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Scope

The Jordan Journal of Natural History is an open access scientific publication published by the Conservation Monitoring Center at the Royal Society for the Conservation of Nature. The aim of the journal is to enrich knowledge on the regional fauna and flora of the Arabian countries of the Middle East (Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates, and Yemen). This includes fauna, flora (Systematics, taxonomy, Phylogenetics, Genetics, Morphology, Conservation, Ecology, Biogeography, and Palaeontology) and Geology. Monographs will be published as a supplementary issue.

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Abstract: an abstract not exceeding 300 words, summarized account of the subject, results and conclusions should be given.

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CONTENTS

Biodiversity Conservation of Wadi Al-Quff Proteccted area (Central Palestine): Challenges and Opportunities

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ABSTRACT

The Occupied Palestinian Territories (OPT) are areas of high but threatened biodiversity. Since the establishment of the Palestinian Authority, there have been increased resources devoted to capacity building and to develop nature protection systems highlighted by the introduction of the Palestinian Environmental Law 1999. One of the mandates of this law is to protect specific areas of high biodiversity and this gained even more importance with Palestine signing the Convention on Biological Diversity (CBD). Wadi Al-Quff (WAQ) region between Tarqumiya and Beit Kahil in the occupied Palestinian territories is an area of special attention as the first Palestinian administered nature reserve and the first one to receive detailed work to generate a management plan. As part of this work we report in these series of papers surveys on the flora and fauna. A significantly rich fauna and flora is noted but is facing a number of threats, with habitat fragmentation and destruction being the most significant. This survey recorded a rich fauna with more than 89 species of birds, 19 species of mammals, 21 reptiles, three amphibians, over 250 identified invertebrates, and over 230 species of plants, despite habitat degradation and limited sampling (time, resource limitations). As a result of our analysis we made four urgent recommendations and six less urgent but highly needed recommendations for biodiversity conservation of WAQ. Urgent recommendations include: 1) Cull/remove feral dogs, 2) Block roads and/or limit access in some areas of WAQ, 3) Discuss with farmers and others stake holders protection measures and limits on activities near or in the park, 4) Prevent fires. The longer-term recommendations are: 1) Monitoring and preventing unlawful activities, 2) Develop sustainable use of some areas, 3) Ameliorate habitat fragmentation and destruction, 4) Work to end the Israeli occupation and empower and educate local people, 5) Address climate change, and 6) Develop an environmental educational center in the protected area.

Keywords: Protected areas; Conservation; Palestine; Habitat destruction.

INTRODUCTION

Biodiversity is variably defined as the diversity of living organisms (flora, fauna, microorganisms) produced via evolutionary diversification and is now considered integral to continuing life on earth as we now know it (Wilson & Peter, 1988). In the late 20th century the conservation of biological diversity started to be recognized as an urgent issue for humanity and this is largely due to the scientific observation of significant decline in biodiversity that accompanied industrialization that spread widely in the 19th and 20th centuries. Two key texts came out of a number of preparatory meetings that rang the danger bell at the global level: publication of the Global Biodiversity Strategy (WRI/IUCN/UNEP, 1992) and the adoption of the Convention on Biological Diversity (CBD) signed at the Earth Summit in Rio de Janeiro (also in 1992).

Palestine was represented at the 7th Special Session of the Governing Council/Global Ministerial Environment Forum in Cartagena, Colombia, 13-15 February 2002. At that time, a resolution was adopted concerning the situation of the environment in the Occupied Palestinian Territories (OPT). The verning Council requested the United Nations Environment Programme (UNEP) to carry out a desk study as a first step in the implementation of the decision to support and advance environmental conservation in the OPT. The study aimed to identify major areas of environmental threats, but was not too detailed (UNEP, 2003). However, it was seminal especially if we combine it with the report by the Environmental Quality Authority which brought in experts and collected materials also in a form of an expanded desk study in compliance with the CBD (EQA, 2015). The report estimates over 50,000 species living in Palestine.

Palestine connects the Euro-Asian and Africa continents and forms the western part of the Fertile Crescent, lands that are rich in alluvial soils near river beds stretching from Egypt to Syria and Iraq. Geologic activities, especially the formation of the Great Rift Valley, ensured varied topography which resulted in a burst of speciation producing many endemic species of plants and animals. This is because of diverse habitats covering five ecozones (Central Highlands, Semi-Coastal Region, Eastern Slopes, Jordan Rift Valley, and Coastal Regions), and four biogeographical regions (Mediterranean, Irano-Turanian, Saharo-Arabian, and Sudanese/Ethiopian). The mild weather, diverse fauna and flora, rich soils, and presence of wild plant species and certain animals in the Fertile Crescent allowed humans to go from hunter-gatherers to agricultural and nomadic shepherd lives. The domestication of animals (e.g. goats) and plants (wheat, barley, lentils), in this region also allowed for population expansion and development of civilizations and religious beliefs among the local Netufian and later Canaanitic people.

Studies of vertebrate biodiversity in the OPT were very limited by contrast to nearby areas of Palestine and Jordan. Research in general still lags behind in our area (Qumsiyeh & Isaac, 2012). As early as 1950, scientists warned of an environmental disaster in Palestine should the trends then evident persist (Ives, 1950). The environmental impacts of the geopolitical changes of the past 100 years has been dramatic (Qumsiyeh, 1996, 2004). But direct studies of our environment are still in the early stages. Most studies of fauna and flora within Palestine were completed by Western visitors who came on short trips to study the "Holy Land" and many of those visitors were connected to Western imperial powers such as France and England (Tristram, 1866, 1884).

Early European Jewish immigrants worked to study nature here (Bodenheimer, 1935). After Israel was founded in 1948, such studies of fauna and flora became a common tool including for example studies on plants (Zohary, 1966, 1972, 1973), spiders (Zonstein & Marusik. 2013), birds (Shirihai, 1996), and reptiles (Werner, 2016).

Very few studies were published by Palestinian scientists. One of the first native Palestinians who engaged in faunal studies was Dr. Sana Atallah who performed a number of studies from 1962 until his death at the age of 27 in 1970. The area of Wadi Al-Quff was not studied zoologically before but nearby areas had significant studies of mammals (Atallah, 1977, 1978; Qumsiyeh, 1985, 1996; Harrison & Bates, 1991; Qumsiyeh *et al*., 1993, 1996, 1998; Mendelssohn & Yom Tov, 1999; Amr *et al*., 2006; Benda *et al*., 2010), reptiles and amphibians (Amr & Disi, 2011; Bar & Haimovitch, 2012; Damhoureyeh, 2009; Disi, 1985; Disi & Amr, 2010; Disi *et al*., 2011; Handal *et al*., 2016; Salman *et al*., 2014; Werner, 1988), Arachnids (Levy, 1985, 1998; Levy & Amitai, 1980; Amr & Abu Baker, 2004b; Qumsiyeh *et al*., 2013), mollusks (Amr & Abu Baker, 2004a; Heller, 2009) and insects (Halperin & Sauter, 1992; Katbeh-Bader *et al*., 2002; Katbeh-Bader *et al*., 2003). The only published research relying on specimens from WAQ itself is a brief note we published on karyotype of the scorpion *Nebo* (Qumsiyeh *et a*l., 2014b).

After the establishment of the Palestine Museum of Natural History (PMNH) in 2014, one of its obligations was to identify the neglected biodiversity of the OPT. Within the past three years, PMNH produced a number of publications in peer reviewed journals on groups of local fauna including freshwater snails, scorpions, butterflies, birds, amphibians and reptiles. We are especially interested in studying vulnerable areas because environmental degradation in Palestine accelerated in the 19th century with industrialization and large-scale deforestation. Under the Ottoman Empire for example, large tracts of forests in the Eastern Mediterranean region were cut down for fuel and tracks for the railroads (e.g. the Damascus to Hijaz railroad). During the British rule (1917-1948), some reforestation efforts were carried out.

In the areas of Palestine that came under Israeli and Jordanian rule (1948-1967) programs of forestation were common but unfortunately without ecosystem considerations. In the case of Israel, European pine trees were used to cover-up the destroyed Palestinian villages and agricultural lands. But also many areas that had native flora and fauna were converted to residential settlement/colonial projects that generated far more pollution than similar settlements inside Israel proper (where there was more regulation). Alon Tal, Founder of the Israel Union for Environmental Defense, acknowledged that: "*...it's a Zionist paradox. We came here to redeem a land and we end up contaminating it*" (Beyer, 1998). It is now well recognized that there is a decline of biodiversity in our area due to habitat destruction and other human activities (Qumsiyeh, 1996; Qumsiyeh *et al*., 2014a; Handal *et al*., 2016).

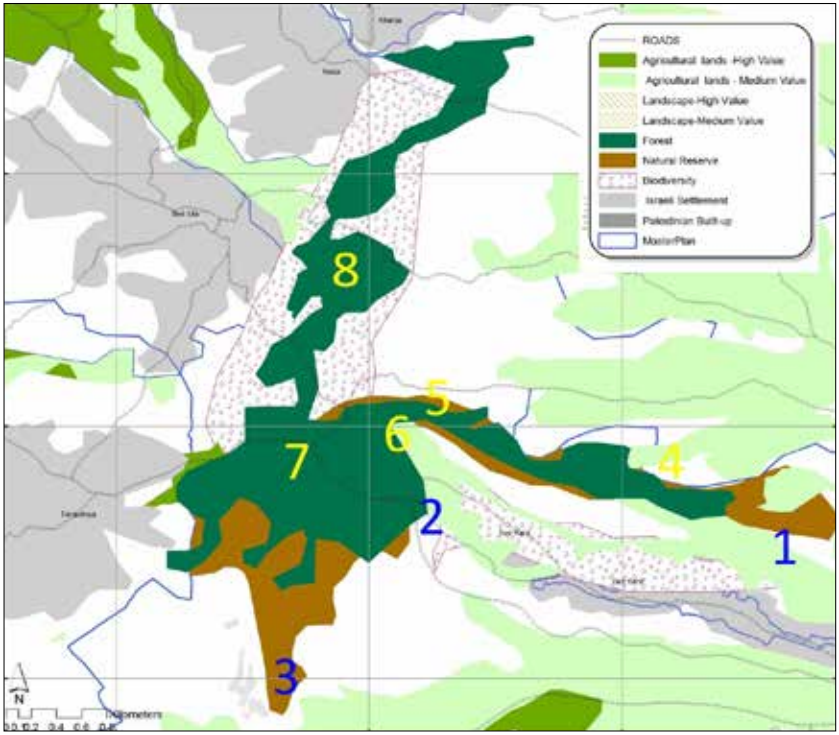
Wadi Al-Quff (WAQ) protected area near Hebron falls into a Mediterranean forested area considered by the WWF as Global 200 priority biomes (Olson & Dinerstein, 2002) and an area of significance for the global plant bioiversity (WWF and IUCN, 1994). It was designated as a protected area of some 145 hectares and a management plan was developed for the area in 2014 (EQA, 2014). The aim of this study is to evaluate status and distribution of fauna and flora in WAQ area in order to make a more informed and detailed management plan and integrate data with ecosystems and habitats to make recommendations in regards to management strategies of the existing fauna in the context of ecosystems. Biodiversity research related to conservation measures is hampered by sampling and distributional limitations (Williams, 1996). Our study is certainly not a comprehensive sampling of the local fauna and flora but is a needed step as plans are made and hopefully executed to protect the declining fauna and flora of the area.

METHODS

Surveys of biodiversity are usually very expensive endeavors especially for selected difficult groups such as beetles, moths, and spiders (Mandelik *et al*., 2010). Our nascent Palestine Museum of Natural History is in the process of accumulating reference collections from fauna of Palestine to use in these studies of Wadi Al-Quff and other protected areas. The National Agricultural Research Center has developed a reference plant collection (herbarium). What we were able to survey shows a remarkable degree of faunal biodiversity studied by us over the years 2013-2015.

STUDY SITE

Wadi Al-Quff (WAQ) protected area is located in the western part of the Hebron Governorate and consists of two confluent valleys between Beit Kahil and Tarqumiya of a total of 145 hectares (EQA 2014; Figure 1).



Figuer 1: Habitat structure of the WAQ area. Numbers in blue indicate water sources of significance for vertebrate biodiversity and numbers in yellow indicate habitats that we noted with significant other conservation value discussed in detail (Figure adjusted from a baseline figure by Applied Research Institute of Jerusalem). Numbered areas will be discussed in details in the text.

The area of WAQ is on the western escarpment of the Hebron hills and falls in the Mediterranean botanical and zoogeographical region (Zohary, 1973). It has elevations ranging from 520 m to about 820 m asl. The area is steep, with rocky limestone with light soil on the rock surface (from which the name Quff comes). It is an important part of the system that replenishes the western water aquifer. The hill structures of WAQ originated through folding and restructuring mainly in the Mesozoic to Cenozoic geological eras. The mean annual temperature in this area is 19-20° C and annual rainfall is 400-500 mm. The soil is *terra rossa* and brown rendzina. Significant cultivation of introduced trees was done in four stages. The first one was started 1927 in the British mandate. The area is around 100 hectares, planted mainly by *Pinus halapensis*. The second stage in 1962 with an area of 150 hectares planted by the Jordanians. The area is called Al Husein Camps since it was the place for the Jordanian soldiers. The third stage was in 1970 with 90 hectares. The fourth stage was in 2010 with 2 hectares for the establishment of Tarqoumia

Park since part of the protected area belongs to Tarqoumia land. The main plantation was *Pinus halapensis* and *Cupressuss sempervirens* in addition to the natural oak, *Pistacia* and many other shrubs. It has to be mentioned that there are some trees of *Pinus canariansis* which are considered as fire resistant.

While this was intended to help preserve the soil, it affected the local forest ecosystem and created a rather artificial environment not conducive to the local species. The native areas are typical Palestinian Mediterranean forested and shrub habitats including a few wetland habitats (near Ain Hasaka). The tree cover included *Pinus halepensis, Pistacia palaestina, Quercus calliprinos, Cupressus sempervirens* and *Rhamnus palaestinus*. These areas still occur in small non-contiguous patches (see below) but could be used as seeding areas to expand with proper forest management policies.

Area 1. Ain Hasaka and its effluence: These are agricultural lands of high value in the valley from Lat: 31° 33' 53.7582" Long: 35° 5' 25.5042" to Lat: 31° 34' 30.4818" Long: 35° 4' 15.5166". To the east of the reserve and following the dirt road to Wadi Hasaka we find significant agricultural development highly dependent on the Hasaka springs (Figure 1). This area was picked because there are open water resources and agricultural fields which attracted bats and insects. Both frog species (*Hyla* and *Rana*) came from this area and nowhere else in the park. Also many species of insects with preference for streams were from here (e.g. dragonflies). This is a very rich insect habitat with many species of butterfly, beetles and bees. It was also a habitat for several bats which fed on two dozen species of moths collected in this area. One particular noteworthy record (initially by ultrasound and later by capture was *Pipistrellus pipistrellus*, the southern-most (and new) record for this species. Here we also collected 12 of the 22 species of reptiles in WAQ, and two frogs. Also this was a rich habitat for spiders, scorpions and birds. A well-balanced ecosystem exists in this area but is threatened with a growing population. The area might even be classified as Wetlands worthy of nomination under the Ramsar convention with at least five of the 9 criteria of Ramsar seeming applicable here.

Area 2. Ain Beit Kahil: Area centered at Lat 31° 34' 32" Long 35° 2' 45". This used to be open water sources releasing into the WAQ area many years ago. At least four sites are noted that have been closed completely and used for human consumption and agriculture primarily supplying the main nurseries in the valley. With exception of small leakages and the water containers that are open, these water sources are no longer available for wildlife usage. Bats (primarily *Pipistrellus*) were noted to use the main water storage container but this structure is not usable by other land animals. One possibility to help biodiversity reclamation is to divert some water into the small area to the west which could also act as a natural bridge between the naturally protected area 7 and area 6.

Area 3: Spring (Ain) and western side of colony of Telem. This area is centered at Lat 31° 33' 55" Long 35° 2' 1". This is an area that is heavily overgrazed with shepherds bring their goats and sheep to the water and hanging around the area. The valley leading up to the spring is dry but seems to have regular floods in winter and we collected many snail shells there as well as observing *Ptyodactylus guttatus*. A small protected area to the east of a tributary to the Wadi and near the spring was promising and had a number of the noted butterfly species and other invertebrates collected here.

Area 4. Area centered at Lat: 31° 34' 45" Long: 35° 3' 34". This is a small secluded valley of the park with mixed forest area in the northwestern side of the reserve. To the north of it is Halhul urban development and all around it are some agricultural development. Here we observed good faunal biodiversity because of the rather undisturbed nature of the habitat. However, there is logging at the edge of this area and encroachment of agricultural development.

Area 5. This area is centered at Lat 31° 34' 58" Long: 35° 2' 34". The south facing cliffs in this area of the Wadi Hasaka are less protected than the opposite side of the valley. However, the geologic formation here is rather interesting and the carcite cliffs (likely Cretaceous) include good roosting sites for fauna that feeds in other places of WAQ. The example is the main fruit bat cave and crevices and smaller caves that provide roosting sites for other bat and bird species. These are primarily roosting sites and ecologically vulnerable areas whose protection can maximize biodiversity maintenance. Between this area and the next area is a dirt road that leads to Hasaka. This road is used by farmers and visitors to the park especially on weekends. Significant dumping occurs in this area (see Figure 5). As this habitat destruction spreads in the valley, both the roosting sites (north side of the valley) and the foraging sites (the valley and the south side) are impacted. One of our recommendations is to block access to this dirt road at least from the asphalt road at the intersection Halhul-Tarqumia-Beit Kahil (see below).

Area 6. North facing side of Beit Kahil hill. Starting from behind the amusement park 31° 34' 43'' N 35° 2' 38'' E going NW to the valley there is an unpaved road that passes first through pine forest then through native *Quercus* patch ending at 31° 34' 51'' N 35° 2' 32'' E. There is a good preserved natural area at the end of the path where we found reptiles and trapped large numbers of forest mice feeding on oak (*Quercus*). Due to steep nature of this area, it seemed to have been maintained well. There are many of the species of reptiles noted here (list at the end) and the area also provides foraging grounds for bats, birds (e.g. the little owl, *Athene noctua*) and mammals.

Figuer 2: Area 6 habitat.

Area 7. Area centered at Lat 31° 34' 44" Long 35° 2' 11". Area 7 is to the south of the road from Tarqumia to Beit Kahil and has a very rough dirt road (only navigated by 4-wheel drive) that separates it into two areas: we call them 7a and 7b (Figure 4). Because of the terrain being not very accessible, it seems this area provided a natural protected area of WAQ. Here we recorded many of our lizard species and also here is where the rare *Mediodactylys (Cyrtodactylus) kotschyi* Mediterranean Thin-toed Gecko was found. This represents the southern-most record of this species and while IUCN does not consider the species of concern, in this area it is likely threatened (we noted only one specimen even after significant search). Also we noted the locally rare Snake-eyed lizard *Ablepharus rueppellii*. Another notable finding in this area is the tiny land snail of the genus *Ena*. The area is also foraging ground for the bats.

Area 8. Area above the road to Halhul (centered at Lat 31° 35' 27" Long 35° 2' 24") and encompassing the area of the protected area that is most disturbed but is an important habitat for butterflies (especial the swallow-tail *Papilio*, the largest of Palestinian butterflies), reptiles, and a vantage point for observing migratory birds.

RESULTS AND DISCUSSION

We studied biodiversity in the first nature reserve administered by Palestinians of the occupied Palestinian Territories (OPT). According to the IUCN Protected Areas Categories System, seven types of categories have

been proposed to suit certain requirements for protected areas. Wadi Al-Quff falls under the IUCN category of V (less likely VI) based on the criteria of the different categories (approved by the Environmental Quality Authority). The survey data published in the accompanying papers recorded a rich fauna with more than 89 species of birds, 19 species of mammals, 21 reptiles, three amphibians, over 250 invertebrates, and over 230 species of plants. This biodiversity is surprising considering habitat degredation and limited sampling due to time and resource limitations.

Our area around the Mediterranean is suffering from significant habitat destruction largely brought about by human development (Hoekstra *et al*., 2005). Assessing biodiversity is critical in planning conservation measures for protected areas. As part of UNDP/PAPP assignment "Management Plan for Protected Area in the West Bank" the IUCN in cooperation with the Ministry of Agriculture, the Environmental Authority, and local experts and interested parties produced preliminary work based on an initial study in Summer 2013 of Wadi Al-Quff area followed by these studies reported in this series of papers. Increasingly, existing data point out that the environmental instability, inequality of resource distribution, and habitat destruction done over the past 120 years have led to significant damage and even catastrophic outcome in Palestine, the Holy Land (Kelly & Homer-Dixon, 1996; Qumsiyeh, 2004, 2013).

Understanding what exists in this area is integral to designing protection schemes that work to preserve the critical elements and the biodiversity in this ecosystem. Our initial and immediate goal should be to protect what exists (a still rich but highly threatened fauna and flora) and then expand the area with natural regrowth and reforestation of degraded areas. Palestinian protected areas did receive some evaluation of threats and potential mitigating factors (Garstecki *et al*., 2010) and a management plan for the WAQ protected area was developed based on our preliminary fauna and flora survey (EQA, 2014). Here we will highlight in more detail some key points under two categories: more urgent actions and long-term actions.

IMMEDIATE ACTION RECOMMENDATIONS

1) Cull/remove the Feral dogs. The Palestinian Canaan dog has lived as feral in our lands for thousands of years around human habitation. Some two dozen feral Canaan dogs were counted primarily in the center of the WAQ area. These dogs have had a devastating impact on the environment including killing of wildlife, removing some natural pray for wild carnivores (foxes, jackals, hyenas, badger), and also in terms of forcing other wildlife to leave and/or do less foraging. There are humane ways to remove those including tranquilizer guns and humane euthanasia or relocation with proper neutering/spading done. We discussed with the local governments who are tasked by Palestinian law for doing his. Unfortunately there were periods when poisoning was done which killed many of the local carnivores.

2) Block roads and/or limit access in some areas of WAQ. This is especially helpful in the valley leading to Ain Hasaka and to areas below Beit Kahil Safa park. At least two blocks can be established for vehicles. Another option is to apply a fence to protect areas on both sides of the road below the x marks in figure 3. These are areas of high biological/biodiversity value.

Figuer 3: Suggested alterations to critical areas (for areas 5, 6, and 7). Either blockage of dirt access roads at yellow X mark and/or apply fence to protect areas on both sides of the road below the X.

3) Discuss with farmers and other stake holders protection measures and limits on activities near or in the park. This is especially needed in the farm area shown in Figure 3 above to protect the environment while maintaining access (if they are legitimately farming their lands). One concern is use of pesticides which would impact the insect fauna and as such also the predator animals that eat them including bats, shrews, reptiles etc. Other stakeholders need to be brought into the picture as partners in the protection of WAQ area: the Environmental Quality Authority, Ministry of Agriculture, local governments, nature lovers, university students, and Ministry of Education among others.

4) Prevent Burning: There are occasional burnings in the area and in one instance a large fire that erupted on 21 February 2014 burned over 13 dunums of forested area.

LONG TERM RECOMMENDATIONS

1) Monitoring and preventing unlawful activities. This includes tree cutting (Figure 4), dumping (Figures 5), hunting (we noted shells of khartoush guns), overgrazing, and taking of products from the forest without license (plants, mushrooms, etc).

Figuer 4: Some forest cutting in Area D. Habitat of Jericho giant scorpion

Figuer 5: Illegal dumping near area 7

Habitat use can guide conservation measures, for example for local bats (Carmel & Safriel, 1998) and more detailed studies over time in these areas are needed. It will be important to study impact of local changes including habitat destruction and habitat changes for example by soil acidification on the fauna of the area (see Graveland *et al*., 1994; Gärdenfors *et al*., 1995).

2) Develop sustainable use of some areas: In our numerous trips to the area we saw much use of its resources including grazing, wood cutting, collection of animals and plants for food, plants collected for medicine etc. Wood culling of the non-indigenous species may be permitted in some areas to reclaim the more natural forest. In some areas replanting of the natural forest is possible. One possible scenario is to also plant and manage a section of the forest specifically for medicinal plants. For a list of Medicinal Herbs used by Palestinians from nature, see Said (2002). For a list of 103 edible plants (62% of them also used medicinally) harvested regularly from the Palestinian areas, see Ali-Shtayeh *et al.* (2008). To organize this better we suggest a partnership with a university like Bethlehem University (and its new Institute of Biodiversity and Sustainability and the Palestine Museum of Natural History) to create a center that would run this facility. See also recommendation 6 below.

3) Ameliorate habitat fragmentation and destruction: The area of the proposed reserve is being fragmented and each segment has its own challenges (and opportunities) with regards to faunal assemblages studied briefly here (but this is not separate from the bird and the floral studies done by separate investigators for this project). Briefly per the areas we studied:

Area 1: Expanding agricultural activities including use of pesticides. Though technically not actually part of the reserve but has a reservoir of amazing biodiversity of species, as the open waters that attract bats and amphibians and odonata.
Area 2: Building development, dumping, over extraction of water for the plant nurseries.
Area 3. The presence of the Israeli colony of Telem and the overgrazing by domestic animals should be considered in this otherwise very promising area.
Area 4: Extensive wood-cutting, agriculture, human encroachment.
Area 5 and 6: Recreational activities especially risk of expansion of those from the muntazah area. Also agricultural activities.
Area 7: Perhaps best protected by nature of terraine but the dirt road is splitting the area and there is human development and encroachment from top of the hill.
Area 8: the northern hill parts of the protected area. This is a good section for butterflies and reptiles and provides a great vantage point for observing migratory birds. There is significant overgrazing by Bedouins in the area.

Agricultural activities can significantly impact biodiversity (e.g. for butterflies, see Pe'er *et al*., 2011). Besides stopping these threats, we can envision reforestation with endemic trees that could potentially link some of the fragmented areas. To protect the vulnerable bat species in the area, we suggest there is a need to protect the key habitats which are mostly the riparian *Quercus* habitats that generate much of the prey species used by these bats (see Carmel & Safriel, 1998)

4) End the Israeli occupation and empower and educate local people: For proper management of this and future reserve, Palestine must become a free country so that it can do national planning such as having appropriate laws and enforcing them. There is a very damaging impact of the occupation including limiting development of Palestinians in other areas of Palestine due to ethnic cleansing squeezing Palestinians into small areas. Many of the people we met living near the park and using its resources are refugees from 1948. We also noted significant potential impact coming from polluting industries to the reserve (e.g. recycling Israeli computers in Idhna see also Hammad & Qumsiyeh, 2013) and impact of the wall once it is built nearby (see EQA, 2010). The issue of enforcement perhaps needs to be put in a separate recommendation. In the nine days and five nights of wandering the reserve for hours and hours, we never encountered any of the supposed reserve rangers that should be guarding the reserve.

5) Start to deal with the impact of Climate Change. Climate change will have a dramatic impact on our country in the next two decades (Evans, 2009; Willis & Bhagwat, 2009; World Bank 2012) and it was shown that it is important to look at how habitats which will change in the coming years might also impact distributions and health of the local fauna (Bilgin *et al.* 2012; Blaustein *et al*., 2010; Yom-Tov, 2001).

6) Develop an environmental educational center in the protected area. We need to educate the youth about the importance of biodiversity and the ecosystem as an integrated system critical for survival of all species living in it including humans. One way we can work to implement a plan of faunal biodiversity protection is to educate young people. We propose that a national nature education center and natural history museum be established in this reserve (we in Bethlehem University are ready to assist). This would begin to transform both biodiversity research and environmental conservation in Palestine.

Local people in Palestine lived in harmony with nature for millenia except for a few documented cases of overuse of the environment for example in Ain Ghazal in Jordan. The more dramatic changes witnessed in the past 100-150 years are exceptional. The impact on the Middle East of Global warming is/will be more pronounced than other areas (Evans, 2009). The World Bank report in November 2012 on the impact of human induced

climate change on the Arab world revealed unsustainable trends (Evans, 2009; Willis & Bhagwat, 2009; World Bank, 2012). Over the past 20 years, climate monitoring stations across the Arab world have already shown an increase in average annual temperature. Computer models predict that in the next two to three decades annual rainfall will decrease in our area by nearly 25% and average annual temperatures will climb by 4-5° degrees. Disentangling the causes of a decline or adverse effect on species is not easy and this includes climate change. Yom-Tov (2001) suggested that decline in body mass of four species of birds between the 1950s and 1999 is due to global climatic change. Per Bergman's rule higher temperature can lead to micro-evolutionary changes producing smaller size. But phenotypic plasticity may also play a role in this case (Teplitsky *et al*., 2008) as may other changes in the environment/resource availability. Bilgin *et al*. (2012) used models and concluded that bat species will be most significantly affected in our area due to climate change. However, caution must be taken in putting out predictive models about effect of climate change on biodiversity because models cannot take into consideration issues like topography, microclimates, and individual species adaptability (Willis and Bhagwat, 2009). We thus feel that direct studies like the preliminary study we presented above are important for monitoring changes in biodiversity (see recommendations section above).

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Protected Areas in the Occupied Palestinian Territories

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ABSTRACT

National designation and management of protected areas (PAs) are critical components in the global effort for biodiversity conservation and environmental protection. In areas of conflict like Palestine, this task becomes more complicated but is even more important considering the environmental challenges posed by colonialism and occupation. Nineteen protected areas were partially or wholly turned over to the Palestinian National Authority and, in 2010, seven others were designated by the Environmental Quality Authority for a total of 26. In 2015, the Palestinian ministerial committee approved a list of 49 protected areas but most of these fall in parts of the Occupied Palestinian Territories (OPT) that are under direct control by the occupying power. In effect only 8 protected areas totaling less than 15 km2 are under Palestinian effective control making management difficult. In this paper we describe the status of protected areas and make a SWOT analysis and recommendations for issues of protected areas in OPT.

Keywords: Protected areas, Biodiversity, Palestine.

INTRODUCTION

The world's protected areas have grown in terms of land size and number of designated sites but there are many remaining challenges to having them provide a critical safeguard against habitat loss and other human activities that decrease biodiversity (Chape et al. 2008). Palestine as a nascent state still falls far behind on implementing provisions of the Convention on Biological Diversity (CBD) partly because it is a state that does not control most of its biodiversity important areas (EQA, 2015). The Palestinian Agriculture Law No. 2 for the year 2003 Article 1 of section 1 defines a protected area as: "A geographically delineated area that is organized and managed for the purpose of its protection and to conserve its biodiversity". Article 9 of section 1 states that: "The Ministry in cooperation with other competent authorities shall develop a protected areas management plan and conserve all plants and living organisms living in protected areas". Continuous increase in human populations as well as the demand for economic development has

severely affected all areas of Palestine, and the protected areas just might be our last hope of preserving our shrinking biodiversity; especially in an unstable political situation (UNEP, 2003; Garstecki *et al*., 2010).

During the Israeli occupation since 1967, 48 natural reserves have been declared in the West Bank, with a total area of 69,939 hectares; forming 12.35% of the total area of the West Bank. However, the National Spatial Plan indicates that the total area of natural reserves in the West Bank is 51,157 hectares forming 9% of the total area of the Palestinian Territories (Isaac & Hilal, 2011). More recent detailed studies from the Applied Research Institute-Jerusalem (ARIJ) show a total of 576,491 dunums of Israeli designated PAs forming 10.2% of the West Bank region (ARIJ, 2015). The Palestinian Authority has expressed concern that some of these PAs have been established mainly for Israeli military objectives and for settlements, rather than conservation goals (UNEP, 2003). No PAs have been designated by Israel in Gaza, but the Palestinian Authority declared the Wadi Gaza protected area in June 2000.

Wadi Al-Quff is the first Palestinian protected area well studied in terms of fauna and flora and with a reasonable managmenet plan (EQA, 2014; Qumsiyeh *et al*., 2018). Another area being investigated intensively by our group is Wadi Zarqa Al-Ulwi (funded by UNDP/GEF/SGP). Very limited information is available on the fauna of the West Bank and most of it is from older literature that needs updating (e.g. Tristram, 1885; Bodenheimer, 1935; Qumsiyeh, 1996) or from nearby parts of Palestine (e.g. Zohary, 1966, 1972). The nascent Palestine Museum of Natural History (PMNH) started to change this (Qumsiyeh *et al*., 2017) resulting in a number of scientific publications (e.g. Adawi *et al*., 2017; Abusarhan *et al*., 2016, 2017; Amr *et al*., 2016; Handal *et al*., 2015, 2016; Qumsiyeh *et al*., 2013, 2014a,b; Salman *et al*., 2014).

In this paper, we will briefly review the status of other protected areas in the Occupied Palestine Territories under the current political state, identify the authorities responsible for managing and protecting protected areas, and give recommendations for what can be done to preserve the rich areas in Palestine.

CURRENT PROTECTED AREAS

Israeli authorities handed over land belonging to 19 distinct areas to the Palestinian National Authority as PAs under the Oslo Agreements. Fifteen of these areas were studied in detail including a SWOT analysis for each area by the IUCN in collaboration with the Environmental Quality Authority (EQA) and key stakeholders (Table 1). In addition, the latter study analyzed seven more areas suggested by the EQA (four fully handed over to the Palestinian Authority): Al-Qarrin (50 dunums), Deir Razzeh (350 dunums), Ein Al-Uja (30,000 dunums but 0 handed over), Suba (200 dunums), Um Al-Safa (1500 dunums, 300 handed over), Wadi Al-Quff (2500 dunums), and Wadi Al-Qilt (15,000 dunums, 0 handed over).

Table 1. List of protected areas handed over to the Palestinian Authority under the Oslo agreements (Garstecki *et al.*, 2010). Area is area handed over in dunums and not the total area of the potential protected area.

Protected area	Governorate	Area (Dunum)	Habitat type
Al-Hashmee	Ramallah	200	*Pinus halepensis* and *Arbutus andrachnae* woodland
Deir Ammar	Ramallah	120	*Pinus halepensis* woodland
Ein Darra	Ramallah	250	*Quercus calliprinus* woodland on limestone
Fahmeh	Jenin	400	Semi-steppe batha
Jabal-Alkabeer	Nablus	9,500	Semi-steppe batha
Jerusalem Wilderness	Hebron and Bethlehem	172500	Steppe vegetation
Sheikh Katrawny	Ramallah	11	*Quercus calliprinus* woodland on limestone
Sheikh Zeyd	Nablus	52	*Quercus calliprinus* woodland on limestone
Shoubash	Jenin	5,000	*Ceratonia siliqua* and *Pistacia lentiscus* forest
Sirris	Jenin	1,118	*Quercus calliprinus* woodland on limestone
Tammoun	Tubas	4,300	Semi-steppe batha
Tayyasir	Jenin	1,200	*Ceratonia siliqua* and *Pistacia lentiscus* forest
Um-Altutt	Jenin	320	*Quercus calliprinus* woodland on limestone
Wadi Al-Dilb	Ramallah	800	*Quercus calliprinus* woodland on limestone
Wadi Zarqa Al-Elwey	Salfeet	2,700	*Quercus calliprinus* woodland on limestone

The 26 areas are varied in habitat and size. Al Qarin is only 50 dunums surrounded by agricultural and residential areas (including Al-Arroub refugee camp) while the Jerusalem Wilderness is over 172 km^2. These PAs include critical forested and other habitats with high biodiversity (ARIJ, 2013). However, most of them are located within Area C and under control of the Israeli civil administration and only 13 are within the Areas A and/or B accounting for 1.3% of the total reserve area and are therefore under Palestinian control (Görlach *et al.*, 2011; ARIJ 2015; EQA, 2015). The Ministry of Agriculture (MOA) through its Directorate of Forests, Rangelands and Wildlife has offices in all governorates in the OPT. 40 rangers are responsible for inspecting and patrolling protected areas and natural forests. The active areas they manage are 8 areas with a total of less than 15 sq km of land accounting for less than 1% of the protected areas (Table 2, Figure 1).

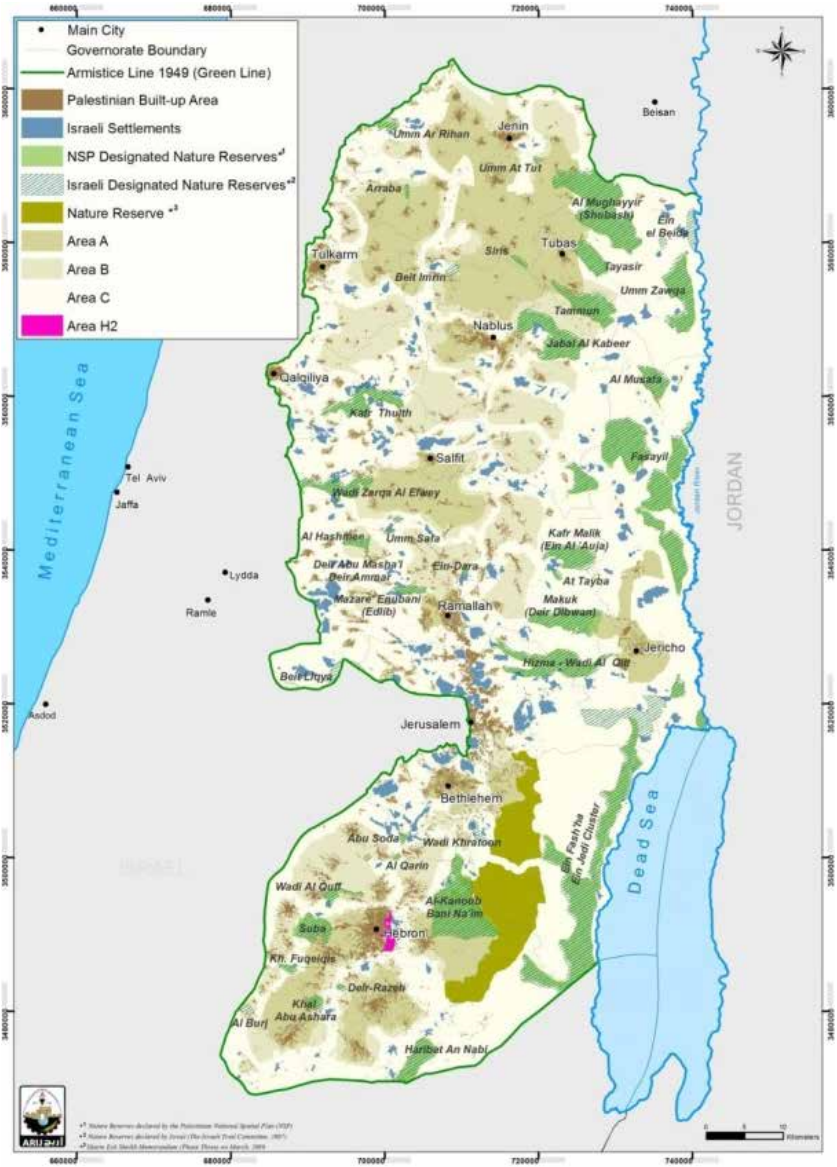

Figure 1: Protected areas in Palestine showing administrative areas (Isaac & Rishmawi, 2015).

Table 2: Protected areas under active management by the Ministry of Agriculture

Protected area	Governorate	Area in Dunums
Tayyasir	Jenin	1200
Sirris	Jenin	1118
Um-Altutt	Jenin	320
Shoubash	Jenin	5000
Tammoun	Tubas	4300
Al-Hashmee	Ramallah	200
Al Qarin	Hebron	50
Wadi Al-Quf	Hebron	2500
Total		14688

On 3 February 2015, the Palestinian Council of Ministers approved the recommendations of the National Committee for the Geographical Names in Palestine (consisting of members from the EQA, MOA and the MOPAD) on recognizing and approving protected areas in Palestine. This document includes 49 protected areas with their names and their locations. These names are approved and all governmental institutions are obliged to use them. Below we discuss those in the West Bank under three categories: Northern West Bank (Jenin, Salfit, Tubas, and Nablus governorates), Central West Bank (Jerusalem and Jericho governorates), and Southern West Bank (Bethlehem and Hebron Governorates).

NORTHERN WEST BANK

Jenin Governorate: Of the five proposed reserves, three were handed to the PA after the Oslo Agreement; Um Al Tut (=El Marj Protected area), Sirris (=El Miksar Protected area) and Fahmeh (=Dhahrat Hayis Protected area) (Table 3, Figure 2). The other two proposed reserves are new additions to the protected areas network. More data on the area, and biological and ecological characteristics are required to classify these reserves.

Table 3. Proposed protected areas in Jenin Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Umm er Rihan	محمية ام الريحان	أم الريحان
Jabel el Aqra	محمية جبل الاقرع	عرابة
Dhahrat Hayis	محمية ظهرة حايص	فحمة
El Marj	محمية المرج	أم التوت
El Miksar	محمية المكسر	سيريس

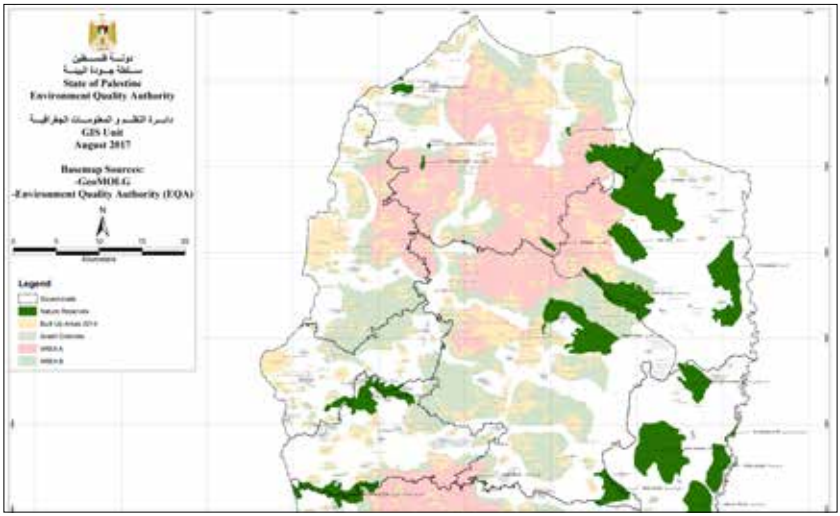

Figure 2: Proposed protected areas in Northern West Bank (Council of Ministers, 2015).

Tubas Governorate: Garstecki et al. (2010) listed both Shoubash (=Shubash) and Tayyasir (=Ras Jadir) protected areas in Jenin Governorate. Now both reserves are listed under Tubas Governorate (Council of Ministers, 2015). Only Jabal Tammun protected area is listed in Tubas (Garstecki *et al.*, 2010). All the three reserves were handed to the PA after the Oslo Agreement (Table 4, Figure 2). El Muzawqa is a new proposed protected area. More data on the area, biological and ecological characters are required for classification.

Table 4. Proposed protected areas in Tubas Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Shubash	محمية شوباش	المغير – شوباش
Ras Jadir	محمية راس جادر	تياسير (Har Gadir)
El Muzawqa	محمية المزوقة	امزوقة (Um Zawqa)
Jabel Tammun	محمية جبل الطمون	طمون

Nablus Governorate: A total of three protected areas are listed (Table 5, Figure 2). Jabel el Kabir protected area is among the areas handed to the PA after the Oslo Agreement. Jebel Taruja and Wadi er Rashshash protected areas are two new proposed areas. Both requires additional surveys to identify their biological and ecological characteristics. The status of Sheikh Zeyd remains to be verified from the list proposed by Garstecki *et al.* (2010).

Table 5. Proposed protected areas in Nablus Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Wadi er Rashshash	محمية وادي فصايل	No name assigned
Jebel Taruja	محمية جبل طاروجا	No name assigned
Jabel el Kabir	محمية جبل الكبير	الجبل الكبير (Har Kabeir)

Ramallah and Al Bireh Governorate: In total, 13 protected areas were listed in the Palestinian Ministerial Cabinet list (Table 6; Figure 2). Wadi Ein ez Zarqa el Elwi was listed under Salfit Governorate and Al-Hashmee under Ramallah governorate as handed reserve after the Oslo Agreement by Garstecki *et al.* (2010) but both straddle the two governorates. Ein Darra (=Ein el Maghara), Deir Ammar (=Wadi Jannata), Wadi el Dilb and Esh Sh. Qatrawani were handed reserves after Oslo Agreement by Garstecki et al. (2010). Ein el Auja is proposed by Garstecki *et al.* (2010) as part of Jericho Governorate. The proposed Um Al-Saffa PA by Garstecki *et al.* (2010) is now subdivided into three new protected areas namely Ein Dara, Ein et Tileib and Ein Qawabish (Council of Ministers, 2015). Additional proposed reserves include Qubbat en Najma, Wadi el Makkuk, Laturn and En Nabi Gheit. Verification for size of these proposed protected areas are needed as well as baseline surveys for their biological and ecological features. Wadi Ein ez Zarqa el Elwi is the first one in the Northern West Bank to be investigated scientifically now with significant data collected by the team of the Palestine Museum of Natural History at Bethlehem University producing data that shows rare species, some new, and some with new distributions. It is a remarkable area but under significant threats from both local activities and Israel occupation activities such as the wall and industrial settlements (Hammad & Qumsiyeh, 2013 and several publications forthcoming).

Table 6. Proposed protected areas in Ramallah and Al Bireh Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Wadi Ein ez Zarqa el Elwi	محمية وادي عين الزرقا العلوي	وادي الزرقا العلوي
Ein Dara	محمية عين دارة	غابة ام الصفا
Ein et Tileib	محمية عين الطليب	غابة ام الصفا
Ein Qawabish	محمية عين قوابيش	غابة ام الصفا
Wadi Jannata	محمية وادي جناتا	دبر ابو مشعل –دير عمار- زرقا
Ein el Maghara	محمية عين المغارة	عين دارا
Wadi el Dilb	محمية وادي الدلب	(مزارع النوباني (الديب
Ein el Auja	محمية عين العوجا	(كفر مالك (ناحال بيتاف
Qubbat en Najma	محمية قبة النجمة	No name assinged
Wadi el Makkuk	محمية وادي المكوك	ناحال مكوك
Laturn	محمية اللطرون	No name assinged
Esh Sh. Qatrawani	محمية الشيخ القطرواني	No name assinged
En Nabi Gheit	النبي غيث	No name assinged

CENTRAL WEST BANK

Jerusalem Governorate: Two protected areas were listed in the Palestinian Ministerial Cabinet list (Table 7; Figure 3). Wadi Al Qilt protected area (Figure 4) is shared between Jericho and Jerusalem. Marj ez Zarur is a new proposed protected area by the Palestinian Ministerial Cabinet list (2015).

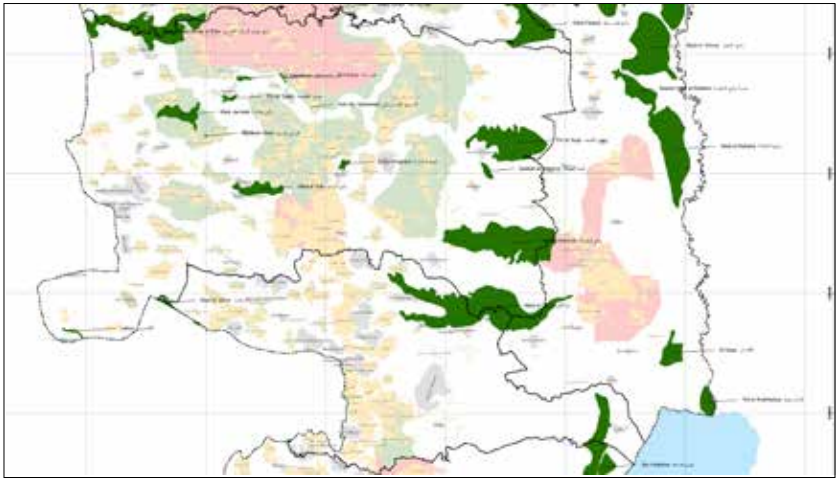

Figure 3: Proposed protected areas in Central West Bank (Council of Ministers, 2015).

Table 7. Proposed protected areas in Jerusalem Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Wadi el Qilt (Fig. 4)	وادي القلط	حزما (ناحال برات) وادي القلط
Marj ez Zarur	مرج الزعرور	بدون اسم

Figure 4: Wadi Al-Qilt.

Jericho Governorate: Nine protected areas have been listed in Jericho Governorate (Table 8, Figure 2 and 3). Wadi Al Qilt reserve is shared between Jericho and Jerusalem. All these proposed protected areas require baseline data on the floral and faunal compositions, as well descriptions for the ecosystems.

Table 8. Proposed protected areas in Jericho Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Ras Umm el Kharrub	محمية راس ام الخروبة	No name assigned
Ein Bassat er Rih	محمية عين بصة الريح	No name assigned
Qarn Sartaba	محمية قرن صرطبه	No name assigned
Wadi Jauzala	محمية وادي جوزلة	No name assigned
Wadi el Ahmar	محمية وادي الاحمر	No name assigned
Bassat Wadi el Mallaha	محمية بصة وادي الملاحة	No name assigned
Wadi el Mallaha	محمية وادي الملاحة	No name assigned
El Katar	محمية الكتار	No name assigned
Tell er Rusheidiya	محمية الرشيدية	No name assigned

SOUTHERN WEST BANK

Bethlehem Governorate: Three protected areas were proposed by the Palestinian Ministerial Cabinet list (Table 9; Figure 5). All were not originally handed or proposed as stated by Garstecki *et al.* (2010). The status of what was previously known as Jerusalem Wilderness from the handed protected area after the Oslo Agreement remains to be clarified. This reserve is the largest protected area with estimated area of 172 km^2.

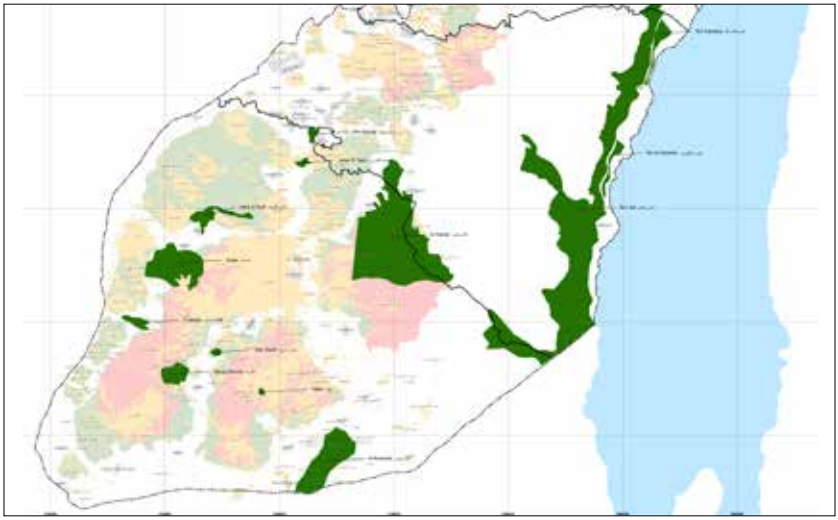

Figure 5. Proposed protected areas in Southern West Bank (Council of Ministers, **2015).**

Table 9. Proposed protected areas in Bethlehem Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Ein Jidi	محمية عين جدي	عين الفشخة – تجمع عين جدي
Ein Fashkha	محمية عين فشخة	No name assigned
Ein el Ghuweir	محمية عين الغوير	No name assigned

Hebron Governorate: Ten protected areas were listed in the Palestinian Ministerial Cabinet list (Table 10; Figure 5). Al Qarin (=Jabel El Qarn), Wadi Al-Quff (=Wadi el Quff, Figure 6), Suba and Deir Razeh (=Deir Razih) reserves were proposed by Garstecki *et al.* (2010). Six newly proposed protected areas by the Palestinian Ministerial Cabinet (2015) include Abu Sauda, El Kanub, Al Kuweiyis, Fuqeiqis, Karza (kurza) and Yatta.

Figure 6. Wadi Al-Quf.

POTENTIAL PROTECTED AREAS DEVELOPMENT AND CONSERVATION

The EQA designated 31 important biodiversity areas besides the ones listed above. Wadi Gaza in Gaza was designated a protected area in 2000 but for some reason was not included in the 49 areas listed above by the Council of Ministers (2015) and that would make for PA # 50. Israel has effectively shut off the water in the valley from its side of the border and the area is heavily pressured in terms of its environment with habitat destruction, pollution, and hunting. Another area is the very important area of Wadi Qana near

Salfit (Figure 7) which is effectively now surrounded by Israeli colonial settlements (preliminary unpublished studies show very rich biodiversity). Um Al Rihan Forest situated in Jenin District with an area of 11 km^2 has value both in natural and cultural heritage. Marj Sanoor and Wadi Al-Muquatta in Jenin area are also critical. The walls of Jerusalem which serve as shelter for a variety of birds including the threatened lesser kestrel, and the Jerusalem wilderness region, a semi-desert area are on the list of importance. Wadi Al Makhrour in Bethlehem and Wadi Haramya in Ramallah area are also important.

Table 10. Proposed protected areas in Hebron Governorate (Council of Ministers, 2015).

Proposed name in English	Proposed name in Arabic	Name on original documents
Abu Sauda	محمية أبو سَوْدة	أبو سَوْدة
Jabel El Qarn	محمية جبل القرن	القرن
El Kanub	محمية الكانوب	الكانوب
Wadi el Quff (Fig. 6)	محمية وادي القف	القف
Suba	محمية سوبا	غابة سوبا
Al Kuweiyis	محمية الكويس	حربة عين النبي (هار عمسة)
Fuqeiqis	محمية فقيقيس	No name assigned
Karza (kurza)	محمية كرزة	No name assigned
Yatta	محمية يطا	No name assigned
Deir Razih	محمية دير رازح	No name assigned

Figure 7. Wadi Qana PA.

PROTECTED AREAS CATEGORIES AND MANAGEMENT TYPE

The IUCN gave definitions, management categories and governance types for the protected areas and these guidelines should be followed in order to standardize the concept of protected areas worldwide. Garstecki *et al.* (2010) categorized the evaluated protected areas in the Palestinian Territories according to the IUCN categories for protected areas. Of the 22 evaluated protected areas, one was listed under category V as Protected Landscape, three under category III as natural monuments, four under category I as strict protected areas, and 14 under category IV as managed reserves (Table 11). Based on this IUCN categorization, the mosaic of natural and cultural landscapes around south-east of Jenin, including Shoubash and Um-Altutt, could potentially be designated as a UNESCO Biosphere Reserve (Garstecki *et al.*, 2010).

Table 11. Protected areas in the Palestinian Territories and their IUCN criteria.

Protected area	IUCN Criteria	Type
Al Qarin	I	Strict Nature Reserve
Al-Hashmee	I	Strict Nature Reserve
Deir Ammar	III or no PA at all	Natural Monument
Deir Razeh	IV	Managed Reserve
Ein Darra	IV	Managed Reserve
Ein El-Uja	IV	Managed Reserve
Fahmeh	IV	Managed Reserve
Jabal-Alkabeer	IV	Managed Reserve
Jerusalem Wilderness	IV	Managed Reserve
Sheikh Katrawny	III or no PA at all	Natural Monument
Sheikh Zeyd	III	Natural Monument
Shoubash	IV	Managed Reserve
Sirris	I	Strict Nature Reserve
Suba	I	Strict Nature Reserve
Tammoun	IV	Managed Reserve
Tayyasir	IV	Managed Reserve
Um Al-Saffa	IV	Managed Reserve
Um-Altutt	IV	Managed Reserve
Wadi Al-Dilb	IV	Managed Reserve
Wadi Al-Quff	V	Protected Landscape
Wadi El-Qilt	IV	Managed Reserve
Wadi Zarqa Al-Elwey	IV	Managed Reserve

Governmental authorities related to protected areas and Conservation

EQA as the legal successor of the Ministry of Environmental Affairs, and the MOA are the two main governmental bodies with legal authority designated to for nature protection, nature reserves, protected areas and national parks. However, it is not very clear which authority has the delegation over biodiversity and conservation, since both the Environmental Law for the year 1999 and the Agriculture Law for the year 2003 include articles related to nature protection.

The EQA has invested in the conservation of nature through their current activities and involvement in international conventions being the focal points of several initiatives. The EQA is responsible for the development of legislations, strategies and policies pertaining to environmental issues. In 2010, the EQA developed a three year strategy for 2011-2013 that identified and prioritized objectives for itself and for the Palestinian environment as a whole (EQA, 2010). EQA gave 48 specific objectives. Here are just some of those:

- Issuing legal and other directives
- Issuing information bulletins and statistical and other data information
- Building human capacity at EQA
- Documenting Israeli violations of the Palestinian Environment
- Founding of an environmental information center which issues regular reports
- Review and modernize the Palestinian Environmental Laws
- Review and evaluate institutional structures related to the environment

The structure of the EQA consists of the EQA President, a Vice President and six main administrative departments, each with a set of directorates. The General Directorate of Environmental Resources is the main body responsible for preparation of studies on biodiversity (Fauna and Flora), and cooperates in protecting designated areas. One important function of EQA is to monitor the NGO's related to environmental issues through the Law of Charitable Organizations and National Authorities for the year 2000.

Through the Agriculture Law for the year 2003, the Ministry is responsible for implementing Article 9 of section 1 of this Law that states: "*The Ministry in cooperation with other competent authorities shall develop a nature reserves management plan and conserve all plants and living organisms living in protected areas*". Two other laws are the Forest and Afforestation and the Rangelands Bylaws. A draft law for protected areas was prepared in 2005, however, it is still not approved yet. A national committee for nature protection would be formed under that law with membership from MoA, EQA, MOLG, MOT, MOL,

MOW, universities, local NGOs and persons with experience. In addition, this national committee has the authority to mandate the protected area issues to national organizations or authorities. The draft law also states "*The Ministry is the authorized authority for protecting targeted areas for the purpose of protection and includes nature reserves, protected areas, national parks and the natural heritage*".

The Vice Minister of Natural resources of the MOA is responsible for three administrative units: General Directorate of Irrigation and Agricultural Water, General Directorate of Agricultural Land, and General Directorate of Forests, Rangelands and Wildlife. The latter Directorate is the main body responsible for managing nature reserves and protected areas. This directorate includes four divisions or departments: Forestry, Nature Reserves, Rangelands, and Nurseries.

LEGAL FRAMEWORK FOR PROTECTION

Jordanian laws on the environment were applied in the West Bank while the Egyptian laws applied in Gaza after the 1949 truce and until 1967. The Second Israeli Military Order designated immediately after the occupation in 1967 stated that all water resources in the newly occupied Palestinian Territories were to be "state owned by Israel" (UNEP, 2003). The PNA did attempt to legislate on issues of water and other natural resources via the water law signed by the late President Yasser Arafat on 17 July 2002. But these remain wishful thinking in context of continued occupation (UNEP, 2003).

The authority to issue laws was derived from signing Oslo agreements between the PLO and Israel which were supposed to be interim arrangements pending conclusions of negotiations on final status issues which include statehood, borders, security, refugees, and Jerusalem. As part of these agreements, the two parties agreed to protect the environment in compliance with International standards, conducts EIA, protect soil, and other natural resources etc. (UNEP, 2003). As early as January 1995, ARIJ and the Environmental Law Institute (Washington DC) drafted an environmental law for consideration by the nascent PNA (Amra, 1998). In 1995, the environmental planning directorate (EPD) was established within the Ministry of Planning and International Cooperation (MOPIC). In December 1996, the Palestinian Environment Authority was created and it was elevated to the Ministry of Environmental Affairs (MOEA) in 1998. A presidential decree in June 2002 created the Environmental Quality Authority (EQA) as a successor to the MOEA. The EQA mandate derives from the above mentioned law in addition to the national environment strategy (Amra, 1998).

In 1995-1996, the Ministry of Planning and International Cooperation developed an Emergency Natural Resources Protection Plan to counter

environmental concerns that will result from development of the newly established State. According to this plan, Gaza and the West Bank were divided into three regions according to their environmental sensitivity (high, medium and low). These regions were divided based on field studies for their importance in terms of biodiversity, nature reserves, water resources, agricultural land and landscape preservation (Amra, 1998). The aim of this plan was to direct all forms of development away from environmentally sensitive areas to the least sensitive areas.

Palestinian Environmental Law was approved by the PLC on 6th of June 1999 and signed by the Palestinian President on the 28th of December 1999. It consists of 82 articles. It states that the Palestinian National Authority (PNA) has the right and responsibility to study and asses any project for environmental impact and to protect the environment.
The EQA was given the task to "…prescribe bases and standards for the protection of natural reserves and national parks, monitor and declare them, and establish and designate the national parks and supervise them." Violations of the law theoretically would include penalties of fines and even imprisonment. But violations are common and we could not even find good examples of any successes in courts dealing with environmental law violations.

Besides the laws listed (especially the Palestinian Environmental Law), there are other laws relating to environmental issues that have indirect impacts on biodiversity: such as the Palestinian Local Government Law No. 1 of 1997, the Industrial Estates and Free Industrial Zones Law No. 10 of 1998, Natural Resources Law No. 1 of 1999, the Palestinian Water Law No. 3 of 2002, and the Protection of Animal Wealth Law No. 8 of 1998.

Agriculture Law No. 2 for the year 2003 is the legal reference for some aspects of protected areas or nature reserves. Article (1) of section (1) defines a protected area as: "*A geographically delineated area that is organized and managed for the purpose of its protection and to conserve its biodiversity*". Article (9) of section (1) of this Law states that: "*The Ministry in cooperation with other competent authorities shall develop nature reserves management plan and conserve all plants and living organisms living in protected areas*".

Finally, Palestine committed to obey international rules when it signed International agreements and conventions such as the Convention on Biological Diversity (CBD), the United Nations Convention to Compact Desertification (UNCCDE), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Migratory Species (CMS), the Convention to Combat Desertification (CCD), and the United Nations Framework Convention on Climate Change (UNFCCC). (Jaradat & Awad Allah, 2015).

DISCUSSION

Article 40 in Chapter 5 of the Palestinian Environmental Law of 1999 states that the Environmental Authority has the task to "prescribe bases and standards for the protection of natural reserves and national parks, monitor and declare them, and establish and designate the national parks and supervise them." Violations of the law would include penalties of fine charges and imprisonment. Yet, as shown above, most of the protected areas are located within Area C where control continues to be under the exclusive authority of Israel. Further, 36.2% of the designated protected areas overlap with Israeli settlement "master plans" and 39.5% overlap with closed military areas and bases (Ghattas, 2008; EQA, 2015). There are many challenges that put stress the Palestinian environment and preclude appropriate protection ranging from rapid population growth, an impoverished economy, and an instable political situation. Collectively, this makes management of protected areas challenging.

Confiscation of land for settlements is one of the major threats to the Palestinian nature reserves. The confiscation of Ras Imweis and six adjacent areas, what is known as Nahal Shilo, located northwest of Ramallah is among the best examples for the Israeli practices of stealing Palestinian land. Previous cases of destruction and distortion of nature reserves in the occupied West Bank for the implementation of the various Israeli colonial projects is just an integral part of the Israeli practices. Israel exploited the term "Nature Reserve" for the sake of Israeli settlements. Such exploitation was obvious in Bethlehem Governorate, when Har Homa settlement was established in 1997 on Abu Ghneim Mountain, which was considered one of the largest forests in Bethlehem (POICA, 2013). Another report was published on the same context (Etkes & Ofran, 2007). It shows Israeli building of settlements in the Har Kabir reserve, and that Alonei Shilo and Elmatan outposts were built in the Nahal Kane reserve. Some Israeli settlements also dump toxic substances into the Palestinian environment including protected areas (Hammad & Qumsiyeh, 2013; EQA, 2015). As a result of these and other factors, some important areas have seen decline in biodiversity (e.g. Qumsiyeh *et al*., 2014).

A challenge to the EQA and relevant agencies is that there are so few baseline studies on where the rich biodiversity areas are, and what they contain in the OPT. The Palestinian Authority designated Wadi Gaza as a nature reserve in Gaza containing 1.25 km^2 of a costal wetland only in June 2000 but it is an area of great promise with limited studies (Abed Rabou *et al*., 2015). Wadi el-Far'a is an area of significant biodiversity stretching from Nablus to the Jordan Valley, including the ecotouristic sites like Badhan and also has significant potential (Abdulfattah & De Vries, 2006). The current work in this volume (see Qumsiyeh *et al*., 2016) is the first detailed scientific study of just one of the 49 (potentially to go up to 51 or more with addition of Wadi Gaza and Wadi Qana among others).

A SWOT analysis for each of the 26 Palestinian protected areas was done by Garstecki *et al.* (2010). Table 12 provides an overall SWOT analysis for issues of protected areas and environmental conservation based on detailed analysis with more intensive work done in Wadi Quff and our current work on Wadi Zarqa Al-Ulwi and overall focus group study with stakeholders from all parts of the Palestinian areas.

Table 12. SWOT analysis (see also Alhirsh *et al.*, 2016)

Strengths	• More than 10% of the OPT can be actually protected areas • Rich biodiversity representative of many biomes. We have fragile but promising ecosystems. • 40 rangers available through Ministry of Agriculture. • Presence of legal framework laws pertaining to nature reserves. • Presence of national biodiversity strategy and action plan. • Presence of structured governmental organizations related to conservation and the environment. • Presence of several active NGOs in environmental issues. • High educational level and awareness among the local community in environmental issues. • Integration of environmental concepts in the Ministry of Education curricula. • Presence of research institutions concerned with biodiversity and the environment (e.g. Palestine Museum of Natural History).
Weaknesses	• Environmental Law (1999) is out of date and does not match with international agreements in terms of obligations on protected areas. • Little enforcement of existing laws. • The Agriculture Law is not comprehensive for nature reserves and their management. • Lack of coordination between the different authorities in the government and non-government sectors. • Limited knowledge: we need data on where biodiversity hotspots are, what areas to protect, and what is in them (scientific research). Lack of research on the protected areas (in terms of their delineation, status, and biodiversity). Only intensively studied one is Wadi Al-Quf and now some work on Wadi Zarqa Al-Ulwi. • Limited size of protected areas and presence near urban areas. • Protected areas mostly under Israeli control. • Increasing human pressures and habitat destruction. • Conflicts between some governmental stakeholders in who manages parks (MOA, EQA). • Significant deterioration in some areas may be irreversible. • Lack of proactive agendas.
Opportunities	• Presence of a trend in the Palestinian National Authority to regulate the environment as one active sector. • Presence of global and international attention and support to environmental issues with promising financial support. • The possibility of cooperation and coordination with governmental, NGOs and academic research institutions. • Presence of environmental conventions that guarantee the right of peoples under occupation to protect their environment. • Potentiality of developing ecotourism and natural park conservation awareness simultaneously. • Available knowledge bases could be mobilized (especially in academia). • Potentiality of small actions with limited budgets making huge impact on conservation but also potentially linked to poverty reduction (Adams *et al.*, 2004).
Threats	• Violations and destruction perpetrated by the Israeli occupation against the Palestinian environment. • Continued occupation/colonization and lack of sovereignty to act on urgent conservation issues including the lack of control over many of the environmental and natural resources due to administrative divisions of the occupied territories. • Global environmental problems such as climate change & desertification pollution etc. • Mismanagement of reserve areas (e.g. turning the reserve into a politically susceptible chip in local policy decisions) • Mobility and other obstructions to conservation programs under occupation. • Economic and social challenges. • The current political situation in the Palestinian territories.

RECOMMENDATIONS

- A comprehensive review and assessment of current environmental and agricultural laws is urgently needed to update and to resolve conservation issues. Revise and update Palestinian Environmental Law (1999) to create a stronger law in line with Palestine's obligations under international treaties signed and others potentially to sign. For example the current law lacks more detailed guidance on how the EQA should fulfill its obligations as stated mainly in Article (40) regarding the management of protected areas.
- Perform more detailed studies on human impact on the environment whether by Palestinians or Israeli settlers (see Tal, 2002; Ginsberg, 2006; Abdullah & Swaileh, 2011; Al-Haq, 2015; Qumsiyeh, 2017).
- Reform and strengthen governmental agencies especially in regard to enforcement of laws. Allocate resources for implementing laws and policies (no law or policy should be issued or revised without clear mechanisms of implementation) (see Esty & Porter, 2005).
- Review international agreements signed or potentially to sign in regards to implementation and obligations for Palestine. This included CBD, UNCCDE), CITES, CMS, CCD, and UNFCCC.
- There needs to be more vigorous and effective action by the EQA based on its mandate for example with regard to regulation of NGOs and regulation of industries based on solid EIAs and solid scientific data.
- There needs to be better coordination and consultation with academia especially to better utilize existing data and encourage collective acquisition of new.
- Palestine needs scientific data covering all areas of protected areas and potential protected areas by using the best available data collection methods on areas like geography, geology, hydrology, fauna, and flora. Such data can also help identify biodiversity hotspots for conservation priorities (Myers *et al*., 2000).
- As a second step we need to develop management plans that use ecosystem approaches and take areas like social, cultural and economics into consideration (Slocombe, 1993; Adams *et al*., 2004).
- Programs in EE in and around the protected areas need to be developed with a cohesive strategy that also helps creativity, innovation, and sustainability strategies. This includes comprehensive public engagement with the parks service resources to ensure communities benefit from protection of their natural resources.
- System wide participation addressing leaders and developing leaders who are able to take on tasks on protected area programs and strategies at a local regional and global scale.
- Increase awareness through marketing, education and cooperative associations which leads to increased interest, research, and protection.

- Due to limited resources, it is critical to identify hotspots and key species to direct resources for conservation (Myers *et al*., 2000) and to use buffer zones around parks with local buy-in.
- The most critical is to solve the conflict between the MOA and the EQA and designate an authority responsible for managing protected areas effectively. There is talk of turning the first protected area properly studied, Wadi Al-Quf to the municipality of Hebron for management. This would be devastating to environmental issues. Local municipalities are subject to various pressures which cannot result in sustainable conservation efforts.

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Flora of Wadi Al-Quff Protected Area, Hebron Governorate, Palestine

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ABSTRACT

We present data based on a preliminary survey of the flora of the Wadi Al-Quff Protected Area (WAQPA), Hebron Governorate in the Occupied Palestinian Territories (OPT). A total of 231 identified species plus ferns were reported through quadrates 20x20m for trees and shrubs and 1x1m for herbaceous plants. Dominant trees and shrubs include *Pinus halapensis, Rhamnus palaestina, Quercus calliprinos, Sarcopotrium spinosum*, and *Cistus creticus. Crataegus aronia, Origanum syriacum, Pistacia lentiscus, and Styrax officinalis* are less common in the reserve and need special attention. Twenty three species are rare at OPT level but were found at WAQPA and thus require protection.

Key words: Wadi Al-Quff, Hebron, Protected areas, flora.

INTRODUCTION

Palestine enjoys a rich flora in spite of its small area due to its geographical position as a meeting point between Asia and Africa, where three phytogeographical regions intersect: Mediterranean, Irano-Turanian and Saharo-Arabian. There have been some studies of the flora of our region (Post, 1933; Zohary, 1966, 1972; Feinburn-Dothan, 1978; Zohary & Feinbrun-Dothan, 1986; Danin, 1992; Fragman *et al*., 1999; Al-Shaikh *et al*., 2000). An estimate of 2655 plant species occur in historic Palestine, while 1591 species were recorded from the West Bank (Al Sheikh *et al*., 2000). More recently 21 additional species were added to the flora of the West Bank (Al-Shaikh, personal communication).

As part of biodiversity assessment and drawing management plans for the first Palestinian administered protected area, we performed a study of the flora of Wadi Al-Quff, Protected Area (WAQPA) the first Palestinian protected area to receive detailed study and a management plan (EQA, 2014). This protected area was afforested in stages that started in 1927 during the British mandate with planting nearly 100 hectares mainly by *Pinus halapensis*. 150 hectares were planted starting in 1962 during the Jordanian rule. This was followed by 90 hectares in 1970, and two hectares in 2010

(mainly in Tarqoumia Park). *Pinus halapensis*, *Cupressuss sempervirens*, *Pistacia* sp. and few other local trees now constitute the main canopy elements. This study aimed to survey the existing flora of WAQPA and comment briefly on threats and opportunities for saving this fragile ecosystem.

METHODS

WAQPA is located in the southern part of the central mountainous ridge in Palestine. It has a Mediterranean climate with elevations of 520-820 m asl, transected by valleys sloping west towards the Mediterranean Sea. With 400-600 mm annual rain fall, the area is characterized by degraded maquis wooded areas mixed with planted pine and cypress trees to garrigue vegetation. On-site vegetation survey was carried out through systematic sampling. Quadrates were set-up along a transect covering varied areas of the reserve for systematic sampling. The starting point for the transect placement was selected randomly. The transect length depends on the distance from mountains tops to the wadi. The first 20x20 meters quadrate was the starting point of the transect then quadrates of 20x20 meters were placed regularly each 50 meters. These larger quadrates were used for large trees and shrubs. 1x1 meter quadrates in the center of the 20x20 meters quadrate were used for the herbaceous plants. The aim of 20x20 meters and 1x1 meter quadrates in many places is to capture the entire range of vegetation along gradients of altitude, slope and slope exposition within the protected area. Recording all plant species and cover percentage for each species was carried out according to Braun-Blanquet scale.

Flora survey was carried out through 60 quadrates (20x20 meters) for trees and shrubs and 60 quadrates (1x1 meter) for grasses in 20 linear transects in different slopes in the targeted area. The coordinates and elevation were recorded at the starting and at the end point of each transect. The 20 transects covered elevations from 550 - 896m above sea level and were chosen to represent as much habitats as possible. The number of quadrates in each transect ranged from 2 to 4 depending on the transect length.

The data analysis produced information including: general habitat structure, dominant species, species composition, plant species richness, existing disturbance. We recorded all plant species in quadrates and some that were out of the quadrates. We recorded obvious existing disturbance such as logging, grazing, and fires.

RESULTS

Total of 231 species were identified plus unidentified ferns. The non-fern species belong to 51 plant families. 54 species are trees and shrubs. 23 species are rare on the country level (Table 1).

Table 1. Floral species list in WAQ. Abundance is at West Bank Level (C = common, F = frequent, R = rare). Growth Form for each species: C = Chemophyte (dwarf shrub), G = geophytes, H = Hemicrytophyte (perennial), S = Shrub, T = tree, V = Vines. Constancy is number of quadrants out of 60 quadrants in which the species occurs. Blank constancy quadrants indicates one observation within the quadrants or one or more observations outside of the selected quadrants.

Speices	Family	Abundance	Growth Form	Constancy
Aegilops peregrina	Gramineae	C	A	
Ajuga chia	Labiatae	C	C	
Alcea acaulis	Malvacea	R	H	
Alcea setosa	Malvacea	C	H	
Allium neopolitanum	Liliaceae	C	G	
Allium stamenium	Liliaceae	C	G	
Allium truncatum	Liliaceae	F	G	
Alopecurus utriculatus	Gramineae	C	A	
Anacamptis pyramidalis	Orchidaceae	F	G	
Anagalis arvensis	Primulaceae	C	A	
Anagyris foetida	Papilionaceae	F	S	
Anarrhinum forskahlii	Scrophulariaceae	C	C	
Anchusa aegyptiaca	Boraginaceae	C	A	
Andrachne telephioides	Euphorbiaceae	C	C	
Andropogon distacyus	Gramineae	C	A	
Anemone coronaria	Runanculaceae	C	G	
Anthemis pseudocotula	Compositae	C	A	
Arbutus andrachne	Ericaceae	C	T	
Arenaria leptoclados	Caryophyllaceae	R	A	
Arisarum vulgare	Araceae	C	G	
Aristolochia maurourum	Aristolochiaceae	R	H	
Arum palaestinum	Araceae	C	G	
Asparagus aphyllus	Liliaceae	C	V	20
Asphodelus aestivus	Liliaceae	C	G	
Astragalus bethlehemiticus	Papilionaceae	C	C	
Astragalus epiglottis	Papilionaceae	F	A	
Astragalus tribuloides	Papilionaceae	C	A	
Atractylis cancellata	Compositae	F	A	
Atractylis comosa	Compositae	C	H	

Avena barbata	Gramineae	C	A	
Avena sterilis	Gramineae	C	A	
Ballota saxatilis	Labiatae	C	C	3
Ballota undulata	Labiatae	C	C	11
Bellevalia flexuosa	Liliaceae	C	G	
Biscutella didyma	Cruciferae	C	A	
Brachypodium distachyon	Gramineae	C	A	
Briza major	Gramineae	C	A	
Briza minor	Gramineae	R	A	
Bromus alopecurous	Gramineae	C	A	
Bromus madretensis	Gramineae	C	A	
Bromus tectorum	Gramineae	C	A	
Calendula arvensis	Compositae	C	A	
Calycotome villosa	Papilionaceae	C	S	10
Campanula erinus	Campanulaceae	C	A	
Campanula rapunculus	Campanulaceae	C	H	
Capparis spinosa	Capparaceae	C	S	5
Carduus argentatus	Compositae	C	A	
Carlina hispanica	Compositae	C	H	
Carthamus glaucus	Compositae	C	A	
Carthamus tenuis	Compositae	C	A	
Catananche lutea	Compositae	C	A	
Centaurea iberica	Compositae	C	A	
Ceratonia siliqua	Caesalpiniaceae	C	T	2
Ceterach officinarum	Aspleniaceae	C	H	
Chaetosciadium trichospermum	Umbelliferae	C	A	
Cichorium pumilum	Compositae	C	A	
Cistus creticus	Cistaceae	C	C	37
Cistus salvifolious	Cistaceae	C	C	24
Clematis cirrhosa	Runanculaceae	C	V	2
Clypeola jonthlaspi	Cruciferae	C	A	
Conium maculatum	Umbelliferae	F	H	
Convolvulus siculus	Convolvulaceae	C	A	
Coridothymus capitatus	Labiatae	C	C	20
Coronilla scorpioides	Papilionaceae	C	A	
Crataegus aronia	Rosaceae	C	T	8
Crepis hierosolymitana	Compositae	C	A	

Crepis sancta	Compositae	C	A	
Crucianella macrostachya	Rubiaceae	C	A	
Cruciata articulata	Rubiaceae	C	A	
Cupressus arizonica	Cupressaceae	C	T	2
Cupressus macrocarpa	Cupressaceae	C	T	
Cupressus sempervirens	Cupressaceae	C	T	16
Cyclamen persicum	Primulaceae	C	G	
Dactylis glomeratum	Gramineae	C	H	
Datura innoxia	Solanaceae	F	A	
Daucus carrota	Umbelliferae	C	A	
Dianthus strictus	Caryophyllaceae	C	H	
Echium angustifolium	Boraginaceae	C	C	
Ephedra aphylla	Ephedraceae	C	S	6
Erodium acaulis	Geraniaceae	C	A	
Erodium malacoides	Geraniaceae	C	A	
Erodium moschatum	Malvacea	C	A	
Eryngium creticum	Geraniaceae	C	H	
Euophorbia peplus	Euphorbiaceae	C	A	
Fibigia clypeata	Cruciferae	C	C	
Filago contracta	Compositae	C	A	
Filago pyramidata	Compositae	C	A	
Fumana arabica	Cistaceae	C	C	25
Fumana thymefolia	Cistaceae	C	C	5
Galium judaicum	Rubiaceae	C	A	
Galium murale	Rubiaceae	C	A	
Geranium molle	Geraniaceae	C	A	
Geropogon hybridus	Compositae	C	A	
Gladiolus italicus	Iridaceae	F	G	
Gundelia tournefortii	Compositae	F	H	
Gynandriris sisyrinchium	Iridaceae	C	G	
Hedypnois rhagadioloides	Compositae	C	A	
Helianthemum salicifolium	Cistaceae	C	A	
Helichrysum sanguineum	Compositae	C	H	
Heliotrobium routundifolium	Boraginaceae	C	C	
Heliotropium europaeum	Boraginaceae	C	A	
Hippocrepis unisiliquosa	Papilionaceae	C	A	
Hirschfeldia incana	Cruciferae	C	A	

Hordeum bulbosum	Gramineae	C	H	
Hymenocarpos circinnatus	Papilionaceae	C	A	
Hyparrhina hirta	Gramineae	C	H	
Hypericum lanuginosum	Hyperaceae	C	C	
Inula viscosa	Compositae	C	S	
Iris palaestina	Iridaceae	R	G	
Isatis lusitanica	Cruciferae	C	A	
Kickxia aegyptiaca	Scrophulariaceae	C	C	8
Lactuca tuberosa	Compositae	C	H	
Lagoecia cuminoides	Umbelliferae	C	A	
Lamarckia aurea	Gramineae	C	A	
Lathyrus aphaca	Papilionaceae	C	A	
Lathyrus blepharicarpus	Papilionaceae	C	A	
Leontice leontopetalum	Berberidaceae	R	G	
Leontodon tuberosa	Compositae	C	H	
Linum pubscens	Linaceae	C	A	
Linum strictum	Linaceae	C	A	
Lolium rigidum	Gramineae	C	A	
Lonicera etrusca	Caprifoliaceae	C	V	3
Lotus peregrinus	Papilionaceae	C	A	
Malcolmia chia	Cruciferae	R	A	
Medicago coronata	Papilionaceae	C	A	
Medicago rugosa	Papilionaceae	R	A	
Mercurialis annua	Euphorbiaceae	C	A	
Micromeria fruticosa	Labiatae	C	C	4
Micromeria myrtifolia	Labiatae	C	C	
Micromeria nervosa	Labiatae	C	C	21
Minaurtia hybrid	Caryophyllaceae	C	A	
Nigella ciliaris	Runanculaceae	R	A	
Noaea mucronata	Chenopodiaceae	C	C	
Nonea ventricosa	Boraginaceae	C	A	
Notobasis syriaca	Compositae	C	A	
Olea europaea	Oleaceae	C	T	
Onobrychis caput-galli	Papilionaceae	C	A	
Onobrychis squarrosa	Papilionaceae	C	A	
Ononis mollis	Papilionaceae	R	A	
Ononis natrix	Papilionaceae	C	C	

Ononis ornithopodiodes	Papilionaceae	R	A	
Ophrys bornmuelleri	Orchidaceae	R	G	
Orchis caspia	Orchidaceae	C	G	
Orchis galilaea	Orchidaceae	R	G	
Origanum syriacum	Labiatae	C	C	5
Ornithogalum narbonense	Liliaceae	C	G	
Osyris alba	Santalaceae	C	C	6
Pallens spinosa	Compositae	C	H	
Parietaria judaica	Urticaceae	C	A	
Paronychia argentea	Caryophyllaceae	C	C	
Paronychia sinaica	Caryophyllaceae	R	C	
Phagnalon rupestre	Compositae	C	C	8
Phlomis viscosa	Labiatae	C	S	13
Phragmites australis	Gramineae	C	H	
Picnomon acarna	Compositae	C	A	
Picris altissima	Compositae	C	A	
Pinus halapensis	Pinaceae	C	T	50
Piptatherum miliaceum	Gramineae	C	H	
Pistacia lentiscus	Anacardiiaceae	C	T	7
Pistacia palaestina	Anacardiiaceae	C	T	22
Plantago afra	Plantaginaceae	C	A	
Plantago cretica	Plantaginaceae	C	A	
Poa bulbosa	Gramineae	C	H	
Prasium majus	Labiatae	C	S	22
Pterocephalus plumosus	Dipsaceae	C	A	
Pyrus syriaca	Rosaceae	F	T	
Quercus calliprinos	Fagaceae	C	T	43
Ridolfia segetum	Urticaceae	C	A	
Reseda alba	Resedaceae	C	A	
Rhagadiolus stellatus	Compositae	C	A	
Rhamnus palaestina	Rhamnaceae	C	S	44
Rhus coriaria	Anacardiiaceae	C	T	
Ricinus communis	Euphorbiaceae	C	T	
Rochelia disperma	Boraginaceae	O	A	
Rosa canina	Rosaceae	R	S	
Rubia tenuifolia	Rubiaceae	C	V	13
Ranunculus asiaticus	Runanculaceae	C	G	

Salvia dominica	Labiatae	C	C	
Salvia hierosolymitana	Labiatae	C	H	
Salvia indica	Labiatae	R	H	
Salvia palaestina	Labiatae	R	H	
Sarcopotrium spinosum	Rosaceae	C	C	53
Satureja thymbra	Labiatae	C	C	
Scabiosa prolifera	Dipsaceae	C	A	
Scandix pecten-veneris	Umbelliferae	C	A	
Scorpiurus muticus	Papilionaceae	C	A	
Scorzonera papposa	Compositae	C	H	
Scutellaria subvelutina	Labiatae	C	H	
Sedum sediforme	Crassulaceae	F	C	
Sideritis pillulans	Labiatae	C	H	
Silene muscipula	Caryophyllaceae	R	A	
Silene vulgaris	Caryophyllaceae	C	H	
Sinapis alba	Cruciferae	C	A	
Smilax aspera	Liliaceae	C	V	11
Sonchus oleraceus	Compositae	C	A	
Stachys neurocalycina	Labiatae	C	A	
Stipa bromoides	Gramineae	C	H	
Stipa capensis	Gramineae	C	A	
Styrax officinalis	Styracaceae	C	T	5
Tamus communis	Dioscoreaceae	C	V	2
Taraxacum cyprium	Compositae	C	H	
Tetrapogon villosus	Gramineae	R	H	
Teucrium capitatum	Labiatae	C	C	11
Teucrium creticum	Labiatae	F	C	3
Teucrium divaricatum	Labiatae	C	C	37
Theligonum cyanocrambe	Theliugonaceae	C	A	
Thesium humile	Santalaceae	R	A	
Thymbra spicata	Labiatae	F	C	
Tolpis varigata	Compositae	C	H	
Torilis arvensis	Urticaceae	C	A	
Trachynia distachys	Gramineae	C	A	
Tragopogon coelesyriacus	Compositae	C	H	
Trifolium campestre	Papilionaceae	C	A	
Trifolium cheleri	Papilionaceae	F	A	

Trifolium clypeatum	Papilionaceae	C	A	
Trifolium pilulare	Papilionaceae	F	A	
Trifolium scabrum	Papilionaceae	C	A	
Trifolium stellatum	Papilionaceae	C	A	
Trifolium tomentosum	Papilionaceae	C	A	
Trigonella berythea	Papilionaceae	F	A	
Tulipa systola	Liliaceae	R	G	
Umbilicus intermedius	Crassulaceae	C	H	
Urginea maritima	Liliaceae	C	G	
Urospermum picroides	Compositae	C	A	
Valantia hispida	Rubiaceae	C	A	
Varthemia iphionoides	Compositae	C	C	16
Verbascum jordanicum	Scrophulariaceae	C	C	
Verbascum sinaiticum	Scrophulariaceae	C	H	
Vicia hybrid	Papilionaceae	C	A	
Vicia palaestina	Papilionaceae	C	A	
Ziziphora capitata	Labiatae	F	A	
Ferns (two species)		R	H	

Dominant trees and shrubs were *Pinus halapensis, Rhamnus palaestina, Quercus calliprinos, Sarcopotrium spinosum, Cistus creticus* and *Teucrium divaricatum. Fumana arabica, Cistus salvifolious, Pistacia palaestina, Micromeria nervosa, Asparagus aphyllus* and *Coridothymus capitatus*, were found in fairly good numbers. *Calycotome villosa, Crataegus aronia, Origanum syriacum, Pistacia lentiscus*, and *Styrax officinalis* were less common in the reserve and require special attention.

Many other species with very low constancy such as *Ballota saxitilis, Lonicera etrusca* (Figure 1A), *Teucrium creticum, Ceratonia siliqua, Clematis cirrhosa, Tamus communis, Anagyris foetida, Arbutus andrachne, Astragalus bethlehemiticus, Echium angustifolium, Noea mucronata, Pyrus syriaca, Rosa canina* (Figure 1B), *Rhus coriaria, and Saturja thymbra. Rosa canina* is a rare species on the country level. Some species were found outside the quadrates and were also rare such as *Salvia indica* (Figure 1C), *Thymbra spicata, Ophrys bornmuelleri* and *Orchis galilaea* (Figure 1D). The last two species are orchids and were at the end of the blooming period.

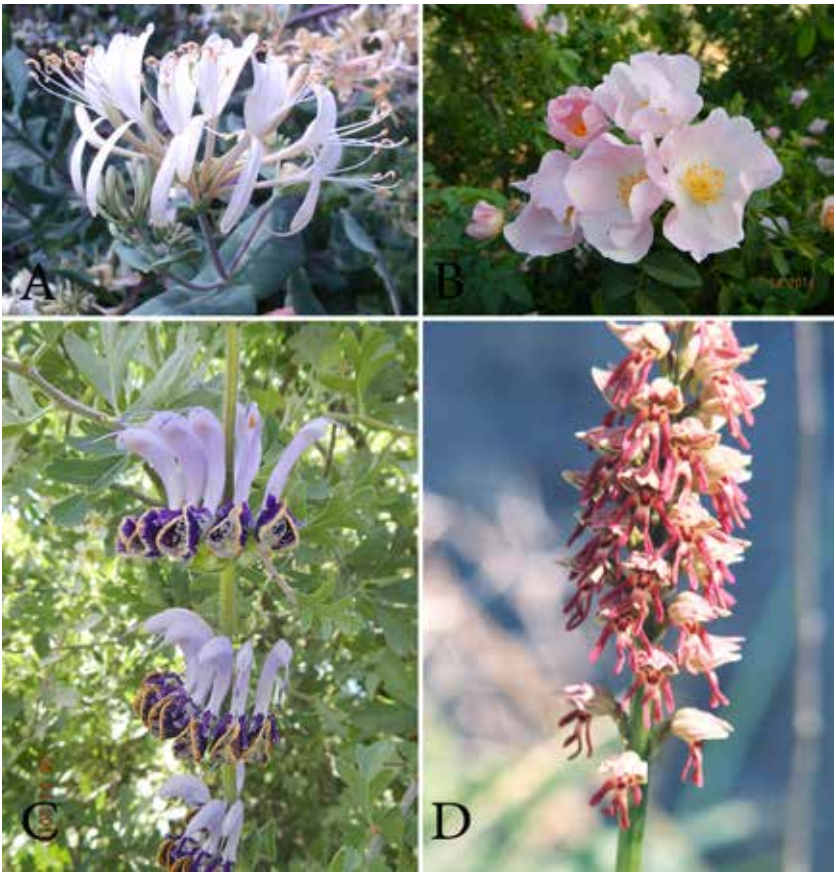

Figure 1. A. *Lonicera etrusca*. **B.** *Rosa canina*. **C.** *Salvia indica*. **D.** *Orchis galilaea*.

DISCUSSION

We noted rich plant biodiversity in the study area including some interesting and rare elements (Table 1). There are several threats affecting the ecosystem in the area. But we can state that as far as the flora is concerned, major threats include overgrazing, harvesting trees and medicinal plants, fires, and pollution due to human encroachment. Those threats caused degradation affecting the abundance of many species in the reserve and we are particularly concerned about *Origanum syriaca, Salvia indica*, and *Salvia palaestina*. We recommend limiting human disturbance for few years to allow recovery and better management of the flora. This includes preventing harvesting of medicinal plants and economically useful plants like *Salvia hierosolymitana* and

Crataegus aronia, preventing grazing, preventing fires and picnicking outside of Tarqumya park, closing the quarry which is very close to the reserve, and preventing solid and liquid waste disposal in park boundaries. We must also raise public awareness and education on the importance of this reserve. Long-term measures may include reintroduction of the rare plants especially the natural trees and shrubs of the Mediterranean climate through collecting seeds to propagate them in the nursery of the Ministry of Agriculture which is already present in WAQ.

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Avifaunal baseline assessment of Wadi Al-Quff Protected Area and its Vicinity, Hebron, Palestine

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ABSTRACT

Birds of Wadi Al-Quff protected area (WQPA) were studied during the spring season of 2014. A total of 89 species of birds were recorded. Thirty species were found to breed within the protected area (24 resident and 6 summer breeders), while the others were migratory. Three species of raptors (Long legged Buzzard, Short-toed Eagle and the Hobby) were found to breed within man-made afforested area, nesting on pine and cypress trees. Within the Mediterranean woodland patches, several bird species were found nesting such as Cretzschmar's Bunting, Syrian Woodpecker, Sardinian Warbler and Wren. Thirteen species of migratory soaring birds were recorded passing over WQPA, two of them (Egyptian Vulture and Palled Harrier) are listed by the IUCN as endangered and near threatened, respectively. In addition, several migratory soaring birds were found to use the site as a roosting area, mainly at pine trees.

Key words: Birds; Palestine; Endangered species.

INTRODUCTION

The land of historical Palestine (now Israel, West bank and Gaza) is privileged with a unique location between three continents; Europe, Asia, and Africa, and a diversity of climatic regions (Soto-Berelov *et al*., 2012). For this reason and despite its small area, a total of 540 species of bird were recorded (Perlman & Meyrav, 2009). In addition, Palestine is at the second most important migratory flyway in the world. Diverse species of resident, summer visitor breeders, winter visitor, passage migrants and accidental visitors were recorded (Shirihi, 1996). Each year over 500 million birds migrate through/over Palestine and adjacent countries, from their breeding grounds in Eurasia during the autumn migration season to their wintering ground in Africa, before repeating this journey in reverse during the subsequent spring (Leshem & Yom-Tov, 1996, 1998; Alon *et al*., 2004). The land of Palestine also serves as an important migration route and wintering ground for more than 250 bird species and a breeding ground for more than 200 resident and summer visitor breeders (Perlman & Meyrav, 2009; Shirihi *et al*., 2000). Other species

are either accidental visitors or went extinct in the last couple of centuries, such as the Ostrich (Shirihi, 1996). Despite the rich avifauna of historical Palestine, there is not much information about bird species existing within the West Bank and Gaza (Palestinian Territories) and there is not a complete checklist of the birds of West Bank and Gaza, but the estimated number of birds is about 367 species (Khalilieh, in preparation).

Very little information is known about the birds of the West Bank and Gaza Strip. The most recent publication about the birds of historical Palestine is dated back to 1996 (Shirihi, 1996) and most of the information does not focus on the avifauna of the West Bank and Gaza Strip. The objectives of this study are: 1) to conduct the first bird survey for WQPA and to establish a species list, 2) to determine breeding species of WQPA, 3) to show the importance of WQPA to migratory soaring birds, 4) to understand the effect of the man-made coniferous forest on the distribution of the breeding birds.

METHODS

Description of the Study Area

Wadi Al-Quff protected area (WQPA) is located in the the Hebron Governorate (31°34'47.19"N and 35° 2'27.40"E) within the Mediterranean climatic region. It is charecterized by hills, steep slopes, several wadies and open rocky areas. It includes a man-made coniferous forest, and in some parts patches of natural Mediterranean plantations are found. The habitat of WQPA and its vicinity can be divided into four types: **1**) man-made forest (MF) dominated by coniferous trees of *Pinus halepensis* and *Cupressus sempervirens*. **2**) Natural plantations (NP), including trees that are emerging as a response to cutting coniferous trees by human or uprooting by extreme weather conditions, or as plant associations where the coniferous trees are in low density and sun can penetrate to the ground. These species include *Quercus calliprinos, Pistacia palaestina, Pistacia lentiscus, Ceratonia siliqua, Rhamnus palaestina*, and *Crataegus aronia*. **3**) Agriculture areas planted with different kind of orchards (AP) mainly at Wadi Hasaka. **4**) Natural open slopes of rocky habitats with scattered trees and rather low vegetation (OS). The area also contains several water sources such as Wadi Hasaka spring, located at the south western part of WQPA (Figure 1).

Field survey

Field surveys were conducted between mid-January and end of May, 2014. Different methods were used to study bird's diversity; for the bird baseline and breeding bird survey point counts were used according to (Bibby *et al*., 2000, Gregory *et al*., 2004), where the distance between points was predefined as 400 m apart. Consequently a total of 54 points were chosen using Google map in order to cover the whole area of WQPA and the different habitats within the protected area and its close vicinity (Figure 1). For the survey

of migratory soaring birds, vantage points were selected at high elevation within the site that provide a clear view of the area and the sky to observe migratory soaring birds that pass through the site and its close vicinity.

Each point count was surveyed for ten minutes preceded by two minutes through which the researcher waited for the birds to settle down and get accustomed to the researcher presence. All heard birds (singing or calling) and/or seen from each point count were recorded. Each point count was surveyed at least three times, once every month, between March and May and the 54 point counts were surveyed in 8 days. The survey was carried out in the early mornings (immediately after sunrise, around 05:30) and was stopped as soon as the weather got too warm and the bird activity was noticed to decline (around 09:00 am). The researcher also recorded bird species while crossing from one point count to another when possible, and any casual or opportunistic observations of birds obtained while walking/driving to the point counts were recorded and added to the list. During the survey, the researcher was equipped with binoculars, telescope, digital camera with telephoto lens, mp3 player and speakers, bird calls, bird field guide, GPS, notebook and data sheet. The researcher recorded the common name of the species, its location, and the bird's status and whenever possible a picture of the recorded birds was taken. Besides that, any observation of roosting migratory soaring birds that were observed during this survey was recorded, including their numbers.

The breeding bird survey was combined with a baseline survey during the spring season and extended to the third week of May. The same 54 point counts and methodology were used. In addition, during the survey, the researcher took additional information of any species that showed signs of breeding such as the typical breeding calls, breeding territorial behavior, birds carrying food or nesting materials, birds feeding chicks, or birds that were found building nests.

After completing the baseline and the breeding bird survey on every day of the survey, the researcher moved to the vantage point (north of the protected area, see Figure 1). The researcher spent the rest of the day until sunset (between 09:30-17:00) at the vantage point to record all soaring migratory species on passage, the total number of birds passing over the study area through the day. In addition, the researcher recorded birds that were roosting in the site overnight, the number of birds that come to roost in the site in the evenings, and the exact roosting locations were recorded when possible. At the vantage point, the researcher was equipped with binoculars, telescope, digital camera with telephoto lens, bird field guide, and notebook and data sheet. The researcher recorded the common name of the species and whenever possible a picture of the recorded birds was taken.

Figure 1. Location of point counts (yellow flags) and vantage point for soaring birds (red flag)

RESULTS

A total of 89 species of birds were recorded during the survey period between mid-January and end of May from WAQPA. This includes breeding birds (resident and summer breeders), passage migrants including migratory soaring birds and winter visitors. The total number of breeding birds at WAQPA and its vicinity is 30 species; twenty four of them are resident breeders while six species are summer visitor breeders (Table 1). Six species were confined to the man-made pine forest which include Jay, Short-toad Snake Eagle (Figure 2A), Eurasian Hobby, Eurasian Sparrowhawk, Long-legged Buzzard (Figure 2B) and Common Kestrel (Figure 2C). Six species were recorded breeding within natural plantations and agricultural orchards which include Spectacled Bulbul, Common Blackbird, Syrian Woodpecker, Sardinian Warbler and Graceful Prinia. Nine breeding species were found to inhabit open slopes of rocky areas and/or creeks, these species include Black-eared Wheatear (Figure 3C), Scrub Warbler, Little Owl (Figure 2D), Crested Lark, Eurasian Eagle Owl, Blue-rock Thrush, Western Jackdaw, Common Cuckoo, and Eurasian Hoopoe. Four breeding species were found in agricultural orchards including Laughing Dove, Winter Wren, Turtle Dove and House Sparrows. The remaining four breeding species-European Greenfinch, Chukar, Great Tit, and Common Linnet-were found to breed in two or more habitats (Table 1).

Table 1. Recorded breeding bird species at WQPA.

English Name	Scientific Name	Status *	Habitat **
Short-toed snake Eagle	*Circaetus gallicus*	PM, SB	MF
Eurasian Sparrowhawk	*Accipiter nisus*	PM, sb	MF
Hobby	*Falco subbuteo*	PM, SB	MF
Turtle Dove	*Streptopelia turtur*	PM, sb	AO
Black-eared Wheatear	*Oenanthe hispanica*	PM, SB	OS
Long-legged Buzzard	*Buteo rufinus*	RB	MF
Common Kestrel	*Falco tinnunculus*	RB	MF
Chukar	*Alectoris chukar*	RB	MF, NP
Spectacled Bulbul	*Pycnonotus xanthopygos*	RB	NP, AO
Blackbird	*Turdus merula*	RB	NP, AO
Graceful Prinia	*Prinia gracilis*	RB	NP, AO
Scrub Warbler	*Scotocerca inquieta*	RB	OS
Great Tit	*Parus major*	RB	NP, AO, MF
Palestine Sunbird	*Nectarinia osea*	RB	NP, AO
Eurasian Jay	*Garrulus glandarius*	RB	MF
Eurasian Hoopoe	*Upupa epops*	RB, pm	OS, NP
Collared Dove	*Streptopelia decaocto*	RB, RD	MF, AO
Laughing Dove	*Streptopelia senegalensis*	RB, RD	AO
Little Owl	*Athene noctua*	RB	OS
Syrian Woodpecker	*Dendrocopos syriacus*	RB, RD	NP, AO
Crested Lark	*Galerida cristata*	RB	OS
House Sparrow	*Passer domesticus*	RB, RD	AO
Eagle Owl	*Bubo bubo*	Rb?, rd	OS
Sardinian Warbler	*Sylvia melanocephala*	RB, wv	NP, AO
Eurasian Wren	*Troglodytes troglodytes*	RB, wv	AO
Blue Rock Thrush	*Monticola solitarius*	RB, wv	OS
European Greenfinch	*Carduelis chloris*	RB, wv	MF, AO
Common Linnet	*Carduelis cannabina*	RB, wv	NP, OS
Western Jackdaw	*Corvus monedula*	RB,wv	OS
Common Cuckoo	*Cuculus canorus*	SB, PM	OS

*Status abbreviation; RB: Resident Breeder, PM: Passage migrant, SB: Summer Breeder, WV: Winter visitor.
**Habitat abbreviation; see description of study site.

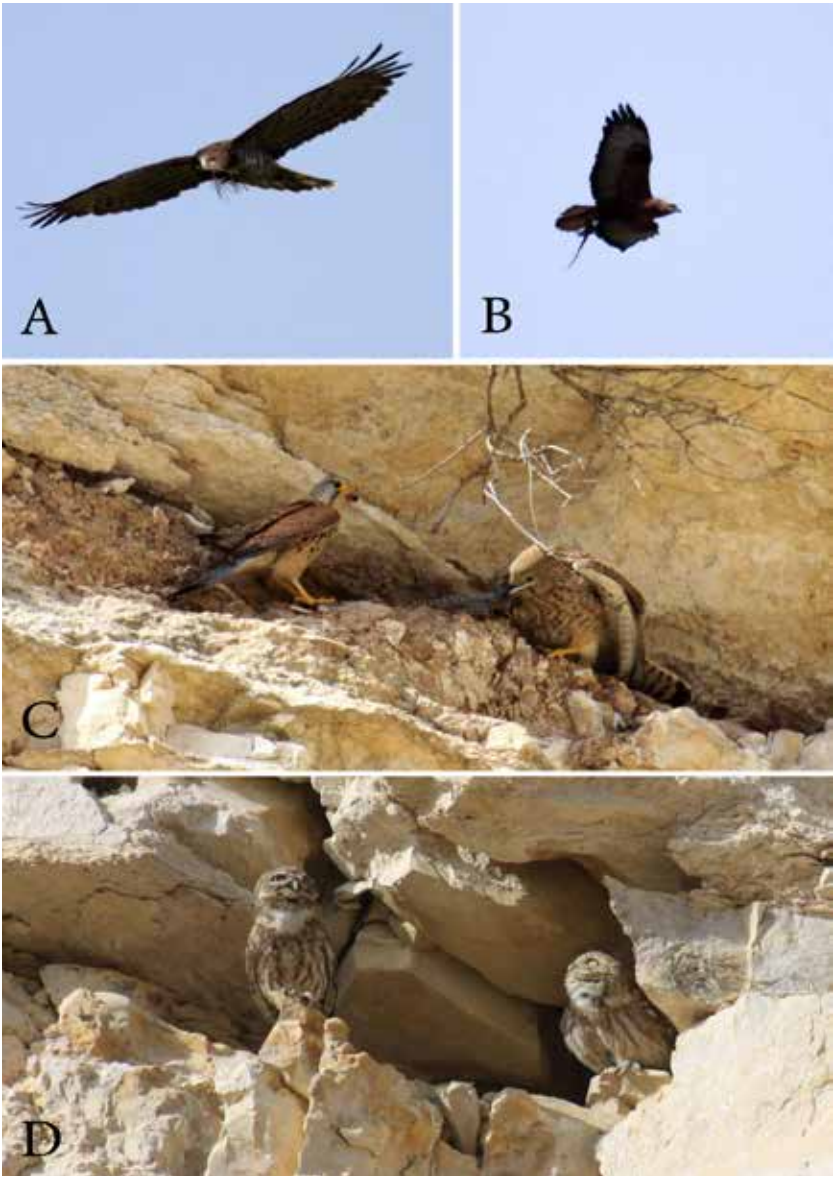

Figure 2. A. Short- toed Eagle carrying nesting materials. **B.** Long-legged Buzzard carrying a lizard to feed its chicks. **C.** A pair of breeding Kestrels at WAQ protected area. The female is feeding on a reptile species. **D.** A pair of breeding Little Owls standing in front of their nest in a rocky edge at WAQPA (Wadi Hasaka)

Figure 3. A. Female Sardinian Warbler foraging at WAQPA. **B.** Male Sardinian Warbler. **C.** The Black-eared Wheatear: a summer breeder at WAQ. **D.** Wren protecting and declaring its breeding territory. **E.** Cretzschmar's Bunting: a migrant and summer breeder. The bird is collecting nesting materials to build its nest at WAQPA.

The breeding of recorded species was confirmed since the survey was carried out during the breeding season of almost all species of the forested habitat in the Mediterranean climate region. Some resident species were present in high densities, and dominated the bird communities at WAQPA forested area. These included Chukar, Jay, Sardinian Warbler (Figure 3A & B), Blackbird, Spectacled Bulbul, Great Tit and Collared Dove. Other species of lower densities are Laughing Dove (near settlement), Hoopoe, Graceful Prinia, Palestine Sunbird, House Sparrow (near settlement) Syrian Woodpecker, Common Linnet and Greenfinch. WAQ forested area is found to be an important area for some resident birds of prey: we found one nest of Long-legged Buzzard, two nests of Little Owls and two nests of Kestrels. We also recorded the presence of the Eagle Owl during different days of survey within about the same location, which might indicate that this species could be breeding at nearby areas of WQPA while foraging within the protected area. In addition, WQPA is an important breeding area for some summer breeding birds of prey, which includes two pairs of Short-toed snake Eagle and one pair of Eurasian Hobby. Other bird species were found to breed in the area; this includes the Winter Wren (Figure 3D) (5 pairs were found to breed in Wadi Hassaka), Scrub Warbler, Blue Rock Thrush, Crested Lark and Western Jackdaw.

A total of 59 bird species that were recorded at WQPA are not breeding species: 48 of them are considered as an exclusive passage migrant, while the other 11 species have mixed populations of passage migrant and/ or winter visitors (Table 2).

Table 2. Non breeding species recorded at WQPA.

English Name	*Latin Name*	Status
White Stork	*Ciconia ciconia*	PM
Black Stork	*Ciconia nigra*	PM
Black Kite	*Milvus migrans*	PM
Egyptian Vulture	*Neophron percnopterus*	PM
Marsh Harrier	*Circus aeruginosus*	PM
Pallid Harrier	*Circus macrourus*	PM
Levant Sparrowhawk	*Accipiter brevipes*	PM
Steppe Buzzard	*Buteo buteo vulpinus*	PM
Lesser Spotted Eagle	*Aquila pomarina*	PM
Booted Eagle	*Hieraaetus pennatus*	PM
Common Crane	*Grus grus*	PM
European Nightjar	*Caprimulgus europaeus*	PM
Common Swift	*Apus apus*	PM
Pallid Swift	*Apus pallidus*	PM

Alpine Swift	*Apus melba*	M
European Bee-eater	*Merops apiaster*	PM
Eurasian Wryneck	*Jynx torquilla*	PM
Barn Swallow	*Hirundo rustica*	PM
Red-rumped Swallow	*Hirundo daurica*	PM
Eurasian Crag Martin	*Ptyonoprogne rupestris*	PM
Common House Martin	*Delichon urbica*	PM
Tawny Pipit	*Anthus campestris*	PM
Tree Pipit	*Anthus trivialis*	PM
Meadow Pipit	*Anthus pratensis*	PM
Thrush Nightingale	*Luscinia luscinia*	PM
Common Nightingale	*Luscinia megarhynchos*	PM
Common Redstart	*Phoenicurus phoenicurus*	PM
Isabelline Wheatear	*Oenanthe isabellina*	PM
Northern Wheatear	*Oenanthe oenanthe*	PM
Rufous-tailed Rock Thrush	*Monticola saxatilis*	PM
Olivaceous Warbler	*Hippolais pallida*	PM
Olive-tree Warbler	*Hippolais olivetorum*	PM
Orphean Warbler	*Sylvia hortensis*	PM
Barred Warbler	*Sylvia nisoria*	PM
Lesser Whitethroat	*Sylvia curruca*	PM
Common Whitethroat	*Sylvia communis*	PM
Garden Warbler	*Sylvia borin*	PM
Eastern Bonelli's Warbler	*Phylloscopus orientalis*	PM
Wood Warbler	*Phylloscopus sibilatrix*	PM
Willow Warbler	*Phylloscopus trochilus*	PM
European Pied Flycatcher	*Ficedula hypoleuca*	PM
Eurasian Golden Oriole	*Oriolus oriolus*	PM
Red-backed Shrike	*Lanius collurio*	PM
Woodchat Shrike	*Lanius senator*	PM
Masked Shrike	*Lanius nubicus*	PM
Ortolan Bunting	*Emberiza hortulana*	PM
Cretzschmar's Bunting	*Emberiza caesia*	PM
Spotted Flycatcher	*Muscicapa striata*	PM,
Common Stonechat	*Saxicola torquatus*	PM, wv
Song Thrush	*Turdus philomelos*	pm, wv
Blackcap	*Sylvia atricapilla*	PM, wv

Brambling	*Fringilla montifringilla*	pm, wv
Corn Bunting	*Miliaria calandra*	PM, WV
Chiffchaff	*Phylloscopus collybita*	PM, WV
Common Chaffinch	*Fringilla coelebs*	pm, WV
European Serin	*Serinus serinus*	pm, WV
White Wagtail	*Motacilla alba*	wv
European Robin	*Erithacus rubecula*	WV
Black Redstart	*Phoenicurus ochruros*	WV

The total number of soaring birds recorded from the vantage point was 571 birds, belonging to 13 species of migratory soaring birds (Table 3). This number is not comparable to other bottleneck sites of soaring birds in Palestine, such as Jericho, where thousands of soaring birds are recorded. In addition, there were three species of migratory soaring birds that used WAQPA for roosting, mainly at pine and cypress trees, these include the Short-toed Snake Eagle, Steppe Buzzard, and Black Kite, with a total number of 17, 47 and 9 birds recorded, respectively. Two species recorded migrating over WAQPA are of global concern (IUCN Redlist): the Egyptian Vulture (Endangered), and the Pallid Harrier (Near Threatened).

Table 3. Soaring birds recorded passing over and/or roosting at WAQPA and their numbers.

English Name	*Latin Name*	Status	Number
White Stork	*Ciconia ciconia*	PM	40
Black Stork	*Ciconia nigra*	PM	17
Black Kite	*Milvus migrans*	PM	43
Egyptian Vulture	*Neophron percnopterus*	PM	1
Short-toed Eagle	*Circaetus gallicus*	PM	110
Marsh Harrier	*Circus aeruginosus*	PM	1
Pallid Harrier	*Circus macrourus*	PM	1
Eurasian Sparrowhawk	*Accipiter nisus*	PM	2
Levant Sparrowhawk	*Accipiter brevipes*	PM	26
Steppe Buzzard	*Buteo buteo vulpinus*	PM	54
Lesser Spotted Eagle	*Aquila pomarina*	PM	5
Booted Eagle	*Hieraaetus pennatus*	PM	2
Common Crane	*Grus grus*	PM	269

DISCUSSION

The results showed that the distribution of recorded breeding bird species was affected by the man-made coniferous forest and the examined habitat within WQPA. For example, many breeding species were only found within the natural habitat such as the Sardinian Warbler, Wren, Blackbird, Spectacled Bulbul, and they were absent from the man-made coniferous forest. Other species, such as the Jay which is considered as a pest, was found to dominate the coniferous forest. In addition, the Jay was also found to forage within the natural patches and affected the survival of other species that inhabit the natural habitat.

The presence of the Wren was not expected since the distribution of this species is limited to the northern areas where Jerusalem is its southern most breeding site (Shirihai, 1996). The Wren was found in five different locations within Wadi Hasaka, and was recorded three times within the natural plantation of the Mediterranean shrub land during March. This indicates that the Wren breeds at Wadi Hasaka and disperses during the winter season to the natural habitats of the forest.

The Sardinian Warbler, Great Tit, Blackbird and the Spectacled Bulbul were found to be common breeders at WQPA, mainly within the natural habitat of the forest and near orchards. The Chuckar was also one of the most common resident birds all over WQPA and its vicinity. Other species have their breeding territories restricted to the open rocky habitat with low vegetation such as Scrub Warbler, Black-eared Wheatear and Crested lark. Other species such as Cretzschmar's Buntings (Figure 3E), Common Linnets and Common Cuckoo were found to breed in open habitat with rocky slopes and scattered trees with low vegetation, in Wadi margins with sparse vegetation and shrubs. Two pairs of Syrian woodpecker were found to breed in fields with mixed groves of trees (natural and Orchards).

The results of the recorded migratory soaring birds, during the spring migration season, indicates that WAQ protected area is not an important migratory route for soaring birds during spring migration season as they are not passing through the area in large numbers. However, the site is important roosting area for some of these species such as the Short-toed Eagle, Steppe Buzzard and the Black Kite: several of these species were found roosting overnight at several locations within WAQ. It is worth mentioning that two important species of soaring birds were recorded passing over the site which are the Egyptian Vulture (Endangered) and Pallid Harrier (Near Threatened). Nevertheless, the survey of the migratory soaring birds has been done on one migration season (spring season) while it must be done, at least, during two seasons (Spring and autumn) in order to indicate if the site is an important migration route for the soaring birds. This is because the soaring birds use different migration route during each migration

season while crossing the Levant (Leshem *et al*., 1996). So, it might be that the site has significant importance for the soaring birds during the autumn migration season.

We believe that the number of species using the protected area throughout the year will exceeds the recorded number of migratory species. Further research is needed to be carried out during the autumn and winter migration season in order to record all bird species that inhabit WQPA all year round.

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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.

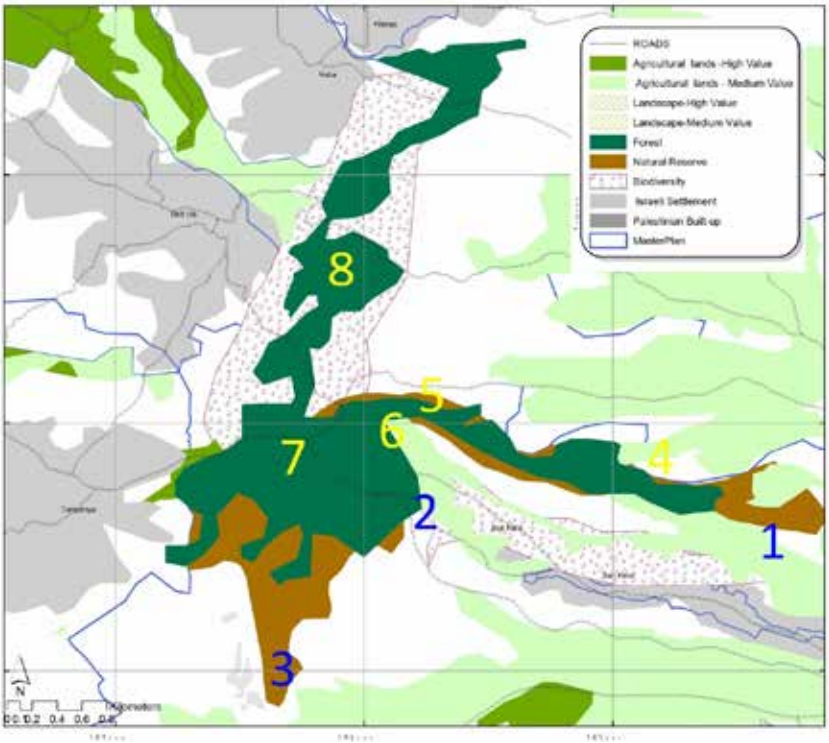

Figure 1. Habitat types of the WAQ area. Numbers in blue (1, 2 and 3) indicate water sources of significance for vertebrate biodiversity and numbers in yellow indicate habitats that we noted with significant for other conservation value discussed in detail (Figure adjusted from a baseline map by Applied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