 52, 53, 55, 56, 58); **D–F.** *Trithemis kirbyi* (Published data: 12, Number of locations: 37, Observation departments: 01, 03, 06, 07, 08, 09, 11, 14, 24, 28, 31, 36, 45, 47, 49, 52, 56, 58).

*Calopteryx haemorrhoidalis* belongs to the West Mediterranean species which have a centre of gravity strictly positioned on the Western Mediterranean basin with its islands, although they can also extend to the Atlantic side of Europe. *Orthetrum nitidinerve* is an Iberian-Maghrebian species which is part of the West Mediterranean libellules, occupying both North-West Africa and the Iberian peninsula. This allows us to deduce the predominance of taxa with a Holo-Mediterranean distribution with eastern expansion with 40%, the three remaining categories represent 1/5 for each. The West Mediterranean species in the broad sense include the Ibero-Maghrebian group, however, due to the limited distribution of the latter compared to the West Mediterranean species in the strict sense, it was useful to treat them separately. In the Laou catchment area in Morocco (El Haisoufi et al., 2008) and in the Bejaia region in Algeria (Chelli & Moulai, 2019), the same findings are raised regarding the superiority of Mediterranean species. The other sub-groups of the Palearctic share the other half, where the Euro-Siberian sub-group, consisting of species widely distributed from Middle Europe to Siberia and not concentrated in the Mediterranean, namely *Aeshna mixta* and *Orthetrum cancellatum*, represents 18% of the odonatological richness of the park, while the West Palearctic species, which are limited to the western part of the Palearctic domain, namely *Chalcolestes viridis*, *Orthetrum coerulescens anceps* and *Sympetrum striolatum*, represent 27%. The sub-Mediterranean sub-group represents 09%, and groups together species with a clear Mediterranean affinity, making the transition to the more strictly Mediterranean species, in our case *Ischnura pumilio* is the only species with this extension. The second group gathers taxa with a wide distribution, with 39% of the odonatological richness of the national park. It forms two sub-groups: the Afro-tropical species occupy 86% of this category and largely exceed the other sub-group. They are essentially African, and become abundant in the South of the Sahara, the Near East, Asia and even, sometimes, reach the South of Europe.

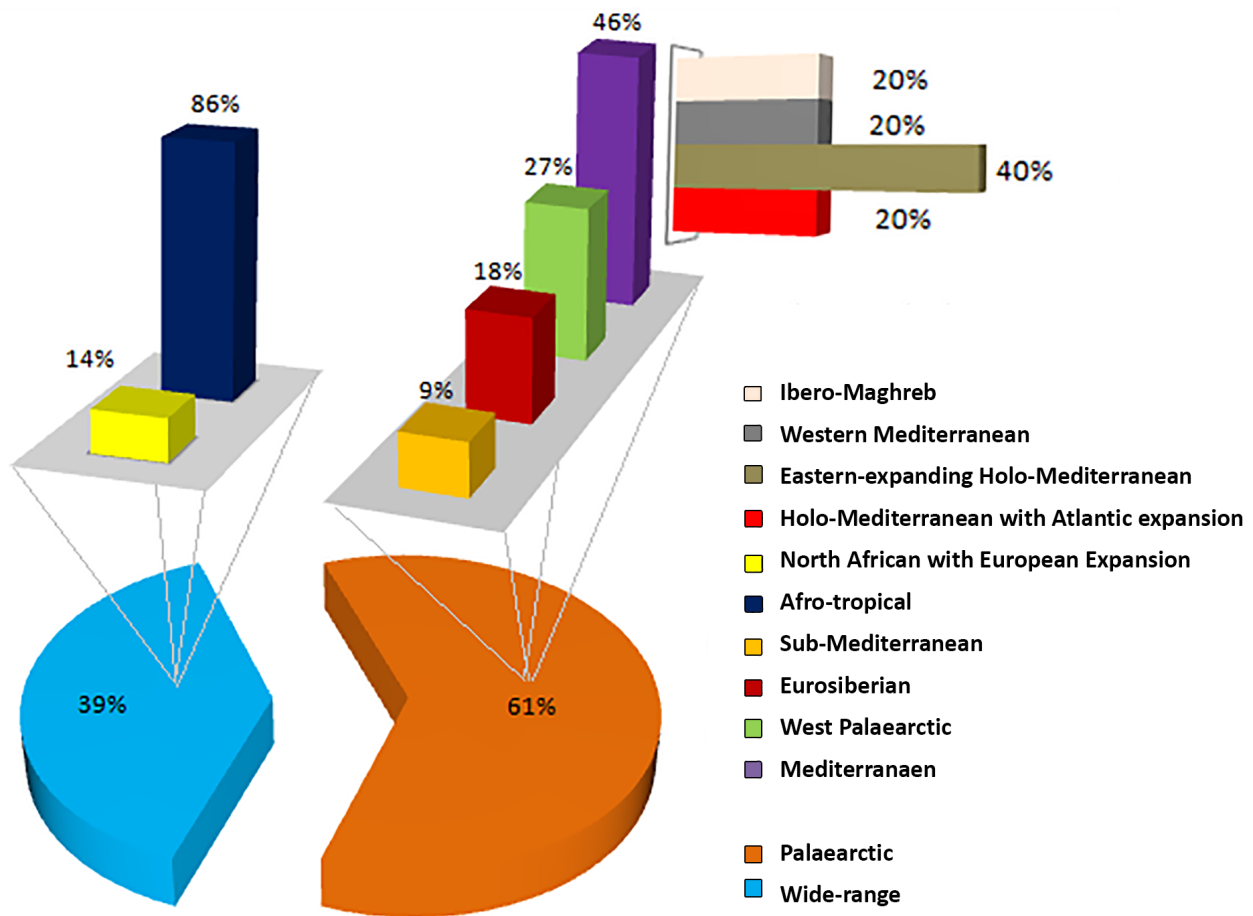
Their existence in the park is represented by *Anax ephippiger*, *Orthetrum chrysostigma*, *Trithemis annulata*, *Trithemis kirbyi*, *Sympetrum fonscolombii* and *Crocothemis erythraea*. The second sub-group contains the North African species with European expansion whose distribution is very wide and includes all of North Africa and a large part of Europe, the only species that represents this sub-group in our study is *Sympetrum sinaiticum*, species with a Saharan distribution, which reach the North of Spain and the South of Italy representing 14% of the odonatological wealth of the group.

**Statistical study of the results.** The hierarchical ascending classification (ACH) and principal component analysis (PCA) of the study sites showed a fairly apparent relationship between the altitude of the water bodies and the distribution of odonates in the park, but the exposure effect did not appear in the clustering. For the water bodies, the ACH classified them into two distinct groups (Fig. 10). Group A contains the four temporary pools at medium altitudes, which contain the majority of the odonates found in the park and are dominated by Anisoptera.

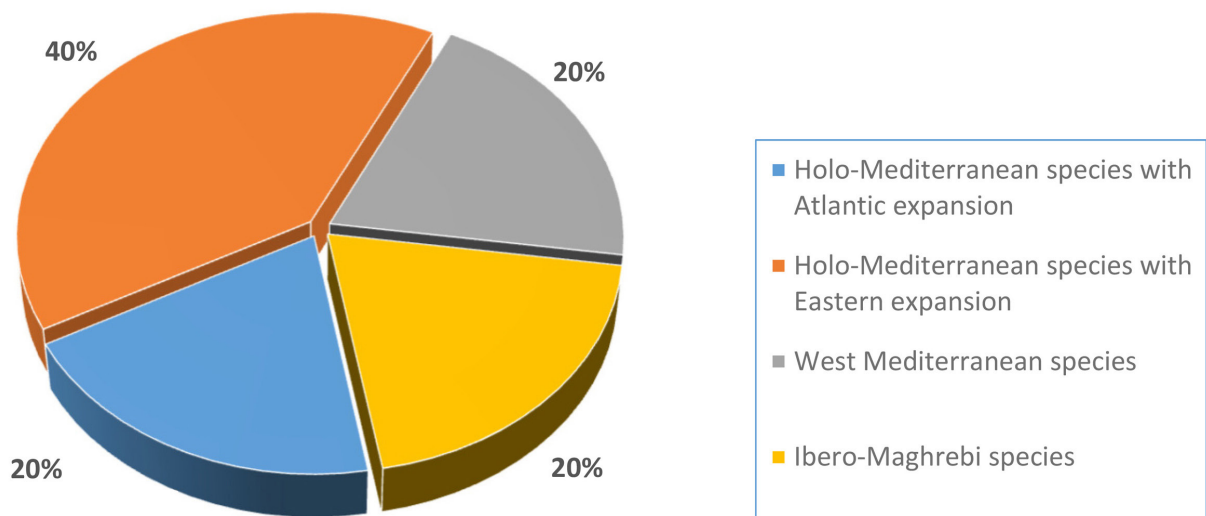
The four sites that remain at high altitudes form a second group B and contain a smaller number of odonates than the first, and are dominated by Anisoptera. In terms of species, the ACH indicates the presence of four groups in terms of numbers and observation sites, with *Sympetrum striolatum* alone forming one group due to its presence in all the study sites. The second group is composed of four species *Aeshna mixta*, *Anax ephippiger*, *Sympetrum fonscolombii* and *Orthetrum coerulescens*; the third group is the most diversified, it includes nine species, *Sympetrum meridionale*, *Orthetrum chrysostigma*, *Anax parthenope*, *Trithemis annulata*, *Erythromma lindenii*, *Calopteryx haemorrhoidalis*, *Orthetrum cancellatum*, *Crocothemis erythraea* and *Ischnura pumilio*. It should be noted that the last four species are recorded in less than half of the study sites. The fourth group includes rare species that are recorded in a single study site regardless of their number, namely *Chalcolestes viridis*, *Orthetrum nitidinerve*, *Trithemis kirbyi* and *Sympetrum sinaiticum*, the latter of which is the least represented in the study area, with a total of one (1) individual at a single site (Fig. 11).



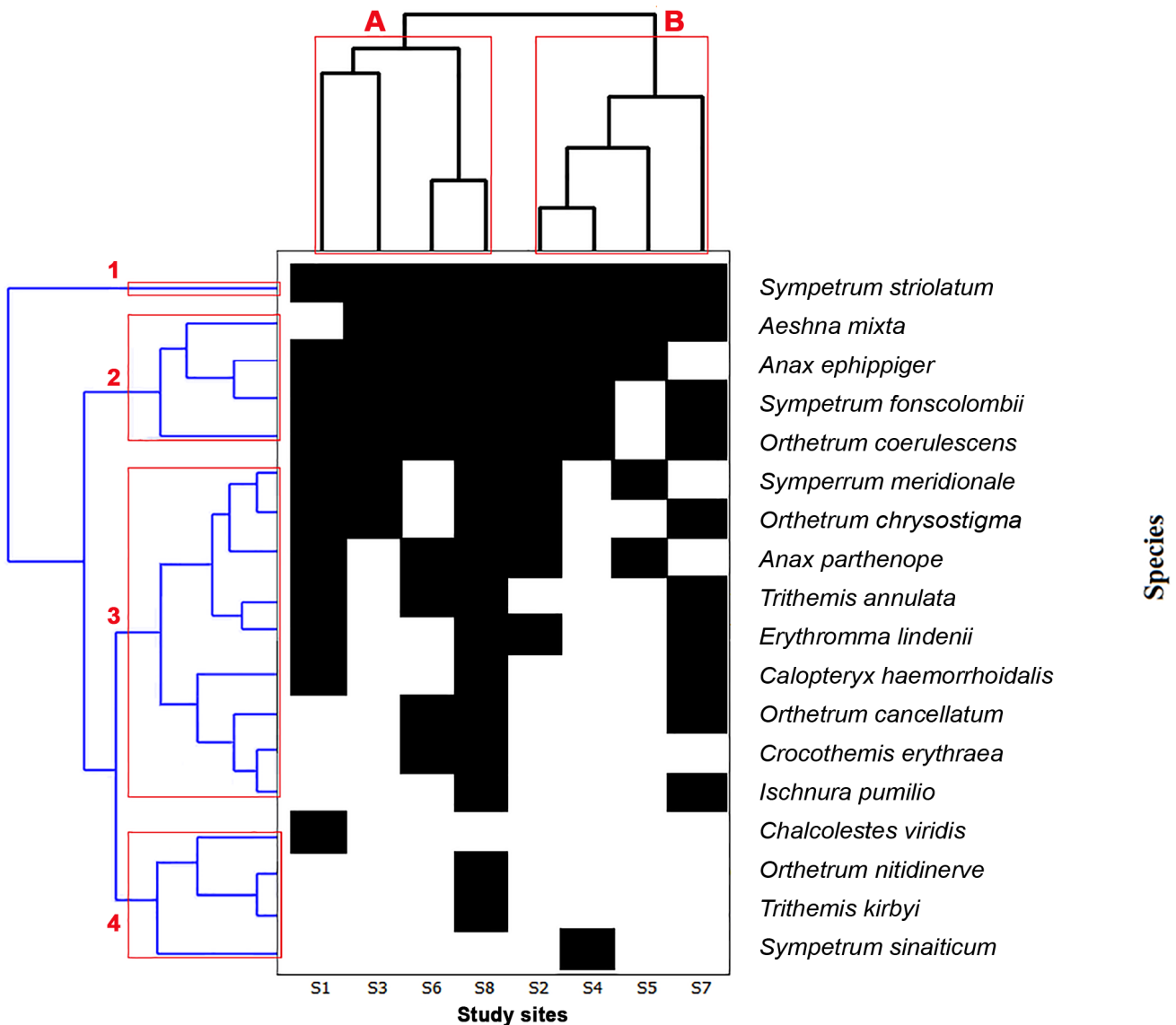
**Figure 7.** Flight phenology of odonates of Theniet El Had National Park.



**Figure 8.** Biogeographical origin of Odonata in Theniet El Had National Park, with the supremacy of the Mediterranean group.



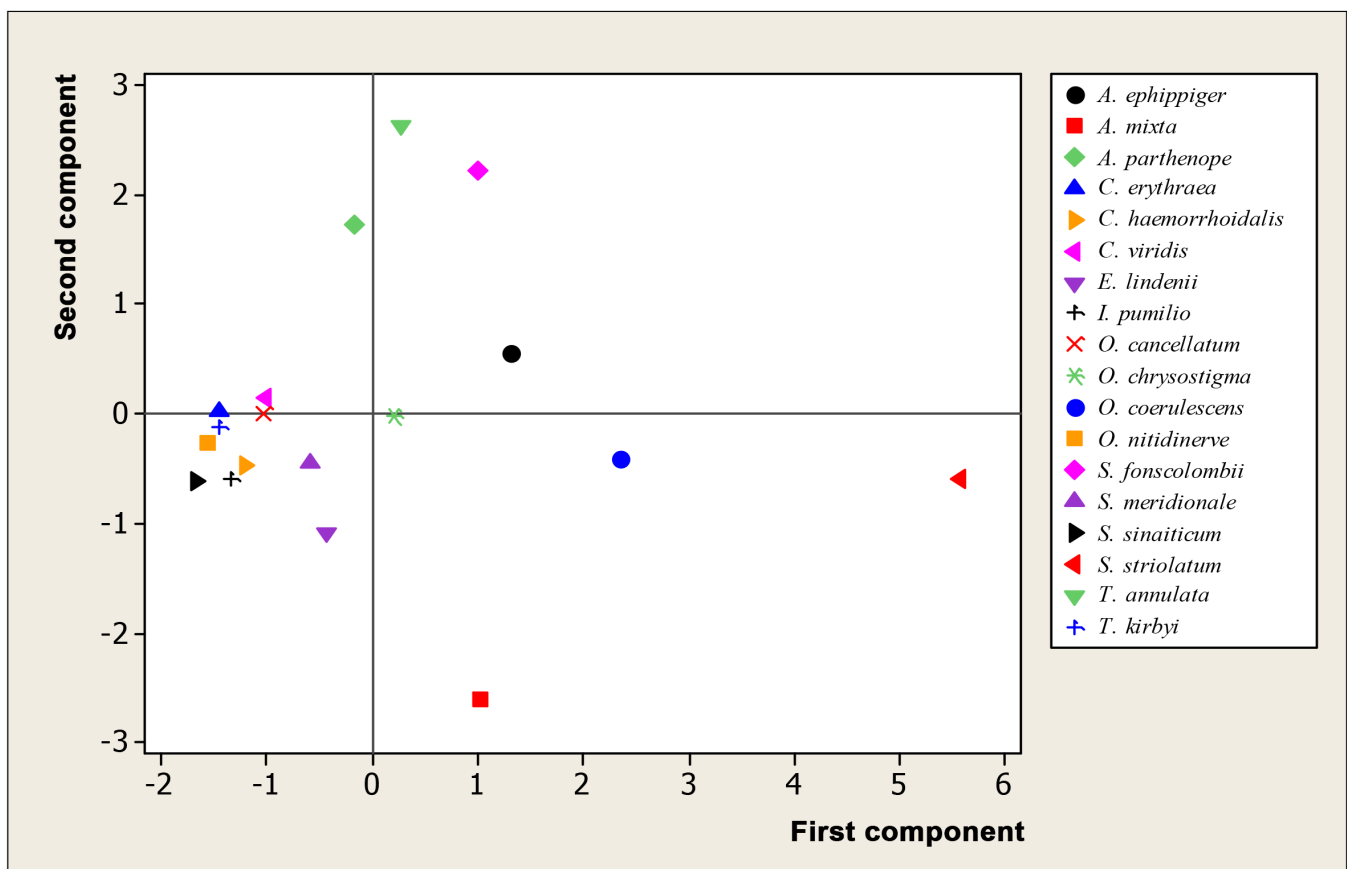
**Figure 9.** Composition of the Mediterranean group of odonates in Theniet El Had National Park, with the supremacy of the Holo-Mediterranean species eastern expansion.



**Figure 10.** Ascending hierarchical classification (AHC) analysis of the odonatological population of Theniet El Had National Park.

**Composition and structure of odonate populations in the National Park.** The first finding of this index study is the inequitable distribution of individuals between the different taxa and the different sites. The Sidi Abdoune reservoir and ponds RPP, DMPI and ATP, where more species are found, are the localities with the best structured and most stable odonatological populations. This is probably due to the open and sunny nature of these locations, which have provided ideal conditions for the establishment of odonates. The values of the Shannon diversity index ( $H'$ ) vary between 1.12 and 2.55. These values reflect the considerable diversity of species found in the different ponds studied. Ponds RPP, ATP and SAHR are characterised by diverse and balanced populations, the least diverse population is found in pond EGP, and the rest of the ponds are characterised by rather moderately balanced populations (Table 3). Values of the evenness index ( $E$ ) vary between 0.62 and 0.93, with the highest value (0.93) recorded in pools DMPII and ATP, followed by the hillside reservoir SAHR (0.92), then pool ERP (0.9). Ponds RPP, DMPI and BP have values close to 0.87 and 0.86, these values are close to 1, therefore the numbers of taxa sampled tend to be in equilibrium between them. The lowest value of equitability is for pond EGP (0.62), which clearly explains the predominance of certain taxa.





**Figure 11.** Principal component analysis (PCA) analysis of the Odonata populations in the Theneit El Had National Park.

**Table 3.** Index study of odonates in Theniet El Had National Park.

Sites	Code	Indices			
		S	N	H	E
S1	RPP	11	40	2, 08	0, 87
S2	DMP I	10	21	2	0, 87
S3	DMP II	6	15	1, 68	0, 93
S4	EGP	6	28	1, 12	0, 62
S5	BP	5	19	1, 38	0, 86
S6	ERP	9	27	1, 99	0, 9
S7	ATP	10	18	2, 14	0, 93
S8	SAHR	16	72	2, 55	0, 92

## DISCUSSION

The results obtained allowed us to report the presence of 18 species of odonates representing 28% of the national odonatofauna. These species belong to 11 genera and five families, Zygoptera represent 22% and Anisoptera 78%. The total number of individuals captured at the end of this study is around 240 individuals. The Libellulidae family is the most abundant with four genera and 11 species, which represents 61% of the national park's specific wealth, followed by Aeshnidae (16%) with three (3)

species, then Coenagrionidae (11%) with two species and finally the two families Calopterygidae and Lestidae with one (1) species for each. The Sidi Abdoune reservoir (SAHR) represents the most diversified habitat with 16 species; it is the lowest water body in the study area (1287 m), and it shelters two species that are specific to it (*Orthetrum nitidinerve* and *Trithemis kirbyi*). This site is threatened by the imminent danger of uncontrolled pumping of water for crop irrigation and livestock watering, which will inevitably cause it to dry up. The least diverse site is the Berdez pond (BP) with five species. The month of June is the richest in numbers and species with 47 individuals belonging to 13 species. *Sympetrum striolatum* is the most frequent and dominant species in the park, it marks its presence in all the study sites with 53 individuals. On the other hand, certain odonates were only encountered a few times or even once, this is the case in particular of *Calopteryx haemorrhoidalis*, *Ischnura pumilio*, *Orthetrum nitidinerve*, *Crocothemis erythraea*, *Sympetrum sinaiticum*, *Trithemis kirbyi*. The observation of these Saharan species (*Trithemis kirbyi* and *Sympetrum sinaiticum*) in the national park confirms the previously reported findings concerning the expansion of these species in Algeria (Khelifa et al., 2011; Boudot et al., 2009). They are rapidly colonising new areas and have succeeded in reaching Southern Europe (Boudot et al., 2009; Boudot, 2010). The appearance of *Trithemis kirbyi* in the national park is anticipated by two months of its usual flight period (Samraoui & Menai, 1999). Although its distribution is Saharan and sub-Saharan in Algeria (Le Roi, 1915; Dumont, 1978; Samraoui & Menai, 1999; Demnati et al., 2019), *Sympetrum sinaiticum* represents the most attractive species recorded in the national park, by its presence for the first time in the Tellian zone. Moreover, its expansion is slow compared to *Trithemis kirbyi* or even *Trithemis annulata*. This *Sympetrum* has already been reported in Morocco in 2007 (Juillerat & Monnerat, 2009) and in Egypt in 2009 (Dijkstra & Boudot, 2010). As odonates are affected by thermal variations (Grand, 2009), global warming is the most likely cause of these expansions (Chelmick & Pickess, 2008; Holuša, 2008), especially as some thermophilic species are increasingly moving northwards and upwards under the influence of climate change (Lamouille-Hébert, 2020). *Orthetrum nitidinerve*, being an indicator species of the semi-arid habitat, presents a certain plasticity and can be found both in the Sahara and in coastal wetland habitats (Senouci & Bounaceur, 2021). The Dwarf *Ischnura* (*Ischnura pumilio*) reached Algeria and the national park from Europe (Sélys, 1871), it is a pioneer species, colonising recently created water bodies (Bailleux et al., 2017), with a Tellian distribution (Sélys, 1849; Lacroix, 1925; Samraoui & Menai, 1999; Samraoui & Corbet, 2000a; Khelifa et al., 2011; Yalles Satha & Samraoui, 2017; Senouci & Bounaceur, 2018; Sellam-Bouattoura et al., 2018). Some inventoried odonates like *Erythromma lindenii* represent an indicator of good water quality (Dusoulier et al., 1999). Three species mentioned in the Theniet El Had region by Morton (1905), were not encountered during the present study, namely *Gomphus lucasii*, *Onychogomphus uncatatus* and *Sympetma fusca*. On the other hand, *Aeshna mixta*, *Orthetrum nitidinerve*, *Sympetrum meridionale* and *Sympetrum striolatum*, were already mentioned by the same author in the said region before the creation of the Theniet El Had Cedar National Park in 1923. The odonatological spectrum of the national park shows 61% of species of Palaearctic origin, almost half of which are Mediterranean and 39% of species with a wide distribution, where 86% is occupied by Afro-tropical taxa. The absence of studies on the fauna of Odonata in the North-Western Algeria, with the exception of a few attempts (Kabouche, 2013; Senouci & Bounaceur, 2018; Senouci & Bounaceur, 2021), makes the monitoring of odonate populations and their dynamics very difficult if not impossible (Samraoui & Menai, 1999).

Theniet El Had National Park presents a remarkable odonatological richness. It has largely surpassed the diversity of the Oran region (9 species) (Kabouche, 2013), Mount Edough (14 species) (Samraoui & Alfarhan, 2015), O. Mazafrane (Sellam-Bouattoura et al., 2018) and Tassili-n-Ajjer (Dumont, 2017) with (15 species). It surpassed a number of taxa in the mountains of Chréa (Djemai & Bounaceur, 2017), Oued Bouarroug (Benchalel & Samraoui, 2012), the Chott Melghir basin (Demnati et al., 2019) and the Tiaret region (Senouci & Bounaceur, 2018), by seven taxa and Oued El-Harrache (Hafiane et al., 2016), Oued el Kebir (Benchalel & Samraoui, 2012; Benchalel et al., 2017), by five odonate taxa and on the other hand, its species richness is lower than those recorded in Numidia (45

species) (Samraoui & Corbet, 2000a), in the Seybous basin, (35 and 33 species) (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017), O. Kibir Est (34 species), Rhumel (32 species) (Yalles Satha & Samraoui, 2017), the Bejaia region (33 species) (Chelli & Moulai, 2019) and the Haute Mina sub-basin (23 species) (Senouci & Bounaceur, 2021). According to the IUCN Red List for North Africa, all odonate species inventoried in the national park have the same status of Least Concern (LC) (Garcia et al., 2010).

The ponds of Theniet El Had National Park represent a unique ecosystem and play an important role in hosting particularly migratory odonate species due to its location, which is only 27 km from the semi-arid climate steppe region and 75 km from the humid climate Mediterranean coast. This represents a connecting strip between Mediterranean and Afrotropical species. In addition to the local species, for which the national park represents a haven thanks to the availability of pure rainfall water, far from any source of pollution, which provides an ideal place for the reproduction and ensuring the perinity of these species. This is a preliminary exhaustive odonatological inventory carried out in the national park of Theniet El had since its creation, allowing the establishment of a list of 18 species (14 Anisoptera and 4 Zygoptera). This study shows that the odonatological population of the national park is relatively rich and all these species are well described in the existing literature. This list will help the decision makers of the National Park to take the necessary measures to protect this fragile group. This inventory is probably not complete, as other species are potentially present in the park, namely the three species mentioned by Morton (1905), *Gomphus lucasii*, *Onychogomphus uncatus* and *Sympecma fusca*, and other species likely to visit the park during their migratory journeys, which should be carefully researched through ongoing studies and the establishment of long-term monitoring of a large number of water bodies in the national park.

**Appendix 1.** National spatio-chronological distribution of Odonata species in Theniet El Had national park.

Species	Spatio-Chronology of the species in Algeria
<i>Calopteryx aemorrhoidalis</i> (Fig. 2C)	La Calle (Sélys, 1849; Martin, 1910). Bône (Sélys, 1871; Martin, 1910). Constantine, Le Tarf, Oubeira (McLachlan, 1897). Biskra (McLachlan, 1897; Martin, 1901; Sélys, 1902). Laghouat (Sélys, 1902). Sebdlou (Morton, 1905). Batna (Martin, 1910; Samraoui & Menai, 1999). El Guerra (Martin, 1910). Hammam R'hira (Ris, 1913; Sellam-Bouattoura et al., 2018). Mascara (Navás, 1922; Lacroix, 1925). Azazga (Lacroix, 1925). Mechroha, Collo, Jijel, Tlemcen, Drea (Samraoui & Menai, 1999). O. Bouarroug (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012). O. Pre-Bou Redim, O. Reguibet, O. Mellah (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. Isser (Bouchelouche et al., 2015). M. Edough (Samraoui & Alfarhan, 2015). O. El harrache (Hafiane et al., 2016). O. Abaren (Djemai & Bounaceur, 2017). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). Media, O. Attli, O. Mouzaia, O. Chiffa, O. Sidi El kebir, O. Djer, O. Bou Roumi (Sellam-Bouattoura et al., 2018). Tounnina, M. Sfa (Senouci & Bounaceur, 2018; Senouci & Bounaceur, 2021). Sebaïne, S. Ouadah (Senouci & Bounaceur, 2018). Bejaia (Chelli & Moulai, 2019). Tagdemt, Medroussa, Frenda (Senouci & Bounaceur, 2021).
<i>Chalcolestes viridis</i> (Fig. 2F)	Tonga, Oubeira (Sélys, 1849). Bône (Sélys, 1871; Martin, 1910), La Calle (Sélys, 1871). Between Blida and Médéa (Kolbe, 1885). Constantine (McLachlan, 1897; Martin, 1901; Martin, 1910). Fetzara (Martin, 1901), Sebdlou (Morton, 1905). Philippeville (Martin, 1910). Tala Kitane (Lacroix, 1925). Lac des Oiseaux (Samraoui et al., 1992). Guerbes (Samraoui & de Bélair, 1997). Jijel, Mechroha, Collo, Batna, Tlemcen (Samraoui & Menai, 1999). G. Hadj Tahar, Lac Sidi Fritis, Marais Mekhada, G. Dakhla, Marais Bou Redim, Lac Bleu, Djebel Ghora, M. Gauthier (Samraoui & Corbet, 2000a). O. Bouarroug, O. Kebir, (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012) Seybouse, (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. Isser (Bouchelouche et al., 2015). O. Kerrache (Djemai & Bounaceur, 2017). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). Media, O. Attli, O. Mouzaia, O. Chiffa, O. S. El kebir, O. H. Righa, O. Djer, O. Bou Roumi (Sellam-Bouattoura et al., 2018).
<i>Ischnura pumilio</i> (Fig. 2I)	Alger, La Calle (Sélys, 1849). Tala Kitane (Lacroix, 1925). Tebessa (Samraoui & Menai, 1999). Lac des Oiseaux, Djebel Ghora (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). Sidi Hosni (Senouci & Bounaceur, 2018), O. H. Righa, O. Djer, O. Mouzaia (Sellam-Bouattoura et al., 2018).
<i>Erythromma lindenii</i> (Fig. 2L)	Alger (Sélys, 1849; Lacroix, 1925), Constantine (Sélys, 1849; Martin, 1910), La Calle (Sélys, 1849). Bône (Sélys, 1849; Sélys, 1871; Martin, 1910). Edough (Sélys, 1871). Lac des Oiseaux (McLachlan, 1897; Samraoui et al., 1992; Samraoui & Corbet, 2000a). Tarf. O. Bou Sba (McLachlan, 1897). Fetzara (Martin, 1901; Martin, 1910; Ris, 1913, Samraoui & Corbet, 2000a). Lac Oubeira, Lac Tonga (Martin, 1910; Samraoui & Corbet, 2000a), Philippeville (Martin, 1910). Mascara (Lacroix, 1925). Guerbes (Samraoui & de Bélair, 1997). Mechroha, Tebessa, Jijel, Bou Saada, Djelfa, Laghouat (Samraoui & Menai, 1999). O. Kebir (Samraoui & Corbet, 2000a; Yalles Satha & Samraoui, 2017), Lac Bleu, G. Boumaiza, G. Sidi Lakhdar, Lac Sidi Fritis (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. El harrache (Hafiane et al., 2016). Rhumel (Yalles Satha & Samraoui, 2017). O. H. Righa, O. Djer, O. Mouzaia, O. Chiffa, O. Bou Roumi (Sellam-Bouattoura et al., 2018), Tounnina, Machraa sfa (Senouci & Bounaceur, 2018; Senouci & Bounaceur, 2021). Sebaïne, Dahmouni, S.Hosni, Bra (Senouci & Bounaceur, 2018), Bejaia (Chelli & Moulai, 2019). Tagdemt, Medroussa, Frenda, (Senouci & Bounaceur, 2021).

## Appendix 1. Continue.

Species	Spatio-Chronology of the species in Algeria
<i>Aeshna mixta</i> (Fig. 3C)	Alger, La Calle (Sélys, 1849). Bône (Sélys, 1871; Martin, 1910). Edough (Sélys, 1871; Samraoui & Corbet, 2000a; Samraoui & Alfaharhan, 2015). Teniet el Had (Morton, 1905). Kabylie (Lacroix, 1925). Lac des Oiseaux (Samraoui et al., 1992). Guerbes (Samraoui & de Bélair, 1997). Collo, Jijel (Samraoui & Menai, 1999). O. Kebir (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012; Yalles Satha & Samraoui, 2017), Mekhada marsh, G. Dakhla, Lac Bleu, Lac Oubeira, M. Gauthier, Lac Fetzara, G. Boumaïza, G. Hadj Tahar (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. Abaren (Djemai & Bounaceur, 2017). Rhumel (Yalles Satha & Samraoui, 2017). Bejaia (Chelli & Moulai, 2019).
<i>Anax parthenope</i> (Fig. 3F)	Edough (Sélys, 1866). Touggourt (Sélys, 1902; Martin, 1910; Samraoui & Menai, 1999). Biskra, Bône (Martin, 1910). Ideles (Le Roi, 1915). Agoulmine Ouroufal (Lacroix, 1925). Bahmer (Reymond, 1952). In Salah, Tagmoute, Arak, G. Imelaouaene, G. Affilal, G. Issakarasène, Temekerest (Dumont, 1978). Lac des Oiseaux (Samraoui et al., 1992; Samraoui & Corbet, 2000a). Guerbes (Samraoui & de Bélair, 1997), El Oued, Djamaa, Ouargla, El Goléa, Ghardaïa, Boussaada, Sidi Bel Abbes, Béchar, Ain Sefra. Ahaggar. Tassili N' Ajjer (Samraoui & Menai, 1999). Mekhada marsh, G. Estah, Lac Okrera, Lac Tonga, M. Gauthier, M. Ruppia, G. Hadj Tahar, G. Sidi Lakhdar, Lac SidiFritis, G. Chichaya (Samraoui & Corbet, 2000a), Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Lac Gharabas, Rio Salado, Barrage El Mafrouche (Kabouche, 2013). O. Isser (Bouchelouche et al., 2015). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). O. Imirhou, O. Djerat, Guelta Tamadjert (Dumont, 2017). Chmora, Sidi Okba (Demnati et al., 2019), Bejaia (Chelli & Moulai, 2019). Medroussa, Machraa sfa (Senouci & Bounaceur, 2021).
<i>Anax ephippiger</i> (Fig. 3I)	Bône (Sélys, 1865). Hassi el Hadjar (Ris, 1913). Temacinin. In Kelemet. Tazzait, O. Agelil (Le Roi, 1915). Ideles (Le Roi, 1915; Koch 1979). Oran (Lacroix, 1925). In Eker, O. Tamanrasset, O. Tit (Kimmins, 1934). Hassi el Meniet (Reymond, 1952) Beni Abbes (Nielsen, 1956; Koch, 1979). Erg Iguidi, Khettamia (Nielsen, 1956). Adrar (Aguesse & Pruja, 1958). El Abiodh Sidi Cheikh, Nukheila, Hassi El Bachir, O. El Gharbi (Dumont, 1988). Hamiz et Barrage Kedara. Tamanrasset à In Guezzam, Mertoutek, G. El Djenoun, O. Igharghar (Dumont & Desmet, 1990). Collo (Samraoui & Menai, 1999). Lac Okrera, Lac Oubeira, Lac Tonga, M. Messina, Boukhadra (Samraoui & Corbet, 2000a). Oasis de Djanet (Dumont, 2017). Bejaia (Chelli & Moulai, 2019).
<i>Orthetrum cancellatum</i> (Fig. 3C)	Edough (Sélys, 1871). La Calle (McLachlan, 1897). Lac Oubeira McLachlan, 1897; Samraoui & Corbet, 2000a). Lac Fetzara (Martin, 1901; 1910; Ris, 1909; Samraoui & Corbet, 2000a). Bône (Ris, 1909), Lac des Oiseaux (Samraoui et al., 1992; Samraoui & Corbet, 2000a). Guerbes (Samraoui & de Bélair, 1997). Jijel, Batna, Laghouat, Sidi Bel Abbes, Mostaganem, Tlemcen (Samraoui & Menai, 1999). G.Dakhla, Lac Okrera, Lac Bleu, G. Afu Magroun, G. Sidi Lakhdar, G.Dissia, Lac SidiFritis, Bordj du Cantonniere, G. Tacha (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Rhumel (Yalles Satha & Samraoui, 2017). O. Mouzaia, O. Chiffa, O. H. Righa, O. Djer, O. Bou Roumi, O. Mazafraan (Sellam-Bouattoura et al., 2018), Bejaia (Chelli & Moulai, 2019).
<i>Orthetrum chrysostigma</i> (Fig. 4C)	Tonga (Sélys, 1871; Samraoui & Corbet, 2000a). Ain Kriar, La Calle (McLachlan, 1897), Lac des Oiseaux (McLachlan, 1897; Samraoui & Corbet, 2000a), Biskra (McLachlan, 1897; Martin, 1901; 1910; Sélys, 1902; Samraoui & Menai, 1999). Ouargla (Sélys, 1902; Le Roi, 1915). El Goléa (Ris, 1913; Samraoui & Menai, 1999). Tahihout, Ideles (Le Roi, 1915). Azazga, Alger, Tala Kitane, Ighzeer, Temda (Lacroix, 1925). Beni Abbes (Nielsen, 1956; Koch, 1979), Zaouiet Kounta (Nielsen, 1956). Regganne, Fetzana, Hassi Maroket. In Salah, Tagmoute. Arak, G. Affilal, G. Issakarasène, G. Idjif Mellène, G. EEGPhra. O. Igharghar, Temekerest (Dumont, 1978). Guerbes (Samraoui & de Bélair, 1997). Collo, Jijel, Tebessa, Negrine, El Oued, Ghardaïa, Laghouat, Bou Saada, Béchar, Ain Sefra, Timimoun, Mostaganem, Ahaggar (Samraoui & Menai, 1999). Lac Sidi Fritis, G. Sidi Makhlof, Mekhada marsh, Lac Bleu, Lac Oubeira, O. Bouarroug, Sidi Amar (Samraoui & Corbet, 2000a), O. El-Kébir (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012; Yalles Satha & Samraoui, 2017). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Sebka d'Oran, Rio Salado (Kabouche, 2013), O. Djamaa, O. Isser (Bouchelouche et al., 2015), M.Edough (Samraoui & Alfaharhan, 2015). O. El harrache (Hafiane et al., 2016). O. Djerat, Guelta Adessei, Aguelmam Azar, Oasis de Djanet, Guelta Tamrit (Dumont, 2017). O. Kerrache (Djemai & Bounaceur, 2017). Rhumel (Yalles Satha & Samraoui, 2017). O. Mouzaia, O. Chiffa, O. Djer, O. Bou Roumi, O. Mazafraan (Sellam-Bouattoura et al., 2018), Chott Melghir à Chmora, Sidi M'hamed Moussa, Hamraia, O. Hai, O. El Kantara (Demnati et al., 2019), Bejaia (Chelli & Moulai, 2019). Tagdemt, Tounina, Medroussa, Machraa sfa (Senouci & Bounaceur, 2021).
<i>Orthetrum coerulescens anceps</i> (Fig. 4F)	Ain Kriar (McLachlan, 1897). Biskra (McLachlan, 1897; Martin, 1901; Sélys, 1902; Morton, 1905; Martin, 1910; Samraoui & Menai, 1999). Touggourt (Sélys, 1902; Martin, 1910; Samraoui & Menai, 1999). Laghouat (Sélys, 1902; Samraoui & Menai, 1999). Hammam R'hira (Morton, 1905). La Calle, Constantine (Martin, 1910). Azazga, Tala Kitane, Alger (Lacroix, 1925). Fetzana (Dumont, 1978). Guerbes (Samraoui & de Bélair, 1997). Mechroha, Negrine, Bou Saada, Djamaa, Djelfa, Sidi Bel Abbes, Oran, Tassili N'Ajjer (Samraoui & Menai, 1999). O. Bouarroug, O. Pre-Bou Redim, G. Hadj Tahar, Demnat Ataoua, Lac Sidi Fritis (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. Djamaa (Bouchelouche et al., 2015). M. Edough (Samraoui & Alfaharhan, 2015). O. El harrache (Hafiane et al., 2016). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). O. Mouzaia (Sellam-Bouattoura et al., 2018). Tounina (Senouci & Bounaceur, 2021).
<i>Orthetrum nitidinerve</i> (Fig. 4I)	Sétif (Sélys, 1849; Martin, 1910). Bône (Sélys, 1871; Martin, 1910; Ris, 1909). Biskra (McLachlan, 1897; Martin, 1901; Sélys, 1902; Martin, 1910; Ris, 1909). Constantine, Ain Kriar (McLachlan, 1897). Laghouat, Ain Rich (Sélys, 1902). Theniet el Had (Morton, 1905). Seboud (Morton, 1905; Ris, 1909). La Calle (Martin, 1910). Mascara (Lacroix, 1925). Mechroha, Batna, Tebessa, Negrine, Bou Saada, Djelfa, Dréa, Oran, Ain Safra (Samraoui & Menai, 1999). Lac Bleu, Sidi Amar (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Rio Salado (Kabouche, 2013). Kebir-East, Rhumel (Yalles-Satha & Samraoui, 2017). O. Chiffa, O. Bou Roumi (Sellam-Bouattoura et al., 2018). Chott Melghir à O. Bou Biada, O. El Hai (Demnati et al., 2019). Tagdemt, Tounina, Medroussa, Frenda, Machraa sfa (Senouci & Bounaceur, 2021).
<i>Crocothemis erythraea</i> (Fig. 4L)	La Calle (Sélys, 1849; McLachlan, 1897). Lac Tonga (Sélys, 1849; McLachlan, 1897; Samraoui & Corbet, 2000a). Lac Oubeira (Sélys, 1849). Bône (Sélys, 1871; McLachlan, 1897; Ris, 1911). Biskra (McLachlan, 1897; Martin, 1901; Sélys, 1902; Morton, 1905; Martin, 1910; Samraoui & Menai, 1999). Lac Fetzara (Martin, 1901; Samraoui & Corbet, 2000a). Philippeville (Martin, 1901). Touggourt (Sélys, 1902; Le Roi, 1915; Martin, 1910; Samraoui & Menai, 1999). Ouargla (Sélys, 1902; Le Roi, 1915; Samraoui & Menai, 1999). Constantine (Martin, 1910). Temacin

Appendix 1. Continue.

Species	Spatio-Chronology of the species in Algeria
	(Le Roi, 1915). O. Kerma, Mascara (Lacroix, 1925). Sali, Bou Faaidid, Bahmer, Reggan (Reymond, 1952). Beni Abbes (Nielsen, 1956; Koch, 1979). Zerhamra (Nielsen, 1956). Hassi Maroket, In Salah, Arak, G. Idjif Mellèn, G. EEGPhra, Temekrest, Fetzana (Dumont, 1978). Lac des Oiseaux (Samraoui et al., 1992). Guerbes (Samraoui & de Bélaïr, 1997). Mechroha, Meskiana, Collo, Jijel, Tebessa, Negrine, Batna, BouSaada, Djamaa, El Oued, Temacin, El Goléa, Laghouat, Ghardaïa, Sidi Bel Abbes, Mostaganem, Ain Sefra, Tlemcen, Béchar, Timimoum, Adrar, Ahagaar, Tassili N'Ajjer (Samraoui & Menai, 1999). Oran (Samraoui & Menai, 1999; Kabouche, 2013). Mekhada marsh, O. Pre-Bou Redim, M. Gauthier, Sidi Amar, G. Sidi Makhlof, Bordj du Cantonnier, G. Tacha (Samraoui & Corbet, 2000a). O.Bouarroug (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Lac de Gharabas, Rio Salado (Kabouche, 2013). M. Edough (Samraoui & Alfarhan, 2015). O. Isser (Bouchelouche et al., 2015). O. El harrache (Hafiane et al., 2016). O. Imirhou, O. Djerat, Guelta Tamadjert, Amguid, Guelta Efenni, Aguelmam Azar, guelta Bordj el Haouas, Oasis de Djanet, Guelta Tamrit, Guelta Tamadjert (Dumont, 2017). O. Kerrache, O. Blat, O. Abaren (Djemai & Bounaceur, 2017). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). O. H. Righa, O. Djer, O. Mouzaïa, O. Bou Roumi, O. Mazafran (Sellam-Bouattoura et al., 2018). Chott Melghir à Chmora, Sidi M'hamed Moussa, Hamraia, O. Chebaba, O. El Hai (Demnati et al., 2019). Bejaia (Chelli & Moulai, 2019). Tounnina, Medroussa, Frenda, Machraa sfa (Senouci & Bounaceur, 2021).
<i>Sympetrum fonscolombii</i> (Fig. 5C)	Edough (Sély, 1871; Samraoui & Corbet, 2000a). Entre Blida et Médéa (Kolbe, 1885). Médéa (McLachlan, 1897). Biskra (McLachlan, 1897; Martin, 1910). Sebdo, Tlemcen (Morton, 1905), Mascara (Navás, 1928). O. Tit (Kimmins, 1934). Aoulf, Hassi el Meniet (Reymond, 1952). Hassi Maroket (Dumont, 1978). El Goléa, Beni Abbes (Koch, 1979). Lac des Oiseaux (Samraoui et al., 1992; Samraoui & Corbet, 2000a). Jijel, Tebessa, O. Oued, Ouargla, Ghardaïa, Laghouat, Ahaggar (Samraoui & Menai, 1999). Lac Fetzara, Lac Sidi Fritis, Lac Okrera, Lac Bleu, Lac Oubeira (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Dayet El Ferd (Kabouche, 2013). O. Djamaa, O. Isser (Bouchelouche et al., 2015). O. El harrache (Hafiane et al., 2016). O. Imirhou, Guelta Efenni (Dumont, 2017). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). O. Djer, O. Bou Roumi, O. Mazafran, (Sellam-Bouattoura et al., 2018). S. Hosni, Bra (Senouci & Bounaceur, 2018). Chott Melghir à Sidi Okba (Demnati et al., 2019). Bejaia (Chelli & Moulai, 2019). Tounnina, Medroussa, Frenda, Machraa sfa (Senouci & Bounaceur, 2021).
<i>Sympetrum meridionale</i> (Fig. 5F)	Constantine (Sély, 1849; Martin, 1910). La Calle (Sély, 1849). M.Edough (Sély, 1871; Samraoui & Corbet, 2000a; Samraoui & Alfarhan, 2015). Bône (McLachlan, 1897; Ris, 1911). Lac des Oiseaux (McLachlan, 1897; Samraoui et al., 1992). Lac Fetzara (Martin, 1901; Samraoui & Corbet, 2000a). Biskra (Martin, 1901). Teniet el Had, Sebdo, Tlemcen (Morton, 1905). Kabylie, Mascara (Lacroix, 1925). Guerbes (Samraoui & de Bélaïr, 1997). Mechroha, Tebessa, Jijel (Samraoui & Menai, 1999). Mekhada marsh, M. Gauthier, G. Boumaïza, G.Hadj Tahar, Demnat Ataoua, Lac Sidi Fritis, G. Sidi Makhlof, Bordj Cantonnier, G. Tacha (Samraoui & Corbet, 2000a). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. Isser (Bouchelouche et al., 2015). Kebir-East, Rhumel (Yalles Satha & Samraoui, 2017). Chott Melghir à O. Bou Biada (Demnati et al., 2019). Bejaia (Chelli & Moulai, 2019).
<i>Sympetrum sinaïticum</i> (Fig. 5I)	Ouargla, Amgid, O. Agelit, Ideles (Le Roi, 1915). G. Imelaouaene, G. Affilal, G.Issakarassène. G.Edjif Mellène, G. Emeghra (Dumont, 1978). Ahaggar (Samraoui & Menai, 1999), O. Imirhou, Amguid (Dumont, 2017). Chott Melghir in Chmora, Hamraia (Demnati et al., 2019).
<i>Sympetrum striolatum</i> (Fig. 5L)	Tonga (Sély, 1849). M. Edough (Sély, 1871; Samraoui & Alfarhan, 2015). Constantine (McLachlan, 1897; Martin, 1910). Biskra, Philippeville (Martin, 1901), Lac Fetzara (Martin, 1901; Samraoui & Corbet, 2000a). Theniet el Had, Sebdo (Morton, 1905). Bône (Ris, 1911). Tala Kitane, Agoulmine, Ouroufal (Lacroix, 1925). Lac des Oiseaux (Samraoui et al., 1992). Guerbes (Samraoui & de Bélaïr, 1997). Mechroha, Tebessa, Jijel (Samraoui & Menai, 1999). G.Boumaïza, G. Hadj Tahar, G.Sidi Lakhdar, Lac Sidi Fritis, G. Sidi Makhlof, Bordj Cantonnier, G.Tacha, Mekhada marsh, M. Gauthier (Samraoui & Corbet, 2000a). O. Kebir (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012; Yalles Satha & Samraoui, 2017). Seybouse (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. Bouarroug (Benchalel & Samraoui, 2012). O. Isser (Bouchelouche et al. 2015). Rhumel (Yalles Satha & Samraoui, 2017). Bejaia (Chelli & Moulai, 2019).
<i>Trithemis annulata</i> (Fig. 6C)	Oubeïra (Sély, 1849; McLachlan, 1897). Tonga (McLachlan, 1897; Samraoui & Corbet, 2000a). Ain Salah, Tidikelt (Ris, 1913). Touggourt (Le Roi, 1915; Samraoui & Menai, 1999). Beni Abbes (Nielsen, 1956; Koch, 1979). Fetzana, Hassi Maroket, Arak (Dumont, 1978). Lac des Oiseaux (Samraoui et al., 1992; Samraoui & Corbet, 2000a). Guerbes (Samraoui & de Bélaïr, 1997). Jijel, Negrine, Biskra, Bou Saada, Djamaa, El Oued, Ouargla, Laghouat, El Goléa, Adrar, Sidi Bel Abbes, Mostaganem, Béchar, Ain Sefra (Samraoui & Menai, 1999). Mekhada marsh, Lac Bleu, M. Gauthier, Lac Fetzara, G. Sidi Lakhdar, G. Dissia, Lac Sidi Fritis, G. Tacha (Samraoui & Corbet, 2000a), O. Kebir (Samraoui & Corbet, 2000a; Benchalel & Samraoui, 2012; Yalles Satha & Samraoui, 2017). Seybouse, (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). O. El harrache (Hafiane et al., 2016). O. Imirhou, O. Djerat, Amguid, Guelta Efenni, Oasis de Djanet (Dumont, 2017). Rhumel (Yalles Satha & Samraoui, 2017). O. Djer, O. Bou Roumi, O. Mazafran (Sellam-Bouattoura et al., 2018). Chott Melghir à O. Djeddi, O. Bou Biada (Demnati et al., 2019). Bejaia (Chelli & Moulai, 2019). Medroussa, Frenda, Machraa sfa (Senouci & Bounaceur, 2021).
<i>Trithemis kirbyi</i> (Fig. 6F)	O. Tit (Kimmins, 1934). Ain Bou Faaidid, Bahmer, Ain Tingueltguemine (Reymond, 1952). Reggan (Reymond, 1952; Dumont, 1978). Beni Abbes (Nielsen, 1956; Koch, 1979). G. Idjif Mellène (Dumont, 1978). Bou Saada, Laghouat, Ghardaïa, El Goléa, Adrar, Timimoun, Béchar, Ain Sefra, Ahaggar (Samraoui & Menai, 1999). Seybouse, (Khelifa et al., 2011; Yalles Satha & Samraoui, 2017). Sebka d'Oran (Kabouche, 2013). O. El harrache (Hafiane et al., 2016). O. Imirhou, O. Djerat, Guelta Efenni, Aguelmam Azar, Guelta Bordj el Haouas, Oasis de Djanet, Guelta Tamadjert (Dumont, 2017). Kebir-East (Yalles Satha & Samraoui, 2017). Chott Melghir à Sidi M'hamed Moussa, O. Saada, O. Djeddi, Sidi Okba, O. Bou Biada, O. Chebaba, O. El Kantara (Demnati et al., 2019). Bejaia (Chelli & Moulai, 2019). Tagdemt, Tounnina, Medroussa (Senouci & Bounaceur, 2021).

## AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the article as follows: M.M.: Responsible for collecting field data and writing the manuscript. D.S: Organized and analyzed the data and made the identifications. B.L: Correction of the final version of the manuscript. All authors reviewed the results and approved the final version of the manuscript.

## FUNDING

This research received no specific grant from any funding agencies.

## AVAILABILITY OF DATA AND MATERIAL

Not applicable.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## CONSENT FOR PUBLICATION

Not applicable.

## CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

## ACKNOWLEDGMENTS

The authors would like to thank Régis Krieg-Jacquier, Sylvain Bost, Eric Detrez, Bertrand Piney, Florian Mongin, and Benoît Guillon for verifying the observations, providing advice and guidance, and making recommendations on the general appearance of the document.

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## تنوع طیاره‌ماندها (Odonata, Anisoptera & Zygoptera) در پارک ملی ثنیه احد، شمال غرب الجزایر

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| تاریخ دریافت: ۰۹ مهر ۱۴۰۱ | تاریخ پذیرش: ۰۷ دی ۱۴۰۱ | تاریخ انتشار: ۱۱ دی ۱۴۰۱ |

**چکیده:** هدف از این تحقیق، فهرست‌برداری فون طیاره‌ماندها در پارک ملی ثنیه احد است تا از این طریق، اجرای برنامه‌های مدیریتی در حفاظت از این گونه‌ها تسهیل شود. منطقه مورد مطالعه، کاملاً جنگلی (گونه‌های *Quercus* و *Cedrus*) با زیستگاه‌های طبیعی متعدد (عرصه‌های باز، علف‌زارها، زیستگاه‌های صخره‌ای، چشمه‌ها، آبگیرها، برکه‌ها و غیره) است که بر اساس ساختار متنوع خود، حاوی گنجینه‌ای شاخص از گیاهان و جانوران می‌باشد. تمرکز این تحقیق بر آبگیرهای جنگلی غیر دائمی طبیعی و مصنوعی بود که در سرتاسر پارک پراکنده بوده و به لحاظ زیستی و اکولوژیک مطلوب طیف گسترده‌ای از حشرات خصوصاً گروه‌های با دگردیسی تدریجی هستند. در این حشرات، شرایط زندگی و زیستگاه مرحله پیش از بلوغ بسیار متفاوت از افراد بالغ است، به این شکل که در طیاره‌ماندها، نوزادان آب‌زی بوده، اما حشرات کامل، خشکی‌زی و اغلب در پرواز هستند. فهرست‌برداری طیاره‌ماندها به صورت ماهانه از مارس ۲۰۱۷ تا فوریه ۲۰۱۸، در هشت آبگیر (هفت برکه جنگلی و یک مخزن آب) انجام شد. نتایج این تحقیق منجر به ثبت اطلاعات ۲۴۰ نمونه از طیاره‌ماندها از ۱۸ گونه و ۱۱ جنس متعلق به پنج خانواده شد. اطلاعات گونه‌های ثبت‌شده طی این تحقیق، روی نقشه پیاده‌سازی شد تا انتشار آنها در ابعاد محلی (پارک ملی) و مقیاس ملی مشخص شود.

**واژگان کلیدی:** حفاظت، سنجاقک‌ها، آسیابک‌ها، جنگل، پارک ملی، تنوع زیستی

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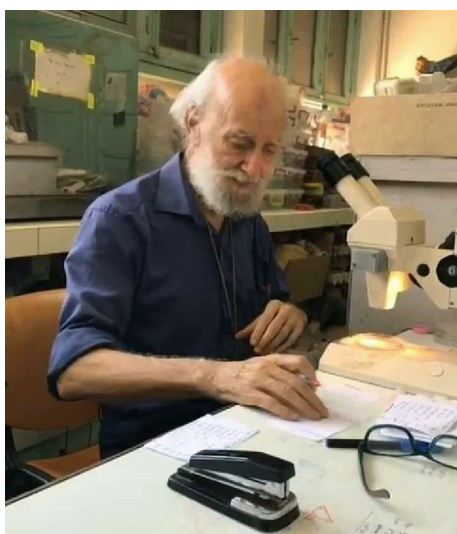
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