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Records of Dragonflies from the Dead Sea Basin (Israel, West Bank, Jordan) with the records of *Orthetrum abbotti* and *Crocothemis sanguinolenta* (Odonata: Libellulidae)

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Abstract

Twenty-five species of Odonata were found on two short holiday trips to the southern part of the Dead Sea Basin in May 2018 and April 2019. Occurrence of *Orthetrum abbotti* and *Crocothemis sanguinolenta* in Jordan was confirmed, many new localities of *O. ransonnetii* in Israel and Jordan were discovered.

Zusammenfassung

Libellenfunde aus dem Toten Meer Becken (Israel, Westjordanland, Jordanien) mit Funden von *Orthetrum abbotti* und *Crocothemis sanguinolenta* (Odonata: Libellulidae) – Bei zwei Kurzurlaubsreisen in den südlichen Teil des Toten Meer Beckens im Mai 2018 und April 2019 konnten 25 Libellenarten nachgewiesen werden. Das Auftreten von *Orthetrum abbotti* und *Crocothemis sanguinolenta* in Jordanien wurde bestätigt, viele neue Fundorte von *O. ransonnetii* wurden in Israel und Jordanien entdeckt.

Introduction

Eastern Mediterranean ("The Levant") is a very interesting region biogeographically: about 86 species of dragonflies have been known so far (Dumont 1991; Boudot et al. 2009), including several endemic (e.g. *Calopteryx hyalina, C. syriaca, Coenagrion syriacum, Pseudagrion syriacum, Gomphus davidi*) and post-pluvial relict species (e. g. *P. sublacteum, Crocothemis sanguinolenta, Orthetrum abbotti*) (Schneider 2004; Boudot et al. 2009). The occurrence of these particular post-pluvial relict species is concentrated especially in a sub-area called the Jordan/Dead Sea drainage. Despite zoogeographical importance of this region only a few faunistic papers have been published so far. Known records from the whole area are summarized e.g. in Fauna Palaestina (Dumont 1991), the dissertation by

Schneider (1986) or older works by Selys (1887), Schmidt (1939) and Morton (1924). Monnerat & Hoess (2011) summed up the collecting done by Klapperich between 1956 and 1969 in Jordan, West Bank and Lebanon.

In the past dragonflies of the area of the Jordan/Dead Sea drainage were studied particularly in the north of Israel: 53 species were recorded there (Dumont 1991). A few recent faunistic studies on dragonflies of Northern Israel exist (De Marmels 1995; Schneider et al. 2013). Some papers focus on one or several selected species (Dumont 1973, 1974, 1975; Schneider 1982). Three endemic subspecies (*Urothemis edwardsii hulae, Rhyothemis semihyalina syriaca, Pseudagrion torridum hulae*) were described from the Lake Hula region in the upper Jordan Valley (Dumont 1975, 1991). Ecological topics were discussed by Schneider (1982).

From the southern part of the Dead Sea Basin, especially the Negev Desert in Israel, there are only minimum data. Dijkstra & Dingemanse (2000) comment on the finding of *Crocothemis sanguinolenta* in Israel. Adawi et al. (2017) published some records of dragonflies from the West Bank.

Slightly more papers are dedicated to the Jordanian side of the Jordan/Dead Sea drainage. Two summary papers on Odonatofauna of Jordan were published (Katbeh-Bader et al. 2002; Katbeh-Bader et al. 2004). Kunz et al. (2006) published a comprehensive study on the distribution of *Zygonyx torridus* in the Palaearctic, including new localities from Jordan. Amr et al. (2013) offer up the newest study concerning the Wadi Mujib, impacts of the Wadi Al Mujib Dam included.

The first finding of *O. abbottti* in Jordan was published by Dumont (1977), being a new species for the Palaearctic as well. However, as for *O. abbotti* and *C. sanguinolenta* in Jordan, maximum information was presented by Christian Monnerat in his lecture and conference paper (2010).

Except for the published information, there are several other data available at the online database observado.org (e.g. Israel 2020, Jordan 2020).

Methods and study area

Eleven localities were visited from the 15th to 19th May 2018 during a field trip to Israel (incl. inspection of 60 km long section of the Nahal Zin valley) and West Bank. Seventeen localities were visited from the 17th to 22nd April 2019 during a field trip to Jordan (incl. inspection of 30 km long section of the Wadi Al Hasa valley). Many species were photographed in the field. All the collected exuviae are deposited with the author. The data are presented at the online database observado.org (Waldhauser 2018, 2019).

The localities visited (Fig. 1) are listed below together with their geographic coordinates in the international geodetic system WGS 84, their altitude in meters above sea level and the date of the visit. Names of the localities agree primarily with http://www.openstreetmaps.org.

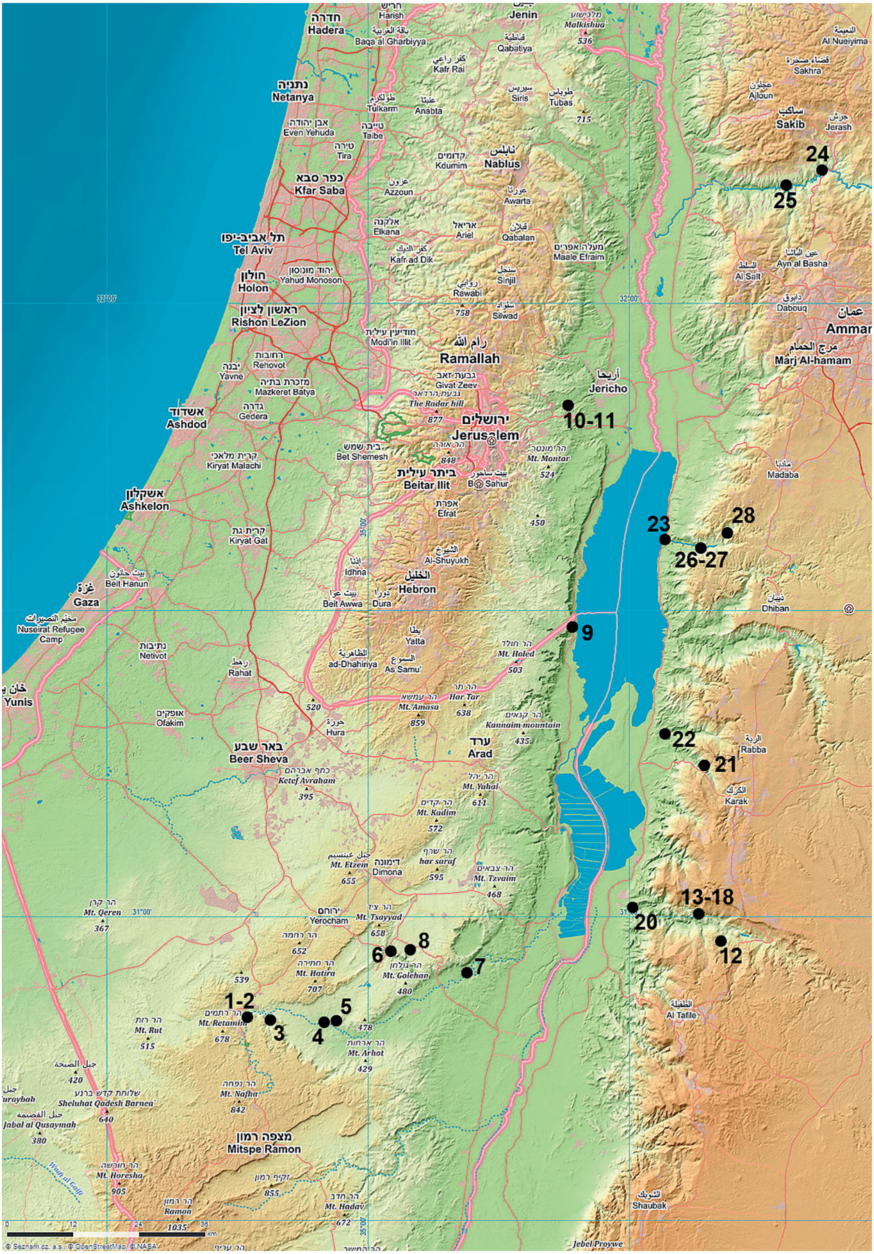

Figure 1. Map of the southern part of the Dead Sea Basin with visited localities. – **Abbildung 1:** Karte vom südlichen Teil des Toten Meer Beckens mit besuchten Lokalitäten.

Israel

(1) Midreshet Ben-Gurion, En Avdat, Nahal Zin river; GPS: 30.8291° N, 34.7665° E; permanent watercourse, waterfalls, boulders, sometimes a rock bed with pools; 420 m a.s.l.; 15-v-2018
(2) Midreshet Ben-Gurion, Nahal Zin river; GPS: 30.8143° N, 34.7676° E; dry river, rocky bed with pools, without vegetation; 510 m a.s.l.; 15-v-2018
(3) Ein Akev; GPS: 30.7944° N, 34.8123° E; brook with a 300 m stretch of flowing water (width 40 cm, depth 5–10 cm), valley overgrown and shadowed by trees and bushes; 480 m a.s.l.; 15-v-2018
(4) Nahal Zin floodplain; GPS: 30.8172° N, 34.9332° E; terrain depression with partially dried muddy pools; 210 m a.s.l.; 16-v-2018
(5) Ein Umm Tina; GPS: 30.818° N, 34.9447° E; rock bowls filled with water in a dry river bed, without vegetation; 220 m a.s.l.; 16-v-2018
(6) Ein Yorke'am Nahal Hatira GPS: 30.9378° N, 35.0412° E; periodic watercourse, rock bowls filled with water; 270 m a.s.l.; 17-v-2018
(7) Nahal Zin River; GPS: 30.8914° N, 35.1693° E; springs onto the surface, then flows for about 10 km, then disappears again, heavily contaminated water from phosphate mines; 30 m b.s.l.; 17-v-2018
(8) Nahal Yemin; GPS: 30.9442° N, 35.0733° E; dry river bed with rock bowls filled with water, without vegetation; 310 m a.s.l.; 18-v-2018
(9) En Gedi, Wadi David; GPS: 31.4711° N, 35.3867° E; permanent watercourse with herbaceous and shrubby vegetation on the banks; 300 m b.s.l.; 18-v-2018

Palestine, West Bank

(10) Mitspe Yeriho, Wadi Al-Qalt; GPS: 31.8356° N, 35.3781° E; permanent watercourse with herbaceous and shrubby vegetation on the banks; 10 m b.s.l.; 19-v-2018
(11) Alon, Wadi Al-Qalt; GPS: 31.8417° N, 35.3553° E; permanent watercourse with herbaceous and shrubby vegetation on the banks; 70 m a.s.l.; 19-v-2018

Jordan

(12) Afra Hot Springs and small brook Wadi Afra; GPS: 30.9656° N, 35.6432° E; 330 m a.s.l.; 17-iv-2019
(13) Confluence of Wadi Afra and Wadi Al Hasa; GPS: 30.986° N, 35.6403° E; boulder stream with dense shrubby vegetation on the banks; 150 m a.s.l.; 17-iv-2019
(14) Wadi Al Hasa; GPS: 30.9952° N, 35.6216° E; open valley, slowly flowing stream with littoral herbaceous vegetation; 100 m a.s.l.; 17-iv-2019
(15) Wadi Al Hasa; GPS: 30.989° N, 35.6148° E; boulder brook, several small waterfalls, open valley, sometimes herbal vegetation with clumps of grass; hot springs rise nearby; 50 m a.s.l.; 18-iv-2019
(16) Wadi Al Hasa; GPS: 30.9900° N, 35.5932° E; open valley, slowly flowing stream with littoral herbaceous vegetation; 20 m a.s.l.; 18-iv-2019

(17) Wadi Al Hasa; GPS: 30.9976° N, 35.5831° E; narrow rocky canyon, without vegetation; 0 m a.s.l.; 18-iv-2019
(18) Wadi Al Hasa; GPS: 30.9997° N, 35.5485° E; boulder brook, open valley, sometimes herbal vegetation; 130 m b.s.l.; 18-iv-2019
(19) Al Safi, Wadi Al Hasa; GPS: 31.0156° N, 35.4944° E; lower end of the canyon, gravel bed, partially open valley, almost free of herbaceous vegetation; 310 m b.s.l.; 19-iv-2019
(20) Al Safi, Wadi Al Hasa; GPS: 31.0183° N, 35.4894° E; the edge of the village of Al Safi, open dry riverbed, only irrigation canals, wide open valley, almost without herbaceous vegetation; 325 m b.s.l.; 19-iv-2019
(21) Mumeya; GPS: 31.2317° N, 35.653° E; irrigation canals; 350 m a.s.l.; 19-iv--2019
(22) Al Mazra, Wadi Ibn Hamad; GPS: 31.2973° N, 35.5545° E; lower end of the valley, permanent watercourse with gravel to boulder bed, smaller waterfalls and pools in rock basins; 190 m b.s.l.; 19-iv-2019
(23) Dead Sea, the mouth of Zara Hot Springs into the Dead Sea; GPS: 31.6007° N, 35.5607° E; 430 m b.s.l.; 20-iv-2019
(24) Wadi Zarqa by the Amman-Jerash motorway; GPS: 32.2182° N, 35.8804° E; at the time of the visit a river of high water, evidently heavily polluted; 230 m a.s.l.; 20-iv-2019
(25) Burma, Wadi Zarqa below the King Talal Dam; GPS: 32.1915° N, 35.7957° E; 60 m a.s.l.; 21-iv-2019
(26) Wadi Ma´in by Ma´in Hot Springs; GPS: 31.6074° N, 35.6182° E; small brook in boulder bed, several waterfalls; 60 m b.s.l.; 21-iv-2019
(27) Wadi Ma´in; GPS: 31.6011° N, 35.6357° E; small stream in a narrow rock canyon without vegetation; 170 m a.s.l.; 22-iv-2019
(28) Wadi Ma´in; GPS: 31.6340° N, 35.6990° E; small brook slowly flowing into a deep bed heavily overgrown by herbaceous and shrubby vegetation; 390 m a.s.l.; GPS: 31.6340°N, 35.6990°E; 22-iv-2019

List of recorded species

Twenty-five species pertaining to seven families were recorded and are listed below together with the corresponding localities and relevant comments.

Discussion

Twenty-five species were recorded (11 species in Israel, 11 species in the West Bank localities and 22 species in Jordan). This amount represents 17% of the 64 species confirmed for Israel, 41% of the 27 species confirmed for Palestinian Territories and 51% of the 43 species confirmed for Jordan (Boudot et al. 2009). Records of *O. abbotti* and *C. sanguinolenta* are the most notable of them all. As they confirm older records of these post-pluvial relict species from the Dead Sea Basin which is a rather isolated site from the compact rest of their area

Table 1. Localities listed above with numbers of specimens of each species – **Tabelle 1:** Lokalitäten mit Anzahl der Exemplare jeder Art.

Country		Israel									West Bank		Jordan		
Locality N°		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Anax ephippiger	imago														
Anax imperator	imago	1		1							1	1	1		
Anax imperator	exuvia			10											
Anax parthenope	imago	1													
Brachythemis impartita	imago														
Calopteryx syriaca	imago														
Crocothemis erythraea	imago		1	10											
Crocothemis sanguinolenta	imago												5		
Epallage fatime	imago											15			
Ischnura elegans	imago													1	
Ischnura evansi	imago	100		30		1		5			1				
Ischnura fountaineae	imago														
Onychogomphus lefebvrii	imago											10			
Orthetrum abbotti	imago														
Orthetrum brunneum	imago			5											
Orthetrum coerulescens	imago			5											
Orthetrum chrysostigma	imago	50	1	100				1			15	100	50		
Orthetrum ransonnetii	imago	10	1			2			15				10		
Pantala flavescens	imago														
Paragomphus genei	imago										10				
Platycnemis dealbata	imago										15	15			
Pseudagrion syriacum	imago										20	5		1	5
Sympetrum fonscolombii	imago		1												
Trithemis annulata	imago			1							1		1		
Trithemis arteriosa	imago	100	10	100	1	1	10	5	15	15	15	100	30		
Trithemis arteriosa	exuvia	100													
Zygonyx torridus	imago										3				
Zygonyx torridus	larva														
Zygonyx torridus	exuvia														
Numbers of species		7	5	8	1	3	1	3	2	1	9	7	6	2	1

Country		Jordan													
Locality N°		**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
Anax ephippiger	imago			1										1	
Anax imperator	imago	1		1		1							1		
Anax imperator	exuvia														
Anax parthenope	imago														
Brachythemis impartita	imago						5								
Calopteryx syriaca	imago											30			
Crocothemis erythraea	imago				1							1			
Crocothemis sanguinolenta	imago	25			10				3				2		
Epallage fatime	imago				1										
Ischnura elegans	imago		1		5	1									
Ischnura evansi	imago														
Ischnura fountaineae	imago									1					
Onychogomphus lefebvrii	imago														
Orthetrum abbotti	imago	15													
Orthetrum brunneum	imago	1													
Orthetrum coerulescens	imago														
Orthetrum chrysostigma	imago	30		15		15		10	15			10	10	10	
Orthetrum ransonnetii	imago			10					5					10	
Pantala flavescens	imago								1						
Paragomphus genei	imago								1						
Platycnemis dealbata	imago										15	10			15
Pseudagrion syriacum	imago		1												
Sympetrum fonscolombii	imago													1	
Trithemis annulata	imago				1							1			
Trithemis arteriosa	imago	30		15		15			15			1	15	10	
Trithemis arteriosa	exuvia														
Zygonyx torridus	imago	1			1				5				1	1	
Zygonyx torridus	larva	1													
Zygonyx torridus	exuvia	10			1										
Numbers of species		7	2	5	6	4	1	1	7	1	1	6	5	6	1

of occurence. Our attention and further discussion should also be directed to the records of the rare species including *Calopteryx syriaca, Ischnura fountaineae, Pseudagrion syriacum, Onychogomphus lefebvrii, O. ransonnetii* and *Zygonyx torridus.*

Approximately 15 imagoes mature as well as immature of *O. abbotti* were found within approx. 300 m long stretch of the Wadi Al Hasa (Loc. 15). This part of the watercourse can be described as a fast running brook 0.5–2 m wide with boulder bed. The banks are mostly bare, without littoral vegetation (Fig. 2). Hot springs rise nearby. Grassy vegetation surrounds the brook. Imagoes could be seen solely in that grass up to 5 m from the watercourse. Neither larvae nor exuviae were found, but due to the occurrence of the imagoes mentioned above the development of this species in this area is highly probable. Due to a diminutive size of this species and its inconspicuous way of life overlooking it in other places cannot be ruled out.

Orthetrum abbotti (Fig. 3) is considered a relict of a past post-glacial pluvial period (Schneider 2004). Published data (Dumont 1977, 1991) involve one male from the Wadi Mujib (Nahal Arnon) found on 17-viii-1941 (leg. H. Bytinski-Salz; collection of dragonflies in the Department of Entomology, University of Tel Aviv, Israel). Monnerat (2010) recorded *O. abbotti* on the eastern coast of the Dead Sea during years 2007–2009. These were five localities including the Wadi Al Hasa, Wadi Ibn Hamad, Zara Hot Springs and Wadi Mujib (C. Monnerat, pers. comm.). However, Amr et al. (2013) did not find this species while exploring the Wadi Mujib. Further closest localities are situated south of the Arabian Desert in Yemen (Dumont & Al Safadi 1993; Schneider & Nasher 2013) and Oman (Franković 2012) as well as in Africa south of the Sahara Desert (Dijkstra & Clausnitzer 2014).

Figure 2. Brook Wadi Al Hasa (Loc. 15), habitat of *Orthetrum abbotti* and *Crocothemis sanguinolenta* (17-iv-2019). – **Abbildung 2:** Bach Wadi Al Hasa (Loc. 15), Lebensraum von *Orthetrum abbotti* and *Crocothemis sanguinolenta* (17.04.2019). Photo: MW

Crocothemis sanguinolenta (Fig. 4) was found in five localities in Jordan altogether – Wadi Afra (Loc. 12), two sites in Wadi Al Hasa (Loc. 15, 18), Wadi Ibn Hamad (Loc. 22) and Wadi Ma´in (Loc. 26). The biotopes are always rocky or boulder brooks with absent or sparse vegetation. Hot springs rise near three of the localities (Wadi Afra, Wadi Al Hasa, Wadi Ma´in).

Crocothemis sanguinolenta is also considered a relict of the past post-glacial pluvial period (Boudot et al. 2009, Schneider 2004). The number of confirmed localities so far has been slightly bigger than those of *O. abbotti*: Morton (1924): Dead Sea, leg. Schwabel in 1918; Dumont (1977): Wadi Mujib, leg. Bytinski-Salz in 1941; Schneider (1982, 1985): three sites; Dijkstra & Dingemanse (2000): one new site in Israel (En Gedi); Katbeh et al. (2002): one new site in Jordan (Khunayzir Dam – collection of dragonflies in the Department of Entomology, University of Tel Aviv, Israel). Monnerat (2010) recorded *C. sanguinolenta* in the eastern coast of the Dead Sea during years 2007–2009. These were approx. twelve sites (C. Monnerat, pers. comm.). Furthermore, the data of Klootwijk (2018) from 18-ix-2018, Wadi Ghuwayr (Dana Biosphere Reserve), Jordan, are also available. Amr et al. (2013) did not find this species while exploring the Wadi Mujib. Further closest localities are situated on the southern edge of the Arabian Peninsula as well as in Africa south of the Sahara (Dijkstra & Clausnitzer 2014).

Figure 3. *Orthetrum abbotti* (17-iv-2019). – **Abbildung 3:** *Orthetrum abbotti* (17.04.2019). Photo: MW

Orthetrum ransonnetii is a typical desert species (Dumont 1991). During the trip the species was being recorded regularly in abundant populations in these biotopes: brooks in rock canyons without vegetation or pools in rock basins within otherwise dry river beds. Altogether it was recorded on four sites in Israel (Loc. 1, 2, 5 and 7) and four sites in Jordan (Loc. 12, 17, 22 and 27).

These rather frequent records of the species during the trip stand in contrast to very sparse published data. Dumont (1991) presents localities in Israel (including the En Avdat and En Gedi) and in Sinai. Schneider (1986) states the occurrence of this species in Jordan south of the Aqaba city. At the online database observado.org a higher number of non-published records from Israel may be found, most of them come from touristically well known location of the En Avdat (de Bruin 2013; Koetsier 2014; Hotting 2015; de Knegt 2017; Bot 2019; Broeckaert 2019), or from other parts of the Negev Desert north of Eilat (Cherrug 2013; Wijker 2013).

Onychogomphus lefebvrii (about 10 individuals) was found only by a brook with rich herbaceous and shrubby vegetation – Wadi Qualt (Loc. 11). This locality is one of the southernmost within the Levant (Schneider 1986; Dumont 1991; Boudot et al. 2009; Monnerat & Hoess 2011).

Calopteryx syriaca (abundant population) was found only within the Zarqa river below the King Talal dam (Loc. 25). Dumont (1991) also states its occurence there. But he also presents data from the eastern drainage of the Dead Sea (incl.

Figure 4. *Crocothemis sanguinolenta* (17-iv-2019). – **Abbildung 4:** *Crocothemis sanguinolenta* (17.04.2019). Photo: MW

the Wadi Hasa and Wadi Mujib). It has not been found within the Wadi Hasa, Amr et al. (2013) did not find it in the Wadi Mujib. Schmidt (1939) states the occurence of *C. syriaca* in the Wadi Quelt (West Bank). This species, endemic of Levant, is generally considered sensitive to water purity and biotope change caused by dam construction (Dumont 1991; Schneider 2004; Boudot et al. 2009).

Pseudagrion syriacum – endemic to the Levant (Dumont 1991; Schneider 2004; Boudot et al. 2009), found by two brooks with rich vegetation – Wadi Qualt (Loc. 10 and 11) and Wadi Hasa (Loc. 13, 14 and 16).

Ischnura fountaineae – known for its tolerance to high salinity (Jödicke 2006). One female found directly on the Dead Sea coast by the Zara Hot Springs mouth (Loc 23).

The most common species, present at most localities often in abundant numbers are in particular: *Orthetrum chrysostigma, Trithemis arteriosa* and *Anax imperator.*

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