

An Investigation of Odonate Communities within Wadi Sayq, Dhofar Province, Oman (Insecta: Odonata)

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ABSTRACT: Two research expeditions surveyed Odonata communities within Wadi Sayq, a coastal wadi system 20 km in length, situated in the southwest Jabal Qamar mountain range, Dhofar Province of Oman. Sample collection was undertaken from 2 to 29 February 2012, and from 6 February to 7 March 2013. Eight hundred and ninety seven individuals were recorded belonging to 20 species and *Tholymis tillarga* (Fabricius, 1798) is new for the Arabian Peninsula. A single record of *Rhyothemis semihyalina* (Desjardins, 1832) increases significantly the known distribution range of this species in Arabia to the West. Reasons for the observed temporal and spatial variation in community composition are explored and notes on species habitat preferences are included.

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INTRODUCTION

Sixty four species of Odonata are known from the Arabian Peninsula (117 including the Levant), among which 42 have been found in Oman and 32 recorded from the Dhofar region (J.-P. Boudot *pers. comm.*). The odonate fauna of Oman is largely of African origin, with some additional species being Indo-Asian, Central Asian or Arabian endemics (Schneider and Dumont 1997; see also Feulner and Judas 2013). Many of the species that have colonised Arabia are widespread on the African continent and invaded the Levant and the Mediterranean coasts using the Red Sea coast of Arabia (Schneider 1985) and the Nile valley (Dumont 1980). Several of the Asian species have ranges spanning continents. Varying levels of precipitation across the Arabian Peninsula control the distribution of odonate species, showing higher levels of diversity in areas with higher rainfall. For example, the coastal mountain ranges support many more species than the arid interior (Waterston and Pittaway 1991).

The mouth of Wadi Sayq (Khor Kharfut) (16°43'48" N, 53°20'11" E) is located on the southern coast of Dhofar, approximately 25 km from the Yemen border. The length of the valley remains undeveloped for a distance of 11 km to the west, where upon As Sultan Qaboos Street and a minor road intercept the valley. Monsoon woodland predominates on the steep slopes and gullies, and species of *Acacia* and *Boswellia* are common. Grasses, shrubs and *Acacia* cover the plateau environments of the valley shoulders, and the gravel plains of the estuary are dominated by reeds, grasses and stands of date palm. In the upper stretches, the smoothed rock of the wadi bottom is scattered with large white marble boulders and vegetation is sparse. The impacts of overgrazing by cattle and camels can be noticed throughout the wadi apart from in the most inaccessible locations. Despite this, Wadi Sayq is considered one of the greenest valleys in the Dhofar mountain range and may

also exist as Oman's most biodiverse landscape, which was confirmed during our multidisciplinary survey.

MATERIALS AND METHODS

Because of the difficulty of moving through the rugged terrain of the wadi, survey sites were identified throughout the duration of the 2012 research period, as they were discovered. Eleven sites showed worthwhile populations of Odonata for surveying (figure 1).

Site A (16°44'44" N, 53°13'50" E; 420 m a.s.l.): Although mostly arid, this area does contain a localised fresh water source creating a series of flowing pools for around 100 m and accompanying vegetation. The levels in these pools fluctuated every few days and occasionally dried up completely. Grazing occurred at this location, minimising the spread of vegetation along the edges of the stream and shortening the *Typha* and *Phragmites* to knee height.

Site B (16°44'29" N, 53°16'58" E; 170 m a.s.l.): The water level in this 5x1 m concrete livestock watering trough, fed by a pipe from the neighbouring village, varied greatly and was probably too temporary for even the most rapidly developing larvae to colonise.

Site C (16°44'3" N, 53°18'43" E; 90 m a.s.l.): Two temporary pools persisted for several months into the 2012 dry season, on account of them being deep and shaded. The water that remained was coloured green and partially stagnant. Over the research period the level of the water dropped within these pools. No emergent vegetation was present however they were in close proximity to the dense vegetation of the valley sides. Water was absent from these pools in 2013.

Site D (16°44'6" N, 53°19'17" E; 35 m a.s.l.): A site at the joining of three large valleys incorporating the boulder-strewn wadi bed and scattered shrubs. Water was absent.

Site E (16°44'2" N, 53°19'39" E; 25 m a.s.l.): Several large freshwater pools occur in the lower reaches of the wadi, approximately 1 km from the coast. At this point

the estuarine plain meets the 'V' shaped valley and large boulders become the prominent feature. The largest pool at the western end of the site measures approximately 50x40 m and a gravel island has formed in the centre of the pool. The western end of this pool becomes gradually shallower, the substrate transitioning from mud to gravel to meet the plain. Above this, a deep pool measuring approximately 30x25 m is fed by a smaller pool measuring approximately 15x15 m. Both are contained within gravel banks and submerged boulders. It is understood these pools emanate from three underground springs and represent the largest source of fresh water in the wadi. Reports from local people and our advanced party in 2011 suggest they persist reliably year round although the water levels appear to fluctuate. The presence of fish supports this information. Some relatively large trees were able to survive in this area including wild tamarind (*Tamarindus indica*) and fruiting fig (*Ficus*). The firm ground makes this location highly suitable for cattle to drink, with the resident herd observed to visit this area regularly. Trees and bushes are present where the sides of the valley steepen. Small stands of *Typha* were present in 2012 whereas in 2013 dense stands of reeds and rushes surrounded the pools.

Site F (16°44'0" N, 53°19'55" E; 12 m a.s.l.): An area of *Typha*, *Phragmites*, *Juncus* and grasses, fed by a natural spring throughout the year, forms a marsh on the northern side of the plain for a distance of approximately 800 m, reaching the rear of the beach. Site F incorporates an area of this habitat measuring approximately 200x60 m. This area is grazed regularly, limiting the spread of vegetation to the gravel plain. It was also heavily trampled and muddy in places.

Site G (16°43'54" N, 53°20'1" E; 5 m a.s.l.) and Site H (16°43'56" N, 53°20'3" E; 9 m a.s.l.): Similar characteristics to site F, but at the interface between the spring-fed marsh and the saline lagoons.

Site I (16°43'50" N, 53°20'4" E; 4 m a.s.l.) and Site J (16°43'53" N, 53°20'13" E; 6 m a.s.l.): A pair of saline lagoons occur behind the beach. These are mostly shallow and flooded during high spring tides, and also fed by fresh water from the marsh. Giant mud crab (*Scylla serrata*) and various fish species were observed here. The area is sparsely vegetated due to grazing pressure. Two sites measuring approximately 80x50 m were surveyed on the northern and southern sides of the estuary.

Site K (16°43'52" N, 53°20'22" E; 8 m a.s.l.): A coastal grassland site measuring 100x60 m located behind the beach.

A focal area for surveys incorporated the verdant estuarine environment, as this boasted the highest abundance of dragonflies. Survey site boundaries were loosely set for each site to incorporate the key aquatic features, but were often determined by the surrounding environment. All surveys were undertaken in good weather conditions favourable for dragonfly activity.

Two to four surveyors used 400 mm white aerial nets to collect individuals. Attempts were made to minimise discrimination between the individuals caught. Once caught, the individuals were identified to species level and their gender noted. They were then marked with nail varnish to avoid double counting, and released. Specimens were collected only when absolutely necessary. A specimen collection permit was issued by the Oman Ministry of Environment and Climate Affairs and specimens were donated to the Oman Natural History Museum in Muscat.

RESULTS

The list and the abundance of the species recorded in Wadi Sayq are shown in Figure 2. Eight hundred and ninety seven individuals were collected, belonging to 20 of the 32 species known from Dhofar. *Trithemis arteriosa* (Burmeister, 1839) was the most commonly occurring species, accounting for over a third (34.9%) of all records. This species was recorded at 9 of the 11 survey locations and was the dominant taxon at 3 of them. *Orthetrum chrysostigma* (Burmeister, 1839) was the second most abundant species, accounting for 15.2 % of the total individuals collected during the survey, and was the dominant species at site F. *Ischnura senegalensis* (Rambur, 1842) was the most common damselfly, and the third most common species in Wadi Sayq, recorded on 86 occasions. Sites on the estuarine plain boasted notably higher species richness relative to other sites. The local dominant species varied according to the characteristics of each site (Figure 2), and also from one year to another (Figure 3). Additionally, a species new to the Arabian Peninsula, *Tholymis tillarga* (Fabricius, 1798), was found.



FIGURE 1. Satellite image of Wadi Sayq showing the locations of survey sites A-K.

Species	Survey Site											Grand Total
	Upper Wadi					Lower Wadi						
	A	B	C	D	E	F	G	H	I	J	K	
<i>Trithemis arteriosa</i>	126		11		119	17	1	5	1	6	27	313
<i>Orthetrum chrysostigma</i>	36		1	1	6	87	2	2	1			136
<i>Ischnura senegalensis</i>		1			22	11		19	29	4		86
<i>Ceragrion glabrum</i>	7				14	48		2				71
<i>Trithemis annulata</i>	1				22	17		1	25	3	1	70
<i>Crocothemis erythraea</i>	11		1		6	31		5	9	4	1	68
<i>Orthetrum sabina</i>					11	14		4	4	3	2	38
<i>Pantala flavescens</i>	5		2	1	5	19		2	1			35
<i>Diplacodes lefebvrii</i>	1					13		2	3	2		21
<i>Orthetrum ransonnetii</i>	20		1									21
<i>Macrodiplax cora</i>					1				4	3	4	12
<i>Azuragrion nigridorsum</i>					6							6
<i>Anax imperator</i>		1			3	1						5
<i>Anax ephippiger</i>					2	3						5
<i>Tholymis tillarga</i>					2							2
<i>Nesciothemis farinosa</i>						2						2
<i>Ischnura evansi</i>					1	1						2
<i>Pseudagrion decorum</i>					2							2
<i>Rhyothemis semihyalina</i>						1						1
<i>Agriocnemis pygmaea</i>					1							1
Grand Total	207	2	16	2	223	265	3	42	77	25	35	897
Species Richness	8	2	5	2	16	14	2	9	9	7	5	20

FIGURE 2. Heat map showing species abundance and community composition at sites A–K.

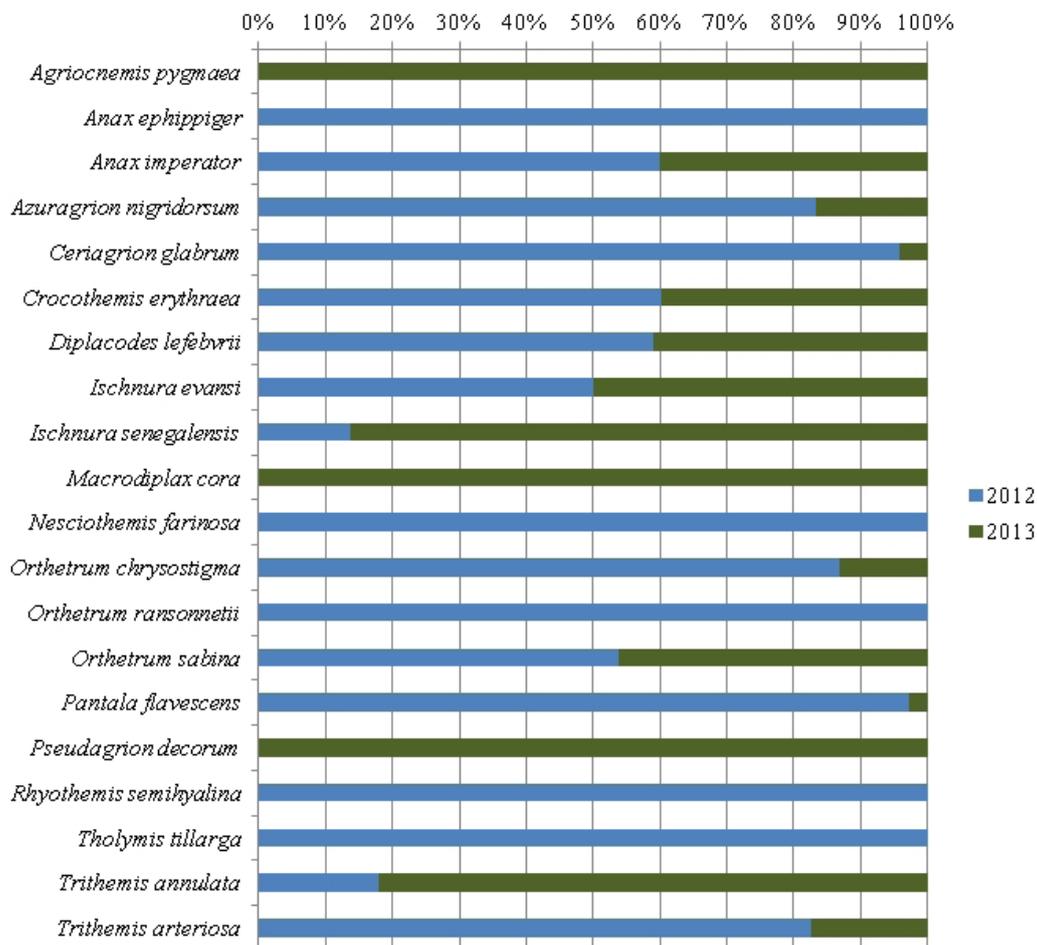


FIGURE 3. Comparison of species abundance in 2012 and 2013.

COMMENTS ON THE SPECIES

Trithemis arteriosa was found in abundance at unvegetated temporary rock pool habitats in the wadi bottom and occurred in lower numbers at vegetated sites. These findings disagree with Giere and Hadrys (2006), who described *T. arteriosa* as an indicator for permanent water bodies like reedy pools, streams or swamps. *Trithemis arteriosa* seems to inhabit environments less favoured by other common species such as *Orthetrum chrysostigma*, *Orthetrum sabina* (Drury, 1770) and *Crocothemis erythraea* (Brullé, 1832).

Orthetrum chrysostigma is largely heterogenic in its habitat preference but has been described as a species of open flowing water in boulder strewn valleys, where it rests vertically on rock faces (Waterston and Pittaway, 1991). Contrastingly, within Wadi Sayq it inhabits estuarine reed beds, vegetated freshwater pools and lotic environments in bare wadi bottoms. It was not found at sites J and K, and only a single individual was recorded at site I, suggesting a negative preference for saline pools.

Ischnura senegalensis was first recorded for the Arabian Peninsula within Wadi Sayq during the 1977 Oman Flora and Fauna Survey (Waterston, 1980), and the species is known to be abundant in Dhofar (Waterston and Pittaway 1991). It occupied vegetated freshwater realms at sites E, F, H and I. These marshes were heavily grazed by cattle and polluted by their dung. Site I was partially saline due to regular tidal fluctuations of the freshwater-seawater interface. One male individual was abnormally black and lacked the blue metallic reflection on the second abdominal segment, which is an unknown feature for this species (K.-D. Dijkstra *pers. comm.*).

The presence of *Ceriagrion glabrum* (Burmeister, 1839) at sites A, E, F and H illustrates its preference for vegetated habitats and agrees with findings by Waterston and Pittaway (1991), Schneider and Dumont (1997), Feulner (1999) and Feulner *et al.* (2007). Feulner (1999) and Feulner *et al.* (2007) comment on its association with dead and dry reeds, which is confirmed by this study as the species was highly abundant at site F, the only site with dry reed beds. The semi-stagnant water here was shallow and polluted by cattle dung and had trampled emergent vegetation, which confirms findings by Schneider and Dumont (1997), who explained that this species prefers stagnant water bodies. It rarely strayed from within the emergent vegetation.

Trithemis annulata (Palisot de Beauvois, 1807) was found to be locally abundant at sites E, F and I. It may be outcompeted for territories at other sites by *T. arteriosa* (Martens, 2010). At Saqamqam in the UAE, *T. annulata* was found amongst a community comprising *Ischnura evansi* (Morton, 1919), *O. chrysostigma*, *O. sabina* and *C. erythraea* in date groves and vegetable gardens irrigated from a perennial spring (Waterston and Pittaway, 1991). The same communities were observed in Wadi Sayq at sites E and F, where a vegetated marsh was supplied with water from a perennial spring. Similar communities probably exist in such habitats throughout the Arabian Peninsula.

Crocothemis erythraea was present at 8 of the 11 survey sites albeit often in low numbers, illustrating its ability to adapt to a wide spectrum of habitats. Feulner *et al.* (2007) reported for the UAE that the males of this species are

dominant over most other perching Libellulid species. However this was not the case within Wadi Sayq, where *T. arteriosa*, *T. annulata* and *O. chrysostigma* were the most abundant perching species. This pattern was probably due to the aquatic habitat types present in the wadi during the survey period. Our data shows that *T. arteriosa* dominates bare rock habitats, where *C. erythraea* has little presence. However, at the vegetated aquatic habitats, *C. erythraea* is more abundant and *T. arteriosa* ceases to dominate.

Orthetrum sabina was first recorded for the Arabian Peninsula in Salalah during the 1977 Oman Flora and Fauna Survey (Waterston, 1980). It is a widespread species and, coupled with *O. chrysostigma*, is probably the most abundant of its genus in Arabia (Schneider and Dumont 1997). It did not occur at the bare rock pool environments at sites A–D but was present at all other sites. This confirms the habitat preferences reported by Waterston and Pittaway (1991), namely vegetated and overgrown water bodies.

Pantala flavescens (Fabricius, 1798) was recorded throughout Wadi Sayq and was the only species observed on the dry plateau of the valley shoulders. Several males were quite red in colour as mentioned by Giles (1998). It was also observed swarming at height near a flowering tree, presumably hunting pollinating insects. A similar behaviour was previously reported by Feulner *et al.* (2007).

Orthetrum ransonnetii (Brauer, 1865) is an eremic species extending from southwest Asia across Arabia and the Sahara to Morocco (Juillerat and Monnerat, 2009; Boudot and De Knijf, 2012). It shows a patchy distribution and is considered rare throughout most of its range (Boudot *et al.* 2009). This species is poorly known and has only been recorded from the UAE (Feulner *et al.* 2007; Feulner 2008; Reimer 2008), Northern Oman (Waterston and Pittaway, 1991; Schneider and Dumont 1997; Giles 1998; Reimer *et al.* 2009) and Dhofar, with a single record from both Western Yemen (Carfi *et al.* 1995) and West Saudi Arabia (Lambret and Boudot 2009). No published records are available from coastal Dhofar near Salalah, where Odonate research is commonly undertaken. This species was collected at sites A and C, with 20 of the 21 individuals present at Site A, indicating the habitat here was suitable to support a viable population. Both sites were sparsely vegetated, bare rock being the prominent feature as usual for this species. At both sites the odonate communities were dominated by *T. arteriosa* but at Site A healthy populations of *O. chrysostigma* persisted, which confirms that these two *Orthetrum* species persist syntopically (Feulner *et al.* 2007). It was observed exhibiting very similar behaviour to *O. chrysostigma*, although perching more often on bare rock faces and making longer flights along the stream.

Macrodiplax cora (Kaup in Brauer, 1867) is an Oriental migrant that is resident in Dhofar. The first Arabian record of this species came from Salalah (Schneider and Dumont, 1997). It is a salt tolerant species which breeds in coastal lagoons, mangroves and estuaries (Sharma, 2010). It was recorded behind the beach and at the saline lagoons in Wadi Sayq.

Only 6 males of *Azuragrion nigridorsum* (Selys, 1876) were collected, exclusively at site E, which is the only

freshwater site with open pools and emergent vegetation not disturbed by cattle and not polluted from their dung. This species, which is mostly found at rest on horizontal stems of *Typha sp.* lying on the water's surface, is therefore probably sensitive to stagnant water conditions.

Anax ephippiger (Burmeister, 1839) is widespread throughout the Arabian Peninsula, including the desert interior, due to its preadaptation to survive under arid conditions (Schneider, 1988). This species was the only odonate species recorded during the Rub al Khali phase of the expedition reported by this author. Records from 1978 described an influx of subadults at Thumrait (Waterston and Pittaway, 1991), a service station in the desert 145 km from our desert location. Its breeding status within Arabia is relatively unknown but egg-laying was documented in the UAE (Feulner *et al.* 2007). No reproductive behaviour was observed during the present research.

Tholymis tillarga is a new species for the Arabian Peninsula. This species is widespread throughout sub-Saharan Africa, Asia, Australia and the Indian Ocean islands and has been recorded from southeast Iran (Heidari and Dumont 2002). This wide range is linked to its well-known migratory activity (Clausnitzer 2011). The male and female collected in Wadi Sayq were found at site E, just before the onset of dusk. Here, the male was observed hawking close to the ground along lengths of a shallow marshy pool. Several minutes later a female was recorded ovipositing by dipping her abdomen into the water's surface and releasing the eggs. This breeding evidence may suggest that these individuals could have been resident in Wadi Sayq, rather than passing through on migration. This species is tolerant to disturbance and is common at pools and swamps in bush, woodland and forest habitats, where its crepuscular activity may cause it to be overlooked (Clausnitzer 2011). Its occurrence within Wadi Sayq, one of the greenest valleys in Dhofar, could be expected, as the Dhofar Mountains constitute an arboreal refugium where further Afrotropical taxa are likely to be discovered (Schneider and Krupp 1993).

Nesciothemis farinosa (Förster, 1898) has only been recorded from Southern Oman and Yemen within Arabia, with a single record from southwest Saudi Arabia (Lambret and Boudot 2009). Only two individuals of this species were recorded in Wadi Sayq and both occurred at site F, where a rich dragonfly community was favoured by an area of reeds, rushes and grasses. This species occurred with *O. chrysostigma*, an abundant and similar looking species, so efforts should be made to separate them in the field.

Two *Ischnura evansi* specimens were recorded at sites E and F. Feulner *et al.* (2007) explained that in the UAE *I. evansi* was considered the dominant *Ischnura* species at mountain sites. They explained "closer investigation now seems warranted to determine the extent to which *Ischnura senegalensis* may also inhabit mountain sites sympatrically with *I. evansi*". Within Wadi Sayq *I. senegalensis* was the dominant species. Establishing the presence/absence of *Ischnura fountaineae* (Morton, 1905) within Wadi Sayq is required to determine its south-easterly extent in Arabia.

The Arabian population of *Rhyothemis semihyalina* is confined to coastal Dhofar and most likely constitutes a relict population from past colonisation persisting in a tropical pocket (Waterston and Pittaway 1991; Schneider

and Dumont 1998). According to Waterston and Pittaway (1991), the specimens from Dhofar conform to the prevalent African morphotype, showing reduced dark areas in the hind wings and no dark colouring on the forewings. The single specimen collected within Wadi Sayq during this research also conforms to this description and increases significantly the known distribution range of this species in Arabia to the West, reaching almost the Yemeni border. It should be searched for in additional suitable habitats on the southern coastline of Arabia (Clausnitzer 2006). Although this species has been described flying in groups (Waterston and Pittaway, 1991), only a single individual was recorded within Wadi Sayq during our research period. Waterston and Pittaway (1991) explain that *R. semihyalina* populations spread out after the monsoon rains and can be found in small populations within wadis on the seaward slopes of the southern Dhofar Mountains. The research undertaken for this paper took place at the end of the dry season, so further research after the monsoon rains could reveal larger populations in the area.

Agriocnemis pygmaea (Rambur, 1842) is one of the few odonate species in Oman of Oriental origin. It was only known from one specimen until 2009 when the late Robert Reimer recorded 16 individuals in a khor in Dhofar. These insects are very small (wingspan 24 mm) and so the records from Oman could be attributed to wind-borne migrations (Schneider and Dumont, 1997). They occupy a variety of natural and man-made habitats and the larvae commonly occur amongst aquatic weeds and algae. A single individual was recorded at Site E in Wadi Sayq.

DISCUSSION

One of the key patterns observed in this research is the variation in community composition from the estuarine vegetated environments to the upper valley rock pool environments. The vegetated estuarine sites boasted higher species richness and a greater number of uncommon species than the rock pool sites. This is due to the fact that lentic habitats support more species of Libellulidae and Coenagrionidae than lotic habitats, and that these two families are dominant in the Omani odonate fauna. Additionally, the presence of livestock at the estuary will attract a greater concentration of prey for predatory insects like Odonata.

Species composition during the 2013 research period was found to be considerably different to that of the 2012 research period (Figure 3). This may be partially attributed to the effects of the late monsoon rains in November 2011. Flash floods ripped out most of the vegetation from the estuarine plain leaving a barren environment with only a few pools where the vegetation could recover. Under these environmental conditions *T. arteriosa* and *O. chrysostigma* were found to dominate. In contrast, the 2013 expedition experienced a more verdant estuarine plain, covered in grasses, with a greater number of pools and vegetated marshes, and here *I. senegalensis* and *T. annulata* were found to dominate. If suitable habitat is not present, species will fail to reproduce successfully and become vulnerable to predation. The length of the larval step of the various local species will also affect community composition after a flush wiping out several generations of larvae, as the new native species will emerge in different years, depending on

their own generation length.

In 2012, 84% of the dragonflies recorded were males, whereas in 2013 only 63% were males. It is suspected the greater amount of vegetation cover in 2013 provided suitable resting and feeding habitats for females closer to the water bodies, making more female individuals to be recorded close to the wadi bed. In 2012 the lack of vegetation on the estuarine plain was forcing females to rest and feed further away in the shrubs and trees at the base of the valley sides.

Urothemis thomasi (Longfield, 1932) is listed as endangered by the IUCN with only eight specimens collected in Oman and four from Somalia (Boudot 2006). Despite records from Dhofar, it is suspected the remaining population is very small, hence it was regrettably unrecorded in our survey. However it was recently found in a new locality in the United Arab Emirates, in a recently created National Park (Feulner and Judas 2013).

Four Arabian endemics were not recorded in this research. *Pinheyschna yemenensis* (Waterston, 1985) is known from eight records in the Sarawat Mountains in west Yemen and has yet to be recorded in east Yemen or Oman (Schneider *et al.* 2013a). *Arabicnemis caerulea* (Waterston, 1984) has a disjunct distribution in Yemen, northern Oman and the UAE but increasing records for this species suggest it is well established in Southern Arabia and its presence could be expected in Dhofar (Schneider and Dumont 1997; Schneider and Nasher 2013; Schneider *et al.* 2013b). *Pseudagrion arabicum* (Waterston, 1980) is a rare high mountain species of arid realms and has been recorded on nine occasions from southwest Saudi Arabia and west Yemen (Schneider *et al.* 2013c). It is unlikely to be recorded at Wadi Sayq. *Arabineura khalidi* (Schneider, 1988) is endemic to the UAE and northern Oman (Schneider and Dumont 1997, Schneider *et al.* 2013d) and is unlikely to reach Dhofar.

Lindenia tetraphylla (Vander Linden, 1825) is a widespread migratory species ranging from Europe to Central Asia. It has only been recorded at Wadi Darbat in Dhofar (Schneider and Dumont 1997; Reimer 2009). It is likely this species may be found in suitable habitats at Wadi Sayq. In addition, we were unable to find some of the most famous Afrotropical species previously reported from this wadi or from other areas in Dhofar, namely, *Urothemis edwardsii* (Selys, 1849), *Tramea limbata* (Desjardins, 1832), *Pseudagrion sublacteum* (Karsch, 1893), *Azuragrion somalicum amitinum* (Waterston, 1991), *Acisoma panorpoides ascalaphoides* (Rambur, 1842) and *Zygonyx torridus* (Kirby, 1889). As winter may be outside of the reproductive or flight period of these species, new insights among the local fauna should be undertaken in other seasons. It must also be taken into account that dragonfly populations are much smaller during the dry winter months for most species. A study undertaken by Al-Safadi (1990) in the subtropical Yemen Mountains revealed that both species density and relative abundance of the various Odonata species were four times higher in summer than in winter in both lowland and highland environments. This increase in dragonfly numbers would probably also occur in the Southern Dhofar mountains as the environmental and climatic conditions are similar to that of subtropical Yemen. Further research within

Wadi Sayq during the summer would be valuable to fully understand the communities in existence.

Conclusion

The odonate fauna within Wadi Sayq comprises 20 of the 32 species recorded for the whole of Dhofar, as well as one new record for the whole Arabian Peninsula. This significant proportion illustrates the richness of the local ecosystem. Although there is little scientific literature covering the microhabitat preferences and community composition of the Arabian Odonata, this remains an important field of research. Odonates are sensitive towards changes in their habitat and so understanding community structure at various habitats is crucial when implementing conservation strategies or planning development. Aquatic habitats in arid regions are super-sensitive to human impacts where only low levels of change can rapidly affect the ecological balance (Schneider and Krupp 1993). Thus, the protection of these sites is important, not only for dragonflies, but also for the wider biodiversity.

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