
Invertebrate Fauna of Wadi Al-Quff Protected Area, Palestine

Mazin Qumsiyeh

Palestine Museum of Natural History and Palestine Institute of Biodiversity and Sustainability, Bethlehem University

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 weneri*. 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*, *Physidae* and *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 *Papilio* 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	<i>Papilio machaon syriacus</i>	Syrian swallowtail
Pieridae	<i>Colotis fausta fausta</i>	Large Salmon Arab
	<i>Euchloe charlonia</i>	Lemon White
	<i>Pieris (Artogtia) rapae leucosoma</i>	Small white
	<i>Pieris brassica</i>	Large White butterfly
	<i>Pontia daplidice</i>	Bath White
	<i>Pontia glauconome</i>	Desert white

	<i>Anaphaeis (Belonis) aurota</i>	White Caper
	<i>Gonepteryx cleopatra</i>	Cleopatra
	<i>Maniola telmessia</i>	Eastern Meadow Brown
Nymphalidae	<i>Lasiommata maera</i>	Large Wall Brown
	<i>Melitaea deserticola macromaculata</i>	Fritillarity
	<i>Melitaea telona</i>	
	<i>Melitaea trivia syriaca</i>	Lesser Spotted Fritillary
	<i>Vanessa cardui</i>	Painted Lady
	<i>Polygonia egea</i>	Southern Comma
	<i>Ypthima asterope</i>	African Ringlet
	<i>Melanargia titeititani</i>	Levantine Marbled
Lycanidae	<i>Lycaena thersamon</i>	Small Copper Butterfly
	<i>Freyeria trochylus</i>	Grass Jewel
	<i>Polyommatus icarus</i>	Common Blue
Hesperiidae	<i>Spialia orbifer</i>	
	<i>Thymelicus sylvestris</i>	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	<i>Hyleslineataor livornica</i>
Zygaenidae	<i>Zygaena graslini</i>
Saturnidae	<i>Saturniapyri sp.</i>
Geometridae	<i>Scopulacminorata.</i>
	<i>Gymnoscelis sp.</i>
	<i>Phaiogramma sp.</i>
	<i>Dicrognophus sp</i>
	<i>Ascotis sp.</i>
	<i>Idaea cf. ochrata</i>
	<i>Idaea sp.</i>
	<i>Lithostege palestinesis</i>
	<i>Rhodostrophia tabidaria</i>
	<i>Ortaliella palaestinesis</i>
	<i>Ortaliella sp.</i>
	<i>Acanthovalva sp</i>
Arctiidae	<i>Cymbalophora (Euprepia) oertzeni</i>
Lasiocampidae	<i>Lasiocampa grandis</i>

	<i>Dendrolimus bufo</i>
Lymantriidae	<i>Orgyia</i> sp.
Erebidae	<i>Catocala</i> cf <i>sana</i>
	<i>Dysgonia</i> algira
	<i>Polypogon</i> sp.
Noctuidae	<i>Aedia</i> sp.
	<i>Acronicta</i> sp
	<i>Eublemma</i> sp.
	<i>Euxoa</i> sp.
	<i>Condica</i> sp
	<i>Cryphia</i> spp.
	<i>Cucullia</i> sp.
	<i>Noctua</i>
	<i>Thysanoplusia daubei</i>
Plutellidae	<i>Plutella</i> sp.
Pyralidae	Several unidentified specie
Nolidae	Three unidentified species
Yponomeutidae	<i>Prays oleae</i>
	<i>Yponomeuta albonigratus</i>



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	<i>Calopteryx syriaca</i>
Platycnemididae	<i>Platycnemis</i> sp.
Epallagidae	<i>Epallage fatima</i>

Family Psychodidae (Sandflies)

We have two sand fly species (one is a *Phlebotomus*) 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 Cerambycidae (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	<i>Anacridium aegyptium</i>
	<i>Doclostaurus (Stauronotulus) hauensteini</i>
	<i>Heteracris syriaca</i>
	<i>Oedipoda aurea</i>
	<i>Prionosthenus galericulatus</i>
	<i>Pyrgomorpha (Pyrgomorpha) conica</i>
	<i>Truxalis procera</i>

CLASS ENOGNATHA

Subclass Collembola

At least four species of Springtails (*Collembola*: 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, the 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	<i>Argiope cf. trifasciata</i>
Dysderidae	<i>Dysadera cf. crocuta</i>
Lycosidae	<i>Hogna sp.</i>
Salticidae	<i>Phlegra cf. fasciata</i>
Theraphosidae	<i>Chaetopelma olivaceum</i>
Thomisidae	<i>Thomisus onustus</i>
Zoropsidae	<i>Zoropsis sp.</i>

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	<i>Scolopendra cingulata</i>
Scutigeridae	<i>Scutigera coleoptrata</i>
Himantariidae	<i>Bothriogaster signata</i>
Geophilidae	<i>Pachymertium ferrugineum</i>
	<i>Geophilus sp.</i>

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 (Gårdenfors *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	<i>Limax</i> sp
Sphinterochilidae	<i>Sphinterochila fimbriata</i>
	<i>Sphinterochita cariosa</i>
Helicidae	<i>Eubania vermiculata</i>
	<i>Helix (Pelasga) engaddensis</i>
	<i>Levantina (spiriplana) caesareana</i>

	<i>Levantina lithophaga</i>
Hygromiidae	<i>Monacha syriaca</i>
	<i>Eopolita sp.</i>
Enidae	<i>Bulliminus labrosus</i>
	<i>Euchondrus septemdentatus</i>
	<i>Paramastus episomus</i>
Chondrinidae	<i>Granopupa granum</i>

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).

ACKNOWLEDGEMENTS

We are grateful to Dr. Zuhair Amr, Mohammad Abusarhan, Mubarak Zawahreh, Michael Salsaa and Shadi Adawi.

REFERENCES

- Abdallah, T. & Swaileh, K. 2011. Effects of the Israeli Segregation Wall on biodiversity and environmental sustainable development in the West Bank, Palestine. *International Journal of Environmental Studies*, 68:543-555.
- Abusarhan, M.A., Handal, E.N., Ghattas, M.M., Amr, Z.S. & Qumsiyeh, M.B. 2016. Some records of butterflies (Lepidoptera) from the Palestinian Territories. *Jordan Journal of Biological Sciences*, 9(1):11-23.
- Abusarhan M., Amr, Z.S., Ghattas, M., Handal, E.N. & Qumsiyeh, M.B. 2017. Grasshoppers and locusts (Orthoptera: Caelifera) from the Palestinian territories at the Palestine Museum of Natural History. *Zoology & Ecology*, 27:143-155.
- Amr Z.S. & Abu Baker, M. 2004a. Freshwater snails of Jordan. *Denisia*, 14:221-227.
- Amr Z.S. & Abu Baker, M. 2004b. The scorpions of Jordan. *Denisia*, 14:237-244.
- Amr, Z. S., & Al-Oran, R. 1994. Systematics and distribution of scorpions (Arachnida, Scorpionida) in Jordan. *Bollettino di Zoologia*, 61:185-190.
- Azim, M. A. & A. Gismann 1956. Bilharziasis survey in south-western Asia: Covering Iraq, Israel, Jordan, Lebanon, Sa'udi Arabia, and Syria: 1950-51. *Bulletin of the World Health Organization*, 14(3):403-456.
- Bdir, S. & G. Adwan. 2011. Larval stages of digenetic trematodes in *Melanopsis praemorsa* snails from freshwater bodies in Palestine. *Asian Pacific Journal of Tropical Biomedicine*, 1:200-204.

- Bdir, S. & G. Adwan. 2012. Three new species of cercariae from *Melanopsis praemorsa* (L. 1758, Buccinum) snails in Al-Bathan fresh water body, Palestine. *Asian Pacific Journal of Tropical Biomedicine*, 2: S1064-S1069.
- EQA (Environmental Quality Authority). 2014. Management Plan for Wadi Al-Quff Protected area. Ramallah.
- Gärdenfors, U., Waldén, H.W. & I. Wäreborn. 1995. Effects of soil acidification on forest land snails. *Ecological Bulletins*, 44: 259-270.
- Geiger, D.L., Marshall, B.A., Ponder, W.F., Sasaki, T. & Warén, A. 2007. Techniques for collecting, handling, preparing, storing and examining small Molluscan specimens. *Molluscan Research*, 27(1):1–50.
- Germain, L. 1921-1922. Mollusques Terrestres et Fluviatilis de Syrie. - Paris, Vol. 1 (1921):523 pp.; Vol. 2 (1922):243 pp.
- Graveland, J., van der Wal, R., van Balen, J.H. & van Noordwijk, A.J.. 1994. Poor reproduction in forest passerines from decline of snail abundance on acidified soils. *Nature*, 368: 446–448.
- Handal, E.N., Amr, Z.S. & Qumsiyeh, M.B.. 2015. Some records of freshwater snails from the Occupied Palestinian territories. *Jordan Journal of Natural History*, 2:23-29.
- Heller, J. 2009. Land Snails of the Land of Israel. Natural History and Field Guide. Pensoft (Sofia- Moscow).
- Heller, J., Mordan, P., Ben-Ami, F. & Sivan, N. 2005. Conchometrics, systematics and distribution of *Melanopsis* (Mollusca: Gastropoda) in the Levant. *Zoological Journal of the Linnean Society*, 144: 229-260.
- Levy, G. 1985. Fauna Palaestina (Arachnida II). Araneae: Thomisidae. The Israel Academy of Sciences and Humanities, Jerusalem.
- Levy, G. 1988. Fauna Palaestina (Arachnida III). Araneae: Theridiidae.. The Israel Academy of Sciences and Humanities, Jerusalem.
- Levy, G., & Amitai, P. 1980. Fauna Palaestina. Arachnida I: Scorpiones. The Israel Academy of Science and Humanities, Jerusalem.
- Levy, G. & Shulov, A. 1964. The Solifuga of Israel. *Israel Journal of Zoology*, 13(3): 102-120.
- Lewis, R.E. 1967. The fleas (Siphonaptera) of Egypt. An illustrated and annotated key. *Journal of Parasitology*, 53(4):863-885.
- Millar, I.M., Uys, V.M. & Urban, R.P. (editors). 2000. Collecting and preserving insects and Arachnids: A Manual for Entomology and Arachnology. SAFRINET, the Southern African (SADC) LOOP of BioNET-International.
- Milstein D., Mienis H.K. & Rittner, O. 2012. A Field Guide to the Molluscs of Inland Waters of the Land of Israel. Nature and Parks Authority,

- Jerusalem, Israel.
- Qumsiyeh, M.B. 2014. Nature museums and botanical gardens for environmental conservation in developing countries. *Bioscience*, 67 (7):589-590.
- Qumsiyeh, M.B., Salman, I., Salsaa', M. & Amr, Z.S. 2013. Records of scorpions from the Palestinian Territories, with the first chromosomal data (Arachnida: Scorpiones), *Zoology in the Middle East*, 59: 70-76.
- Qumsiyeh, M.B., Amr, Z., AbuSrour, K. & Al-Fawaghra, N. 2014. The karyotype of the Diplocentrid Nebo with comments on scorpion chromosomal evolution. *Cytologia*, 79(2):1-4.
- (RSCN) Royal Society for the Conservation of Nature 2005. Field Research Manual. RSCN, Amman, Jordan.
- Sama G., Buse, J., Orbach, E., Leib, A., Friedman, L., Rittner, O. & Chikaturnov, V. 2010. A new catalogue of the Cerambycidae (Coleoptera) of Israel with notes on their distribution and host plants. *Mun. Ent. Zool.*, 5(1):1-52.
- Sturm, C.F., T.A. Pearce, & Á. Valdés (eds). 2006. The Mollusks: A Guide to Their Study, Collection, and Preservation. American Malacological Society. Pittsburgh.
- Tristram, H.B. 1884: The Survey of Western Palestine. The Fauna and Flora of Palestine. London: The Committee of the Palestine Exploration Fund, xxii+455 pp.
- Vachon, M. 1966. Liste des scorpions connus en Egypte, Arabie, Israel, Liban, Syrie, Jordanie, Turquie, Irak, Iran. *Toxicon*, 4: 209-218.
- Vachon, M. 1974. Etude des caracteres utilises pour classer les familles et les genres de Scorpions (Arachnides). *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 3:857-895.
- Zonstein, S. & Y.M. Marusik. 2013. Checklist of the spiders (Araneae) of Israel. *Zootaxa*. 3671 (1):1-127.