Fauna of Wadi Al-Quff Protected Area: Amphibians, Reptiles and Mammals

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ABSTRACT

A survey on the vertebrates of Wadi Al-Quff Protected Area (WAQPA) was conducted as part of a management plan preparation. Nineteen mammal species were recorded and all but one (Marbled Polecat, *Vormela peregusna* listed as vulnerable species) are of "least concern" by the IUCN. The pipistelle bat *Pipistrellus pipistrellus* was a notable finding as its most southern range of distribution so far in Palestine. Three amphibians were recorded. Among 21 reptile species recorded, three species of geckos were noted including Kotschy's Gecko, *Mediodactylys* (*Cyrtodactylus*) *kotschyi*, representing the southern-most record for this species. Other reptiles recorded include the starred agama *Stellagama stellio* (most common reptile in WAQPA), seven species of lizards, and seven species of snakes. The Spur-thighed Tortoise (*Tesudo graeca*) and Gunther's Skink (*Chalcides guntheri*) are considered vulnerable species according to the IUCN Red List.

Keywords: Vertebrates; Palestine; Mammals; Pipistrellus; Mediodactylus.

INTRODUCTION

Faunal studies in the occupied Palestinian Territories have not been studied for many reasons including the Israeli occupation since 1967. For example, the last detailed study on the mammals of the area was conducted over 20 years ago (Qumsiyeh, 1996). Recently, the Palestine Museum of Natural History began accumulating data on the fauna of the West bank including vertebrates (Salman *et al*., 2014; Handal *et al*., 2016). The Wadi Al-Quff area is the first Palestinian administered Nature Reserve. With help from the IUCN and the Environmental Quality Authority, a study was initiated to draft a management plan for this reserve. As a first step in such management plans, a baseline survey of fauna and flora was carried out, and here we report on the vertebrate fauna, excluding birds, of Wadi Al-Quff Protected Area (WAQPA).

MATERIALS AND METHODS

Wadi Al-Quff area is located to the north of Hebron, with a Mediterranean maquis forest patched with planted pine forest. The study area is described in detail and a management plan was created for it by the Palestinian Environmental Quality Authority (EQA, 2014). Figure (1) illustrates key areas that were intensively studied based on habitat type.

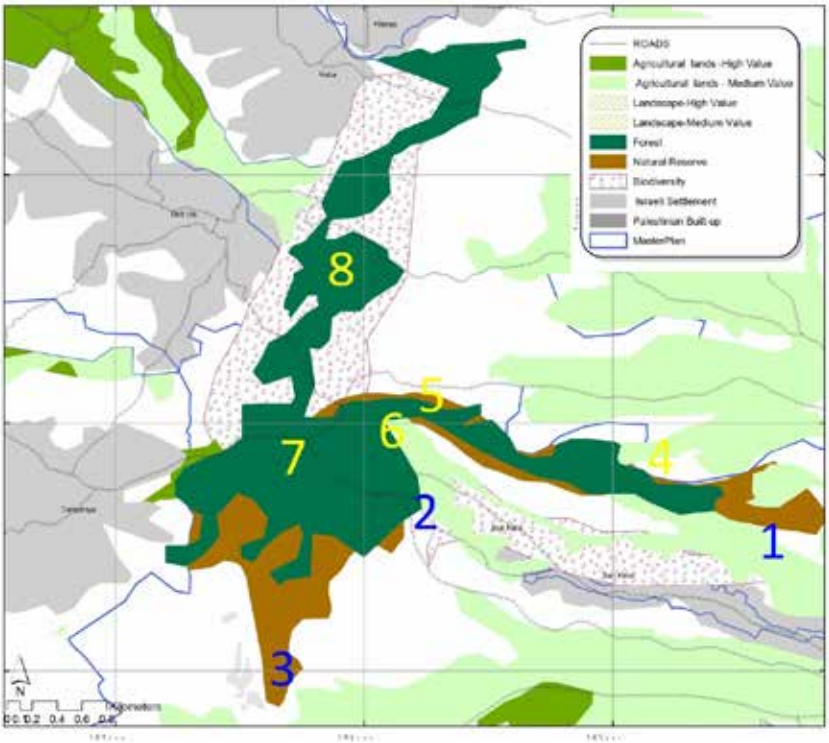

Figure 1. Habitat types of the WAQ area. Numbers in blue (1, 2 and 3) indicate water sources of significance for vertebrate biodiversity and numbers in yellow indicate habitats that we noted with significant for other conservation value discussed in detail (Figure adjusted from a baseline map by Applied Research Institute of Jerusalem).

Amphibians were observed at night using a flash light. Tadpoles were taken directly from the water using a small net. Reptiles were observed during daylight and at night and were photographed. Occasionally some individual specimens of reptiles were captured for more accurate laboratory identification. Signs of mammals (footprints, feces, burrows and quills), were checked during daytime. Potential hideouts (e.g. caves and crevices were also inspected, Sherman traps were used to trap small mammals (rodents and shrews), while mist-nets were set for bats. Traps were collected before sunrise, and then a subsequent area sweep was performed for morning animals. Bats were observed by checking for roosting sites. BatBox III detector was used to detect bat activity between sunset/dusk and midnight in three locations (Areas 3 ,2 ,1) and two times in the early morning hours in two locations (Areas 6 and 7). A simple recorder was used to record these calls. A camera trap was installed on a spring near Telem colony.

Species were identified using standard keys (Qumsiyeh, 1996; Disi *et al*., 2001; Bar and Haimovitch, 2012). For many specimens, identification was done at Palestine Museum of Natural History (PMNH) including our nascent Palestine Biodiversity Research Center (PBRC) and the Bethlehem University laboratories for genetic studies. Some voucher specimens were kept or photographs and stored at PMNH and PBRC).

RESULTS AND DISCUSSION

AMPHIBIANS

One specimen of the common green toad, *Pseudepidalea variabilis*, was obtained from a cave inhabited by the Egyptian Fruit Bat. Not quite in the reserve area but in the area of Hasqa near the water spring, *Pelophylax bedriagae* and *Hyla savignyi* were observed. *Hyla savignyi* was far more common with the chorus of males in May making extremely loud noises from dozens of individuals.

Amphibians are good indicators of environmental quality and deterioration. Tree frogs were rather common in the areas of Solomons' pools and Artas about 15 km north of WAQ but have declined. They still occur in Husan and Battir areas though may be also in decline (Salman *et al*., 2014).

REPTILES

A total of 21 species of reptiles representing ten families were recorded in WAQ (Table 1, Figs. 2-3). Two are listed as vulnerable (*Chalcides guentheri* and *Testuo graeca*) according to the IUCN Red List.

Table 1. Reptiles recorded from WAQ.

Family	Species	Common Name	IUCN status
Testudinidae	*Tesudo graeca*	Spur-thighed Tortoise	VU
Gekkonidae	*Hemidactylus turcicus*	Turkish Gecko	LC
	Mediodactylus kotschyi	Kotschy's Gecko	LC
Phyllodactylidae	*Ptyodactylus guttatus*	Spotted Fan-toed Gecko	LC
Agamidae	*Stellagama stellio*	Starred Agama	LC
Chamaeleonidae	*Chamaeleo chameleon*	Common chameleon	LC
Lacertidae	*Acanthodactylus sp.*		
	Phoenicolacerta laevis	Lebanon Lizard	LC
	Ophisops elegans	Snake-eyed lizard	LC
Scincidae	*Ablepharus rueppellii*	Rueppel's Snake-eyed skink	LC
	Trachylepis vittata	Bridled Mabuya	LC
	Chalcides guentheri	Günther's Cylindrical Skink	VU
	Eumeces schneideri	Schneider's Skink	LC
Typhlopidae	*Typhlops vermicularis*	Worm snake	LC
Colubridae	*Dolichophis jugularis*	Black Whip snake	LC
	Hemorrhois nummifer	Coin snake	LC

	Eirenis rothi	Roth's Dwarf Snake	LC
	Eirenis coronella	Crowned Dwarf Snake	LC
	Platyceps rogersi	Roger's racer	LC
	Rhynchocalamus melanoceplalus	Black-headed Snake	LC
Viperidae	*Daboia palaestina**	The Palestine Viper	LC

* Described by locals but not encountered

The family Testudinidae was represented by one species, *Testuo graeca*. We observed only four individuals over 30 field trips. Locals seem to collect this animal to keep in their garden. One family in Tarqumia had eight Spur-thighed Tortoise in their garden. It is thus possible to reintroduce and enrich the local population in WAQ using these local stocks. Testuo graeca is listed as a vulnerable species.

The most common species of reptiles observed were *Stellagama stellio* and *Ptyodactylus guttatus* with 33 and 32 observations respectively. *Stellagama stellio* was the most common reptile in WAQ found mostly in exposed areas and at the margins of the wooded areas associated with rocky areas.

Figure 2. Some lizards from WAQ. **A.** *Phoenicolacerta laevis*. **B.** *Ophisops elegans*. **C.** *Mediodactylus kotschyi*. **D.** *Trachylepis vittata*.

The next most common reptile was *Phoenicolacerta laevis* (15 observations). For most other species, they were observed one or two times. We found an interesting area where *Ptyodactylus guttatus* individuals were congregated in the valley in the extreme southern area of the nature reserve. They were most active around late afternoon. This could provide a site to study social behavior and other ecological and reproductive data on this species. Most of our observations were in the area least frequented by visitors and local farmers (except for *Stellagama stellio*), indicating that human activities do have an impact on reptile biodiversity. This is similar to observations in Jordan (Damhoureyeh *et al*., 2009). The record of *Mediodactylus kotschyi* (Figure 2C) is the southern-most distributional limit of this Mediterranean species. It is known from Southern Europe and into Turkey and the Eastern Mediterranean. The closest records are in the northern parts of Palestine (Galilee) and northwestern Jordan.

Eight species of snakes representing three families were observed or reported by the locals. Family Colubridae constituted the higher number of species with five genera (Table 1, Figure 3).

All reptilian species recorded from the study area are of Mediterranean affinities and were reported from similar Mediterranean areas within the West Bank (Handal et al., 2016)

Figure 3: A. *Eirenis lineomaculta.* **B.** *Eirenis rothi.* **C.** *Platyceps rogersi.* **D.** *Typhlops vermicularis.*

MAMMALS

A total of 19 species of mammals belonging to ten families were recorded from the study area (Table 2).

Table 2. Mammal species in WAQ.

Family	Species	Common name
Erinaceidae	*Erinaceus europaeus*	European hedgehog
Soricidae	*Crocidura leucodon*	Bicolored White-toothed Shrew
Pteropodidae	*Rousettus aegyptiacus*	Egyptian fruit bat
Emballonuridae	*Taphozous nudiventris*	Maked-rumped bat
Vespertilionidae	*Eptesicus serotines*	Serotine bat
	Pipistrellus kuhli	Kuhl's pipistrelle
	Pipistrellus pipistrellus	Common Pipistrelle
	Plecotus christiei	Long-eared plecotine bat
	Myotis sp	Mouse-eared Bat
Canidae	*Vulpes vulpes*	Red fox
Mustelidae	*Martes foina*	Stone marten
	Vormela peregusna	Marbled polecat
Spalacidae	*Spalax leucodon*	Palestine Mole Rat
Muridae	*Acomys dimidiatus*	Arabian Spiny Mouse
	Apodemus mystacinus	Eastern Broad-toothed Field Mouse
	Mus musculus	House Mouse
	Rattus rattus	House Rat
Hystricidae	*Hystrix indica*	Crested Porcupine
Leporidae	*Lepus capensis*	Arabian Hare

A cave in area 5 was visited three times. A fairly large colony consisting of about 150-100 Egyptian fruit bats, *Rousettus aegyptiacus,* was found. The cave is frequented by humans who light fires there. It has a fairly large opening narrowing slightly after about 20 meters but then opening into a wide chamber with a depression and an enlarged ceiling where bats hang. The fruit bat was considered an agricultural pest by the Israeli authorities soon after the foundation of the State of Israel and programs were instituted to wipe it out by fumigating caves in the 1950s as part of a national campaign. This however killed mostly the more sensitive insectivorous bats (Makin & Mendelsohn 1987; Qumsiyeh, 1996). In any case, a recent examination of its local diet sheds doubt on the hypothesis that it is a major agricultural pest (Korine *et al.*, 1999).

Preliminary analysis of bat fauna via ultrasound detector and visual observations of bat behavior in flight revealed at least six insectivorous bat species in the area and they were in order of commonality: *Taphozous nudiventris, Pipistrellus kuhli, Pipistrellus pipistrellus, Eptesicus serotinus, Plecotus christei*, and *Myotis* sp.

All species were recorded around water sources in Hasaka and in the lower elevations of the reserve (areas 1, and 5). Of the over 60 recordings made, the most common was for *P. kuhlii* near the human habitations with over 25 recordings. The distinctive pattern for *P. pipistrellus* was recorded near Ain Hasaka (area 1) and in Beit Kahel (area 2) by ultrasound. Then confirming the finding we collected one female specimen (forearm 32 mm) with two late embryos on 24 May 2014 in the area around the spring in Ain Hasaka. This suggested a healthy population worthy of protection.

Pipistrellus pipistrellus was reported from one locality in northern Palestine many years ago (see Qumsiyeh 1996). The presence in WAQ (like the gecko *M. kotchyi*) is the southern-most record for this species in Palestine. Perhaps lack of earlier records had to do with methodologies (use of ultrasound and mist-netting now) and we expect to see more of this species after additional studies. For example, Benda *et al.* (2003) recorded it from Syria and Benda *et al*. (2010) showed that in Jordan *P. pipistrellus* was found in many localities ranging from the north to oasis in the deserts in the South. We now have unpublished data from more localities in the occupied Palestinian territories including other specimens in the north near Ramallah area (Qumsiyeh, unpublished data).

Tristram (1884) noted that *Plecotus auritus* (*Plecotus christie*) is "very common in all the hill country in Palestine especially the caves and tombs around Bethlehem and Jerusalem, and by the Sea of the Galilee." However, we have only a brief recording which suggests this bat by ultrasound (see above). Bat diversity in Jordan was noted to have been impacted by insecticide use and habitat destruction (Qumsiyeh *et al*., 1998; Amr *et al*., 2006).

Mounds of the Palestinian mole rat, *Spalax leucodon* are quite common in Wadi Al-Quff. These mounds are found in many areas, even very rocky habitats with the exception of areas under pine trees where apparently few or no vegetation is left. We also found evidence for the presence of the Indian crested porcupine, *Hystrix indica*, via quills and feces in all areas of the park.

Sherman traps yielded four species of mice and rats and one shrew species. Our trappings in forested areas near Ain Hasaka (Area 1) and forested

areas designated number 6 and 7 showed 100% *Apodemus mystacinus*. This species was confined to Maquis Quercus remnants habitats. *Acomys cahirinus* was restricted to the rocky steppe area. Both *A. cahirinus* and *Mus musculus* were trapped near valleys and agricultural areas. The shrew was found in moist habitat under oak trees and the rat was collected near human habitation.

One Cape hare was observed on the road just above WAQ and the Stone Martin, *Martes foina* and the marbled polecat were encountered in a night walk in areas 4 and 6 respectively. The Red Fox, *Vulpes vulpes*, was observed on several occasions in areas 1, 4, 5 and 6. Numbers are hard to estimate but it may be no more than a few individuals in the whole area of WAQ. One fox had its tail damaged likely by feral dogs. The hedgehogs are common and we made three observations during late spring and early summer 2014.

More than 100 species of mammals including 32 bat species occur in different habitats in Palestine (Qumsiyeh, 1985; Qumsiyeh, 1996). We recorded 18 mammals in WAQ area (Table 1) including the five bat species. There are more species that potentially can exist in the area, based on the habitats present or on previous observations, but were not recorded during this study (Table 3). For example, we recorded an unidentified bat species via ultrasound. But clearly the large mammals are gone. In extensive survey we did not see any fresh droppings of gazelles anywhere in the park. This could be due to hunting and habitat destruction. Habitat destruction has resulted in significant degradation of mammalian biodiversity (see Qumsiyeh 2013; Qumsiyeh *et al*., 2014).

Locals mention that they had observed gazelles (most likely the common mountain gazelle, *Gazella gazelle* IUCN Red List: vulnerable) in the area many years ago. The team intensively looked for any signs (observations, feces) of wild Artiodactyls and nothing could be found.

Locals also reported seeing Striped Hyena (Threatened) years ago but stated that there were more recent observations of jackals (*Canis aureus*) though no observations were recorded of any of these carnivores. There has been a decline in Jackal populations in Jordan and Palestine over the past 40-50 years and habitat destruction and potentially competition with the red fox can be possible explanations (Qumsiyeh *et al*., 1993).

Table 3. Mammal species that likely also occur in the area because of habitats or from local reports. Those noted from reports by locals are marked with an asterisk (*)

Family	Species	Common name
Rhinolophidae	*Rhinolophus blasii*	Blasius's horseshoe bat
	Rhinolophus mehelyi	Mehely's Horseshoe Bat
	Rhinolophus hipposideros	Lesser horseshoe bat
	Rhinolophus ferrumequinum	Greater horseshoe bat
Canidae	*Canis aureus**	Golden jackal
Herpestidae	*Herpestes ichneumon**	Egyptian mongoose
Hyaenidae	*Hyaena hyaena**	Striped hyena
Mustelidae	*Meles meles*	European badger
Procaviidae	*Procavia capensis*	Rock hyrax
Suidae	*Sus scrofa*	Eurasian Wild Pig/Wild boar
Bovidae	*Gazella gazella**	Mountain Gazelle
Gerbillidae	*Gerbillus dasyurus*	Wagner's Gerbil
	Meriones tristrami	Tristram's Jird

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Invertebrate Fauna of Wadi Al-Quff Protected Area, Palestine

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ABSTRACT

We report results of a preliminary survey of the invertebrate fauna of Wadi Al-Quff area (occupied Palestine). We recorded 23 species of butterflies in 5 families. Moths were a difficult group to classify but we have at least 45 species. Dragon flies and damsel flies were noted in the Wadi Hasaka area. Four mantids in three families, two species of stick insects, one earwig species (Dermeptera) and at least seven species of Orthoptera were noted. There were at least 13 species of Hemiptera (true bugs) and 5 species of Neuroptera (netwing insects). We noted at least 13 species in ten families of the Order Diptera (the flies). We also collected/observed at least 17 species of Hymenoptera in eight families. In the Order Blattoidae (roaches), we noted two species only but the Order Coleoptera (Beetles) was very richly represented with at least 23 species in 10 families. Among parasitic arthropods we collected two species of fleas and three species of ticks (Ixodidae), one of the latter involved in transmittal of spotted fever. Five species of scorpions were noted, the largest being the Jericho or Mt. Nebo scorpion Nebo hierichonticus and the smallest being the brown scorpion *Compsubuthus werneri*. Two species of pseudoscorpions and two species of camel spiders were collected. A more difficult group was the regular spiders (Araneae) and we noted over two dozen species in at least 8 families. We have some specimens of Collembola and of small spiders that likely represent new taxa. Five Chilopod species (centipedes), one woodlouse (Isopoda), and the very common Syrian Millipede (Order Diplopoda) round the arthropods (joint legged animals). Two species of earthworms were identified but others likely occur. A significant biodiversity of molluscs (snails and one slug) was noted with at least 13 species. While this was a preliminary work on invertebrates and much more remains to be done in alpha level taxonomy, the report adds to the ones in this series identifying fauna and flora and emphasizes the need for implementing the management plan for WAQ nature reserve.

Keywords: Invertebrates; Palestine; Orthoptera; Conservation.

INTRODUCTION

The Occupied Palestinian Territories (OPT) received little zoological attention largely because the area suffered from nearly fifty years of Israeli occupation. The few zoological studies done were mostly focused on the more visible

organisms: plants and vertebrate animals. Most studies of invertebrates were carried out in historic Palestine or in Jordan but little work was done in the OPT. For example, work for scorpions was done by Vachon (1966, 1974), Levy & Amitai (1980), Amr *et al*. (1994) and Amr & Abu Baker (2004b) and Amr *et al*. (2015). Only two papers dealing with scorpions of the OPT are available (Qumsiyeh *et al*., 2013, 2014).

Similarly previous studies on the freshwater snails of historical Palestine include the old work of Tristram (1884) and Germain and de Kerville (1921-1922). Azim & Gismann (1956) included data on freshwater snails collected from the West Bank (now OPT) during a study on the snail intermediate host for schistosomiasis in south-western Asia. More studies on the snails of the genus *Melanopsis* including records from the West Bank was published by Heller *et al*. (2005). In nearby areas there are works by Israeli (e.g. Milstein *et al*., 2012) and Jordanian (e.g. Amr & Abu Baker 2004a) scientists. Bdir & Adwan (2011, 2012) investigated the presence of larval stages of trematodes among freshwater snails collected from the Palestinian Territories. A recent study by Handal et al. (2015) was the first to systematically study freshwater snails from the West Bank (OPT) reporting a total of 10 species of freshwater snails belonging to seven genera (*Galba, Haitia, Lymnaea, Melanoides, Melanopsis, Pseudoplotia*, and *Theodoxus*) in five families (*Neritidae, Melanopsidae, Lymnaeidae, Physidaeand Thiaridae*).

Hundreds of studies of other groups of invertebrates exist that focus on areas nearby like areas of Palestine occupied in 1948 and Jordan. But this area of the West Bank is still poorly known in terms of the invertebrate fauna. Two recent studies of the West Bank reported 54 species of butterflies and 40 species of grasshopper and locusts (Abusarhan *et al*., 2016, 2017).

MATERIALS AND METHODS

Field work in the area was conducted initially in eight different trips in the summer with three of these trips involving overnight trapping and observations throughout the day and some nights including collections between 27 August to 8 September 2013 (plus earlier work done in April and July). Spring work (January 15 to June 15 2014) was carried out with 10 trips (again some with overnight stay). The field work was essentially almost continuous from morning to morning with the exception of 12:30-4:30 AM. Briefly the method involved going to each location and walking in a team of a minimum of three researchers spaced 10 meters apart to walk for about 300-500 meters in the selected habitats. This process took 3 hours. Fauna was observed, photographed and in selected cases animals collected for proper laboratory identification and preservation. We also checked these areas for animal signs including dens, footprints, scats, remains of prey, etc.

Butterflies and some other flying insects are captured with a butterfly net. For moths, we put a fluorescent light at night in promising locations near wooded areas and with a white cloth under it. This attracts moths which then can be

picked up into containers directly or transferred to containers via aspirator. Other arthropods are simply picked up from substrates and plants they feed on. Insects were killed in killing jars or by freezing and all other preparations done by standard zoological methods (Millar *et al*., 2000). Scorpions were collected via turning rocks and other objects they use to hide under during daytime or at night-time (usually 10 PM to midnight) by sweeping the area using a UV light. Spiders are collected from under rocks, among plants. Snails were simply picked up where they occur (usually under rocks, in crevices, around trees or shrubs). In winter, slugs and active snails are noted and can be photographed in more natural settings. A hand held lens was used for smaller snails. Other methodologies for molluscs (collecting, cleaning, preservation, storage) followed standard protocols (Millar *et al*., 2000; Sturm *et al*., 2006; Geiger *et al*., 2007).

Species were identified using standard keys and works (e.g. Vachon, 1966, 1974; Levy 1985, 1988; Levy & Amitai, 1980; Amr & Abu Baker, 2004b; Heller, 2009; Sama *et al*., 2010). For many specimens, processing was done at Palestine Museum of Natural History (PMNH) including our nascent Palestine Biodiversity Research Center (PBRC) and the Bethlehem University laboratories for genetic studies. Some voucher specimens were kept or photographs stored for future work/publication at PMNH and PBRC. For more on other field and laboratory methodologies see RSCN (2005).

RESULTS

Phylum Arthropoda
Class Insecta

Order Lepidoptera (Butterflies and moths)

We recorded 23 species of butterflies in 5 families from WAQ (Table. 1). These were easier to classify than moths. The largest and most aesthetically interesting species was the Syrian swallowtail butterfly *Papilo* which was noted mostly in open areas of the park including in the northern mountainous but less forested area (several observations). None of our butterflies are listed by IUCN.

Table 1. The Butterflies that exist in WAQ.

Family	Scientific Name	English Name
Papilionidae	*Papilio machaon syriacus*	Syrian swallowtail
Pieridae	*Colotis fausta fausta*	Large Salmon Arab
	Euchloe charlonia	Lemon White
	Pieris (Artogia) rapae leucosoma	Small white
	Pieris brassica	Large White butterfly
	Pontia daplidice	Bath White
	Pontia glauconome	Desert white

	Anaphaeis (Belonis) aurota	White Caper
	Gonepteryx cleopatra	Cleopatra
	Maniola telmessia	Eastern Meadow Brown
Nymphalidae	*Lasiommata maera*	Large Wall Brown
	Melitaea deserticola macromaculata	Fritiality
	Melitaea telona	
	Melitaea trivia syriaca	Lesser Spotted Fritillary
	Vanessa cardui	Painted Lady
	Polygonia egea	Southern Comma
	Ypthima asterope	African Ringlet
	Melanargia titeatitani	Levantine Marbled
Lycanidae	*Lycaena thersamon*	Small Copper Butterfly
	Freyeria trochylus	Grass Jewel
	Polyommatus icarus	Common Blue
Hesperiidae	*Spialia orbifer*	
	Thymelicus sylvestris	Small Skipper

Of the latter (moths), we had a minimum of 45 species in 13 families (Sphingidae, Zygaenidae, Saturnidae, Geometridae, Arctiidae, Lasiocampidae, Lymantriidae, Erebidae, Noctuidae, Plutellidae, Pyralidae, Nolidae and Yponomeutidae), most of the observed species are from the family Geometridae and Noctuidae (Table 2).

Table 2. Moths collected in WAQ.

Family	Species
Sphingidae	*Hyleslineataor livornica*
Zygaenidae	*Zygaena graslini*
Saturnidae	*Saturniapyri sp.*
Geometridae	*Scopulacfminorata.*
	Gymnoscelis sp.
	Phaiogramma sp.
	Dicrognophus sp
	Ascotis sp.
	Idaea cf. ochrata
	Idaea sp.
	Lithostege palestinensis
	Rhodostrophia tabidaria
	Ortaliella palaestinensis
	Ortaliella sp.
	Acanthovalva sp
Arctiidae	*Cymbalophora (Euprepia) oertzeni*
Lasiocampidae	*Lasiocampa grandis*

	Dendrolimus bufo
Lymantriidae	*Orgyia sp.*
Erebidae	*Catocalacfsana*
	Dysgoniaalgira
	Polypogon sp.
Noctuidae	*Aedia sp.*
	Acronicta sp
	Eublema sp.
	Euxoa sp.
	Condica sp
	Cryphia spp.
	Cucculia sp.
	Noctua
	Thysanoplusia daubei
Plutellidae	*Plutella sp.*
Pyralidae	*Several unidentified specie*
Nolidae	*Three unidentified species*
Yponomeutidae	*Prays oleae*
	Yponomeuta albonigratus

Figure 1. A. The moth *Dendrolimus bufo* with its eggs (June 2014).

Order Odonata (Dragonflies and Damselflies)

These were noted only in Wadi Hasaka area near the water. Three species of damselflies belong to three families (Table. 3).

Table 3. The damselflies from WAQ.

Family	Scientific Name
Calopterygidae	*Calopteryx syriaca*
Platycnemididae	*Platycnemis sp.*
Epallagidae	*Epallage fatima*

Family Psychodidae (Sandflies)

We have two sand fly species (one is a Phlebotomussp) in Wadi Al Quff though we have no evidence of any Leishmania (probably due to absence of intermediary rodent hosts). Orshan (2011) attributed a sharp increase in abundance of sand flies in the Israeli settlement of Kfar Adumim to human disturbances especially the building boom in those settlements.

Family Cerambicidae (Longhorn beetles)

Sama *et al*. (2002) studied this family in historic Palestine. It is a diverse family but with complex systematics that still needs much work. We noted three species from WAQ but decided not to pursue the systematics until later.

Order Siphonoptera (Fleas)

We did not delve into the classification of fleas collected but we did find Leptopsylla species hosted on forest mouse Apodemus and spiny mouse Acomys and we also observed a flea from the bat *Pipistrellus pipistrellus* (likely *Ischnopsyllus sp*.) (Lewis, 1967).

Order Orthoptera (Grasshoppers and Locusts)

Seven species of grasshoppers were identified from the study area (Table 4).

Table 4. Grasshoppers collected from WAQ

Family	Species
Acrididae	*Anacridium aegyptium*
	Dociostaurus (Stauronotulus) hauensteini
	Heteracris syriaca
	Oedipoda aurea
	Prionosthenus galericulatus
	Pyrgomorpha (Pyrgomorpha) conica
	Truxalis procera

CLASS ENOGNATHA

Subclass Collembola

At least four species of Springtails (Collembolla: Hexapods) were collected from leaf litter under oak trees in WAQ. Since no previous work of this group was done in Palestine, these likely represent novel taxa of this group that has been found to be extremely diverse (many new species have been described from Europe in the past two decades).

CLASS ARACHNIDA

Order Ixodida (Ticks)

A tick tentatively identified as *Rhipicephalus sanguineus* was collected near the area that the feral dogs congregated. This tick is a known carrier of rickettsia, he agent of spotted fever (Mumcuoglu *et al*., 1993). Two other species of ticks were collected, one from a tortoise and the other from a

domestic sheep. The relationships of ticks to the human population in this area and to the wildlife needs to be studied by a qualified parasitologist.

Order Scorpionidae (Scorpions)

Five species of scorpions were noted in our study of WAQ: The small brown scorpion *Compsubuthus werneri* (in bushy areas of the WAQ, less common), the Palestine yellow scorpion *Leiurus quinquestriatus* (noted in non-forested and rocky areas of the WAQ), Black scorpion *Hottentotta judaicus* (less common and mostly noted in areas with good plant cover), Palestine golden scorpion or large clawed scorpion *Scorpio maurus fuscus*, and the Jericho or Mt. Nebo scorpion *Nebo hierichonticus* (all forested areas of WAQ). The most poisonous of these is the Palestine yellow scorpion known also as "deathstalker" (*Leiurus quinquestriatus*). None of the scorpions noted is listed by IUCN as of any conservation concern.

We reported earlier on the species of scorpions from the occupied Palestinian territories including first chromosomal data (Qumsiyeh *et al*., 2013). We also published on chromosomes and systematic of Jericho or Mt. Nebo scorpion *Nebo hierichonticus* (Fig. 2) obtained from Wadi Al-Quff (Qumsiyeh *et al*., 2014). That was the first scientific paper to our knowledge to be published mentioning animals specifically from WAQ.

Figure 2. A. Pseudoscorpion. **B.** Jericho or Mt. Nebo scorpion *Nebo hierichonticus*. **C.** A spider of the order Araneae. **D.** *Scolopendra cingulate*.

Order Psudoscorpionida (False or pseudoscorpions) (Fig. 2A)

Order Araneae (Spiders) (Fig. 2C)

Spider diversity noted here is an underestimate of the actual diversity as we could not identify many species and what we know from the nearby areas lead us to believe that when studied intensively, we may have dozens of species in WAQ (see Levy 1998 ,1985; Zonstein & Marusik, 2013). Eight other species of spiders collected are yet to be identified.

Table 4. Spiders collected from WAQ.

Family	Species
Araneidae	*Argiope cf. trifasciata*
Dysderidae	*Dysadera cf. crocuta*
Lycosidae	*Hogna sp.*
Salticidae	*Phlegra cf fasciata*
Theraphosidae	*Chaetopelma olivaceum*
Thomisdae	*Thomisus onustus*
Zoropsidae	*Zorposis sp.*

Order Solifugae (Camel spiders)

Camel spider as a group of arachnid needs more studies in the Middle East. We have 54 described species belongs to five families (Rhagodidae, Karschiidae, Daesiidae, Solpugidae and Galeodidae), and the most common species in the West Bank are species from the family Galeodidae (Levy & Shulov, 1964).

Family Galeodidae

Galeodes arabs Arabian Camel Spider

One unidentified species

CLASS CHILOPODA

Order Scutigomorpha

Table 5. Centipedes collected from WAQ.

Family	Species
Scolopendridae	*Scolopendra cingulata*
Scutigeridae	*Scutigera coleoptrata*
Himantariidae	*Bothriogaster signata*
Geophilidae	*Pachymerium ferrugineum*
	Geophilus sp.

CLASS MALACOSTRA

Order Isopoda

Family Armadillidae

Armadillidium sp. Woodlouse

Class Diplopoda

Order Spirostreptida
Family Spirostreptidae
Archispirostreptus syriacus Syrian millipede

Phylum Annelida
Class Oligochaeta

Order Megadrilacea
Family Lumbricidae (Earthworms)
Dendrobaena veneta
Healyella syriaca

Over 27 species of earthworms are known in Palestine (Szederjesi *et al*., 2013) and we expect more species present in WAQ if a more systematic work is carried out.

Phylum Mollusca
Class Gastropoda

Order Mollusca
Molluscs are extremely important components of ecosystems because they decompose organic compounds and recycle nutrients and provide food and calcium for other faunal elements including invertebrates, amphibians, reptiles, birds, and mammals. In Palestine, we have started conducting collection of molluscs and in the occupied territories in the West Bank alone, we were able to collect over 42 species in the past four years. Molluscs would be best collected and photographed alive in the winter months. Wadi Al-Quff seems to be rich in species of mollusks even considering the short survey period done here. Roads and other forms of structures created by human activities can significantly erode mollusk population health due to dispersal and fragmentation. Acidification in forested areas can also have a significant impact on snail population (Gärdenfors *et al*., 1995) and attendant impact on bird populations (Graveland *et al*., 1994). A significant biodiversity of molluscs (snails and one slug) was noted with at least 13 species in seven families in WAQ area (Table 6).

Table 6. Land snails and slugs of WAQ.

Family	Species
Limacidae	*Limax sp*
Sphinterochilidae	*Sphinaterochila fimbriata*
	Sphinaterochita cariosa
Helicidae	*Eubania vermiculata*
	Helix (Pelasga) engaddensis
	Levantina (spiriplana) caesareana

	Levantina lithophaga
Hygromiidae	*Monacha syriaca*
	Eopolita sp.
Enidae	*Bulliminus labrosus*
	Euchondrus septemdentatus
	Paramastus episomus
Chondrinidae	*Granopupa granum*

DISCUSSION

This group of taxa (invertebrates) is the least studied in our region. In the West Bank, this is the first report of invertebrate fauna from a protected area though some are with tentative identification or unidentified species pending further systematic studies. Notable findings in this study:

1. We recorded 23 species of butterflies in 5 families from WAQ. This is a diverse group with aesthetic value. Syrian swallowtail butterfly *Papilo* which was noted mostly in open areas of the park including in the northern mountainous but less forested area (several observations). None of our butterflies are listed by IUCN.
2. Moths were a difficult group to classify but we have >45 species in 13 families.
3. Four mantids in three families, two species of stick insects, one earwig species (Dermeptera) and at least 13 species of Orthoptera were noted. The latter group has more diversity in the area and we expect that WAQ will have many more species than those listed in section 2.
4. There were at least 13 species of Hemiptera (true bugs), 5 species of Neuroptera (netwing insects), and seven species of Orthoptera.
5. We noted at least 13 species in ten families of the Insect Order Diptera (the flies). By comparison we also collected/observed at least 17 species of Hymenoptera in eight families.
6. In the Order Blattoidae (roaches), we noted two species only but the Order Coleoptera (Beetles) was very richly represented with at least 23 species in 10 families.
7. Among parasitic arthropods we collected two species of fleas and three species of ticks (Ixodidae), one of the latter involved in transmittal of spotted fever.
8. Five species of scorpions were noted, the largest being the Jericho or Mt. Nebo scorpion *Nebo hierichonticus* and the smallest being the brown scorpion *Compsubuthus werneri*. We published the first scientific paper from WAQ area and it deals with chromosomes and systematics of *Nebo*.
9. One pseudoscorpion and two species of camel spiders were collected.

10. A more difficult group was the regular spiders (Order Araneae). Over two dozen species in at least 8 families were collected and are being worked/identified. At least two likely represent new species.
11. Five Chilopod species (centipedes), one woodlouse (Isopoda), and the very common Syrian Millipede (Order Diplopoda) round the arthropods (joint legged animals) of WAQ.
12. Two species of earthworms were identified from WAQ but others likely occur
13. A significant biodiversity of molluscs (snails and one slug) was noted with at least 13 species in seven families in WAQ area.

While much more remains to be done, the preliminary data above indicates a faunistically rich area and indeed justifies the management plan for Wadi Al-Quff as a significant and the first Palestinian managed protected area (EQA, 2014). The rich fauna faces significant threats in our region (Abdallah & Swaileh 2011; Qumsiyeh, 2017).

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