Results under Output 1: Faunal Survey/Initial faunal and habitats for animals evaluation

Biodiversity Conservation and Community Development in Al-Makhrour Valley in Bethlehem, Palestine

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Introduction

This project titled "Biodiversity Conservation and Community Development in Al-Makhrour Valley in Bethlehem, Palestine" is a British and Palestinian collaboration to conserve biodiversity in Al-Makhrour Valley of Bethlehem (Palestine) benefitting the local communities through sustainable use of ecosystem services. The area is recognized as a UNESCO world heritage site. A literature, desk-top, was conducted relating the biophysical and natural environment of the site. The desk-top cover the published information of previous papers, books and technical ecological and biodiversity reports available. This literature review included biogeographic zones, bio-climatic zones, ecosystems, key biological habitat, sensitive and important habitat, specdiversity with concentration on red list and indicator (see part 1 here

https://app.luminpdf.com/viewer/cE66ke5vJknCufSzL/share?sk=bc34372d-80bf-4f77-bfa9-a253dd46895c)

The objectives of this project included (a) full biodiversity assessment including producing a management plan, (b) promoting agriculture/green practices and ecotourism, and (c) reducing human impact via environmental awareness and education programs while promoting sustainable lifestyles. Project outputs delivered will focus on biodiversity conservation, traditional farming reviving, eco-tourism enhancement, and capacity building. All activities will be done supported with project committees' consultation, gender inclusion, media coverage, and evaluation. The main partner is the Palestine Institute for Biodiversity and Sustainability (PIBS) and the Palestine Museum of Natural History (PMNH) at Bethlehem University (BU) and with three junior partners: PCC (Pioneer Consultancy Center for Sustainable Development, represented by Ms. Roubina Ghattas who is doing the plant survey), Byspokes CIC Sustainable Community Development (England, represented by Alice Gray), and the Institute for Community Partnership at Bethlehem University (represented by Moussa Rabadi) and with collaboration and consultation with the Environmental Quality Authority (EQA) and other key stakeholders (Ministry of Tourism and Antiquities, Ministry of Education, Ministry of Agriculture, local authorities, farmers, environmentalists and more, see below). The project is funded by Darwin Initiative (grant number 25-030; internal BU grant number 10-295). We have a complimentary grant from National Geographic Society that covers exploratory issue of the valley and helped us cover some work unfunded by this grant (ie. the two grants are mutually reinforcing but not competitive). Below is an interim report based on each of our proposed objectives and activities.

Materials and Methods for Faunal Biodiversity Study

In the period of this reporting we expanded our desktop and explotratory literature work and human interactions to produce a more detailed mapping of the area before our intensified field study (see study report of this posted at https://app.luminpdf.com/viewer/cE66ke5vJknCufSzL/share?sk=bc34372d-80bf-4f77-bfa9-a253dd46895c Darwin Study 1). We conducted first yeatr biodiversity inventory for Al-Makhrour valley including studying habitats, flora/fauna/birds, values of biodiversity, threats using scientific methods such as RSCN (2005) and Braun and Blanquet methodology (species richness, distribution and others)(CMP 1978). This work is still ongoing to result in preparing biodiversity Conservation Action and Master plan for the valley with conservation frameworks and restoration schemes for selected habitats using CMP model (1978) IUCN guidelines and GIS/RS analysis. We want to alos

make recommendation long term to restore key habitats upon further consultation (mostly cultivation of native tree species).

Refinement of Study Site

The four biogeographical zones identified in Palestine (Mediterranean, Irano-Turanian, Saharo-Arabian, Ethiopian-Sudanese) identified in Palestine were mapped based on plant distribution by Zohary (1947) and have been used with little modification since. Soto-Berelov et al. (2015) refined and added to these things and noted changes both recent and in historic and prehistoric times. The Mediterranean Zone has special and rich biodiversity that is threatened and considered key hot-spot for biodiversity conservation (Myers et al., 2000). This Mediterranean Zone in Palestine stretches from the Haifa and Galilee region across the hills and slopes (especially those facing west to the Mediterranean zone all the way down to Hebron. In the southern region, we have areas designated as protected areas with Mediterranean Habitats especially in the Hebron region such as Al-Quff and Al-Qarn areas (Qumsiyeh et al. 2016).

We carried three exploratory trips to valley to plan our future work and visit the key sites and select sites for study. The first trip focused on Al-Makhrour valley itself plus Cremisan Valley (done on 05/09/2018). The second on the villages of Battir and Al-Walaja (19/09/2018), and the third on Husan village (24/09/2018). The three trips considered ideas of adding three areas to our study (Figure 1).

Wadi Al-Makhrour is a valley located about 7 km south of the old city of Jerusalem and about 6 km northeast of the old city of Bethlehem. It is connected to other valley systems stretches from the Walaja and Cremisan valleys to the South of Jerusalem and takes in the water of the Makhrour itself (between Beit Jala, Al-Khader, and Al-Walaja) to drain into the Battir and then Husan and Nahhalin valleys. Al-Makhroor is an important part of the system that refills the water aquifer of Bethlehem District area and the fresh water springs pass from the center of old trees plant there. The area is the last remaining biodiversity-rich area south of Jerusalem and in Bethlehem and Jerusalem districts. The valley is mentioned early in travel books (e.g. Robinson, 1856). Excavations in the valley show humans used the bounty of the valley from Middle Bronze Age (Rapoport 2006) going through use in the Iron Age, Persian, Hellenistic, and early Islamic Periods until today (Dagan 2010). Wadi Al-Makhrour sensu strictu is 2.6 Km^2 of natural areas interspersed with agriculture and rich flora and fauna (Amr et al., 2016) also with an equivalent buffer zone of an area more than 5 km^2 was initially selected for study (Figure 1). It is also one of the rich biodiversity areas according to the government and of 13 important bird areas per BirdLife International (see below) in Palestine. It is also rich in cultural heritage, including old Roman tombs, wells along with old Palestinian watchtowers. However, no environmental management plans or conservation programs have been implemented by any organization in the area. As the valley is located in Area C it suffers from diverse pressures: (1) habitat loss and land fragmentation; causing biodiversity loss, (2) challenging livelihood conditions as a result of the lack of economic motivations, no subsidies for farming practices, and inadequate markets for extra production and others. It is an area estimated to have rich biodiversity (see maps in Levin & Shmida 2007) and was designated by the Palestinian authority as a biodiversity hotspot. The Bethlehem Governorate between Hebron and Jerusalem has only one remaining rich habitat based on our preliminary studies: that is the Makhrour Wadi and Hill System.

Battir in 2014 was submitted for UNESCO under title "Palestine, lands of Olives and Vines, Cultural Landscape of southern Jerusalem" and immediately included on the List of World Heritage in Danger, after it was acknowledged that the landscape was threatened by emerging and intensifying sociocultural and geopolitical transformations with the potential to cause irreversible damage to the site's authenticity and integrity. The World Heritage Site stretches from Al-Makhrour Valley to Battir village to Al-Aion Valley in Hussan including traditional footpaths , various human settlements that developed around the many springs that dot the slopes of the mountains, that have contributed to the creation of a unique cultural landscape composed of agricultural terraces that are supported by dry-

stone walls, agricultural watchtowers (manatir or qusoor), olive oil presses, ancient irrigation pools to collect the water flowing from the springs, ancient irrigation canals, and the remains of human settlements (khirab),were conserved by the local villagers (Battir, Hussan, and Beit Jala) for centuries.

Based on these maps and that initial exploratory field work we decided to study the whole valley of Al-Makhrour and Al-Uyunn valley behind Battir and Husan in other words the whole UNESCO world heritage site (Figure 1). The world heritage property which covers an area of 481 hectare core property, 631 hectare buffer zone, and 133 hectare residential areas inside Battir for a total of 1112 hectares.

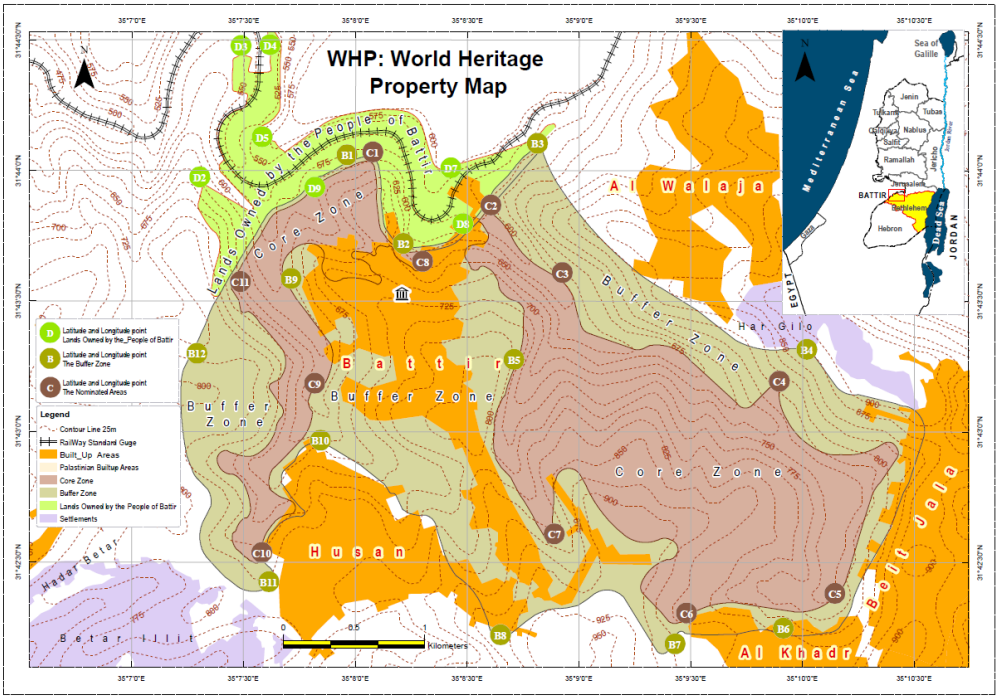

Figure 1 World Heritage site that includes Al-Makhrour valley near Husan and Battir (MOTA, 2018) decided upon as the area for biodiversity study and monitoring.

Methods for different faunal elements

Via consultation with the biodiversity oversight committee for this project the following groups were studied (in parenthesis name of person focusing on them):

- Mammal survey/inventory (Mazin & M. Abusarhan), we already have significant data using camera traps for large mammals, small traps for rodents and shrews, and echolocation data showing 10 species of bats
- Bird survey/inventory (Anton)
- Reptiles/Amphibians survey/inventory (Elias)
- Snails- very interesting data on snail biodiversity being collected from different parts of the valley, different sides of hills showing microhabitat variation
- Tenebrionidae & other beetles (Aysha)
- Leaf Litter & Soil micro fauna- again interesting data on material underneath different treas like oak and carob etc. (M. Abusarhan)
- Mushrooms (Max & Alea)
- Spiders (Aysha)
- Dragonflies & Mantids (Elias & Shadi)
- Coccinelidae (M. Najajreh)
- Endemic species

Fauna methods varied for each group of animals (Vertebrate and Invertebrate), so in this case we will describe the most important kind of methods that we used in the study to cover as much as we can of the variation in fauna specially the invertebrate groups.

Methodology for Mammals: Signs of mammals are looked for during day and night walks. This included things like footprints, feces, burrows, other potential hideouts (caves and crevices), other remains (like quills for porcupines) etc. Just before sunset (at this time around 7-8 PM), Sherman traps are set for small mammals and mist-nets were set for bats (Figure 2). Traps are collected before sunrise (at this time of year about 5-5:30 AM) and then a subsequent area sweep was done for morning animals. We will leave bait for large carnivores (sardines and raw meat but observed no activity around these except in one case by a feral dog). Bats are observed by looking for roosting sites and by echolocation calls registered between sunset/dusk and midnight. 'For bats roosting in caves, daytime collecting was undertaken by exploring caves by flashlight and specimens were collected by hand' (Qumsiyeh, Sami and Musa, Further Records of Bats From Jordan and a Synopsis 1998) . We use a simple recorder that allows frequency detection. However, by using a simple tape recorder, we can also study spacing of clicks for hunting echolocation signals. 'In this expanded study we will organize a more sophisticated recorder that can be left for hours'. (M. B. Qumsiyeh 1997) 'The arrangement and order of genera and species' (M. B. Qumsiyeh 1997).

Figure 2 Mouse traps, camera trap setting, larger mammal traps, and echolocation devise use for bats

Methodology for Reptiles and Amphibians: Both during night walks and day walks, reptiles are observed and photographed. Any signs of reptiles were also observed (such as tracks on soft surfaces or eggs in crevices or under logs). Non-poisonous reptiles were simply captured by chasing or surrounding them and then by hand. Poisonous snakes are handled with a snake stick. Frogs are best observed at night via flash light and are captured by hand. We can also identify tadpoles directly taken from the water (scooping or small net).

Methodology for birds: Birds where monitored with binoculars and documented with camera with telephoto lens usually atround sunrise to 10 AM and then again in the evening (Figure 3). The bird survey was conducted during the breeding and spring migration seasons of 2019. The survey was conducted mainly during April, in a total of 6 days. The survey comprises three main line-transects and 31 point counts (Figure 4). Since the bird survey was limited to 6 days, the purpose of this study was to focus on the breeding bird species- resident and summer visitor breeders- and to record all observed migratory species to identify the maximum species of bird and to confirm potentially breeding birds. Hence, all bird species that were seen at any point of the line-transects, point counts or while walking from one point to another were recorded. Birds considered breeding at the site if they showed breeding signs (for example, birds showed territorial behavior, carrying nesting materials, seen building nests or incubating nests, or by observed fledged birds, or adults species seen feeding chicks at /or near nesting sites). The counts were performed in the morning period, mainly between sunrise and before mid-day hours, when the birds are mostly active. A description of the habitat of each line-transect and point count was recorded during the survey. The line-transects and point counts were distributed in a way to cover the maximum areas of the site with the limited days of survey. Google Earth was used to distribute the line-transects and the point counts. The casual point count were added in the field and installed to the map after conducting the survey. Both the preassigned point counts and the casuals are merged in one category and given specific numbers (P0, P1, to P34 in Figure 4).

Figure 3 Bird monitoring early morning.

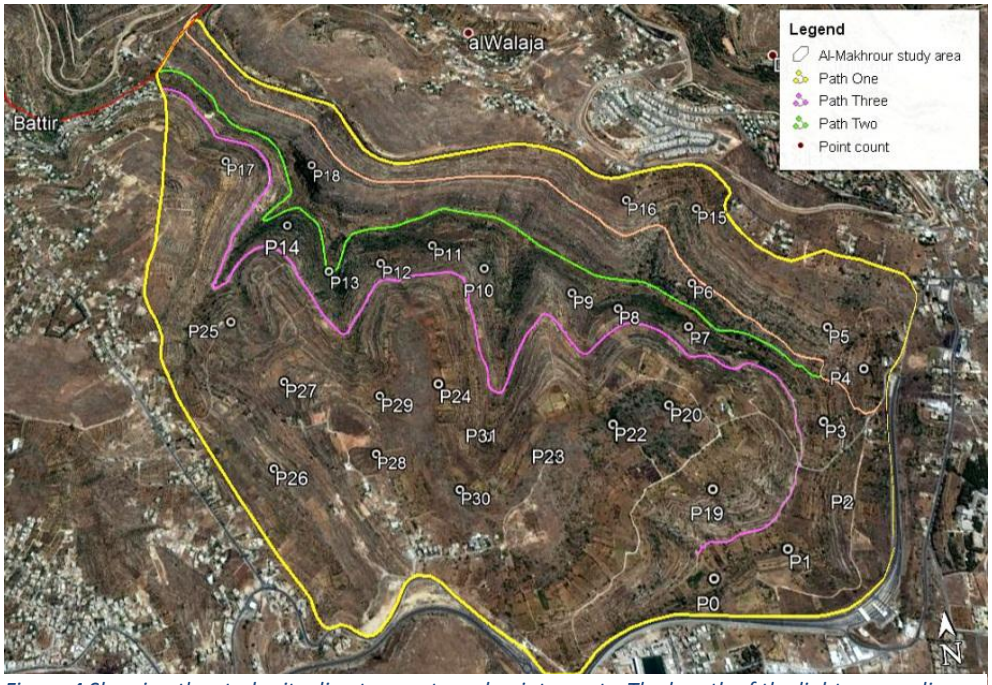

Figure 4 Showing the study site, line transects and point counts. The length of the light orange line transect is about 3.9 km, the length of the Green line-transect is 3.3 km, and the length of the pink line- transect is about 5.9km

Methodology for Mollusca: Snails are simply picked up where they occur (usually under rocks, in crevices, around trees or shrubs).

Methodology for Scorpions: Scorpions are 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 (**Error! Reference source not found.**).

Figure 5 UV loight identifies Scorpio maurus in Al-Makhrour.

Methodology for other invertebrates: Butterflies and some other flying insects are captured with a butterfly net. For moth, a fluorescent light is used at night in some locations 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. 'We will also include previous field observations during field trips conducted in different parts of Palestine during the last several years'. (Katbeh-Bader et al. 2003). Other methods used included using light trap at night to collect moths and insects males from different orders (Figure 6&Figure 7). We also studied leaf litter micro, meso- and macro- fauna.

Figure 6 Setting up an insect pitfall trap.

Figure 7 Field work in various settings.

Results

A total of 16 field tip done to Al Makhrour Valley were undertaken during the project period for the sake of the basic habitat study, faunal work, and mushroom work (see separate report for thew plants): 09/08/2018, 28-29/08/2018, 04-05/09/2018, 19-20/09/2018, 24/09/2018, 11/10/2018, 12/10/2018, 29/10/2018, 31/10/2018, 05/11/2018, 01/12/2018, 17/12/2018, 05/01/2019, 12/01/2019, 21/01/2019, and 22/02/2019**.** For examples of field work notes see https://docs.google.com/document/d/18-fZ8GmGZdYaAXswzKREN4FZkDgc-_OQHNfytDxfA-s

General features, geology, and paleontology

The first few trips identified key habitats and areas worth further investigation for the fauna. We also used existing information. The World Heritage Site stretches from Al-Makhrour Valley to Battir village to Al-Aion Valley in Hussan including traditional footpaths, various human settlements that developed around the many springs that dot the slopes of the mountains, that have contributed to the creation of a unique cultural landscape composed of agricultural terraces that are supported by dry-stone walls, agricultural watchtowers (manatir or qusoor), olive oil presses, ancient irrigation pools to collect the water flowing from the springs, ancient irrigation canals, and the remains of human settlements (khirab),were conserved by the local villagers (Battir, Hussan, and Beit Jala) for centuries.

As a part of its commitment, the Ministry of Tourism and Antiquities prepared a draft management and conservation plan for the WHS and buffer areas. The final management plan aims to expand on the existing MOTA (2018) draft management plan for this UNESCO site but also to improve self-sustainability in order to conserve the outstanding universal value (OUV) for this area. The management includes a SWOT analysis for the area and detailed recommendations including an action plan. It also includes human capacity building activities. We decided to take this as a basis for work, refinement, new plans etc.

Al-Makhrour sensu strictu is the valley (Wadi) *sensu strictu* is 2.6 Km^2 of natural areas interspersed with agriculture and rich flora and fauna (Amr *et al*., 2016) also with an equivalent buffer zone of an area more than 5 km^2 was initially selected for study (Figure 8). It is named as such because of the way the water trickles fdown the old limestone rocks (Figure 9).

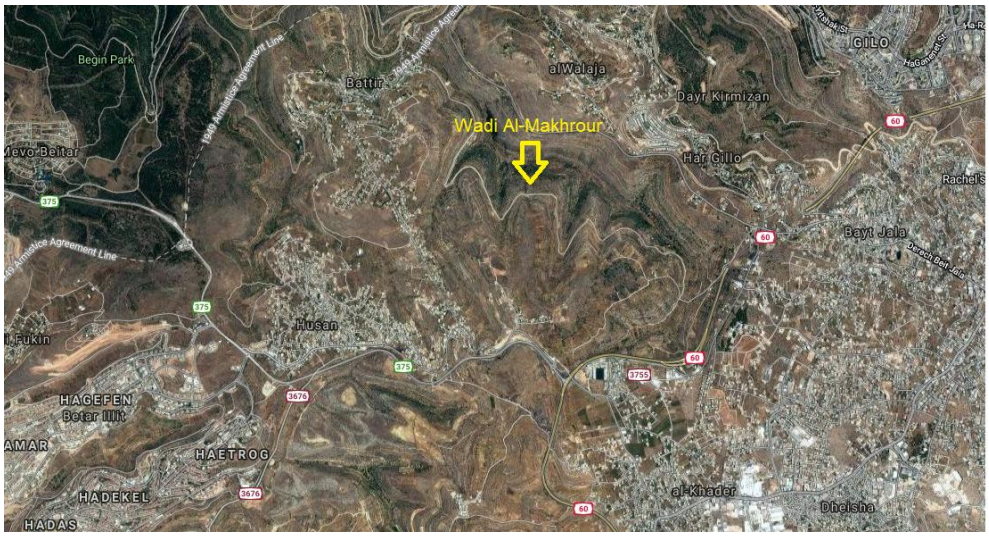

Figure 8 A map shows the location of Wadi Al-Makhrour in Bethlehem district.

Figure 9 The reason the valley is called Al-Makhrour (seepage of water).

In order to submit based on landscape considerations, the people of Battir with help of international experts from France and Italy performed a thought and highly detailed mapping of the whole area including Al-Makhrour. The resulting maps (e.g. Figure 10 & Figure 11) are a treasure trope of information on topography, land use etc.

Figure 10 Map of the area used in supporting documents submitted to UNESCO.

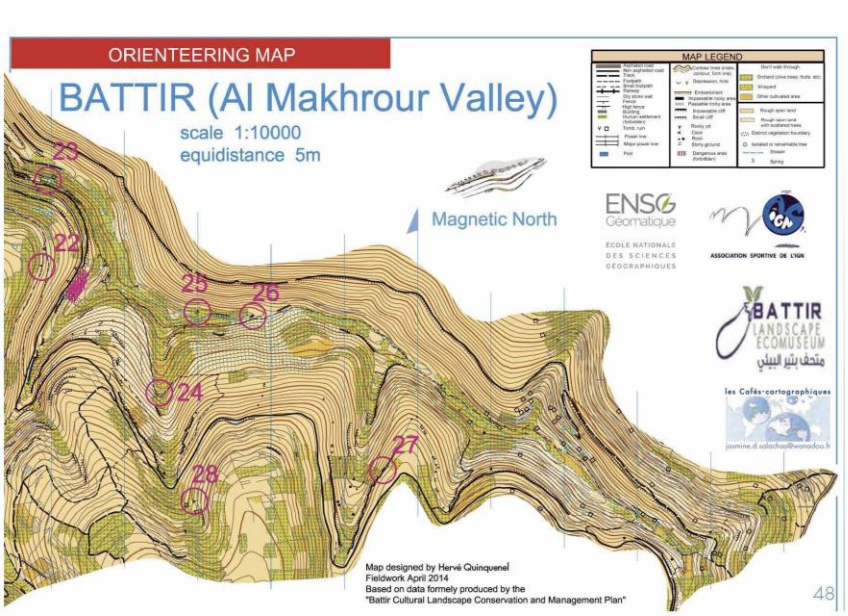

Figure 11 Topographic map of the Al-Makhrour valley used in supporting documents submitted to UNESCO.

The study site is very picturesque with deep valleys some of them terraced for hundreds or thousands of years (part of the reason it is a UNESCO World heritage Site) with typical Mediterranean vegetation and springs in the areas of Al-Walaja, Husan and Battir (e.g. Figure 12).

Figure 12 Battir pool that is used to regulate village allocation of water according to the 8 main families.

The Meditterranean habitat is a mosaic of natural and human impacted habitats (Figure 13, Figure 14 & Figure 15)

Figure 13 Train tracks (Jaffa-Jerusalem train) creates an artificial border between built-up areas and other lands of Battir village.

Figure 14 Typical valley structure in Al-Makhrour. Note different vegetation and terracing on the side facing the sun.

Figure 15 More forested areas and olive grove on the NW facing side of the valley than on the SE facing side.

Wadi Al Makhrour flows from the Beit Jalla highland in the east towards the Mediterranean in the west. The topographic slope of the Wadi in the median part is approx. 12 o -15 o , while on both sides it exceeds 25° -35° .The erosional activities that have been acting since thousands of years, had led to the exposure of the older geological strata on both sides of the Wadi. On the foots of both sides, rocks of Cenomanian age do outcrop and gently dip towards westwards; the dipping angle increases going downstream in the Wadi. The main lithology of the rocky section is composed of different calcareous beds, most of them are layered thin-bedded limestone strata in the base that grade up to be thick-bedded nodular limestone at higher latitudes where from which we extracted our herein described fossil assemblage. A survey for the Paleontology specimens from the valley were collected by the PINS\PMNH team with a geologist expert (Dr. Taleb Al Harithy) to study the fauna of the area that back for several million years to understand the status of the ecology and habitat that exist today in the area. More than 35 species of fossils were detected and Identified by experts (see Figure 16)

Figure 16 Fossils from Al-Makhrour Valley.

Al Makhrour area is well –known as the governorate's most fertile land and its traditional breadbasket. The valley is announced as Important Bird Area (IBAs) (Birdlife International, 2018a) and was designated as a Key Biodiversity Area (Birdlife International, 2018b) at national and global levels. AL Makhrour Valley and its surroundings falls in the Mediterranean botanical and zoogeographical region (Zohary, 1973) and the Mediterranean biogeographical zone (Soto-Berelov, et al. 2012). It is also an important part of the hydrological system that replenishes the western aquifer. The mean annual temperature in this area is 16˚C. The annual precipitation is between 601mm-688 mm, with

highest elevation that reaches up to 804m above sea level. The soil is mainly a mixture of terra rossa and brown rendzina (Isaac, J. et-al, 2010).

The valley also encompasses series of agricultural valleys extending along Al Makhrour Valley towards the west of Beit Jala, then towards the village of Husan, encircling the village of Battir, and extending to the neighboring village of Al Walaja to the northeast. The valley enjoys a strategic location and the availability of springs that attracted people to settle in the area and adapts its steep landscape into arable land, through developing complex irrigation system for the water supply that has led to the creation of dry walls terraces, agricultural watchtowers (manatir) locally known as palaces (qusoor), and olive presses. All were the basis for a strong presence of agriculture of olives and vegetables and others (Figure 17). The traditional system of irrigated terraces is an outstanding example of technological expertise, which constitutes an integral part of the cultural landscape. The existing landscape reflects one of the oldest farming methods known to humankind and are an important source of livelihood for local communities (MoTA, 2013).

Figure 17 Terraced agricultural fields in Battir near spring.

Figure 18 Qaiqab tree, an otherwise rare Palestinian native (Mediterranean habitat) tree found in patches but threatened in Al-Makhrour.

Geology and paleontology: Palestinian geologic studies proliferated with the increased interests of Europeans in Palestine in the second half of the 19th century (see Benzinger1895; Blanckenhorn, 1896, 1925; Lartet 1873; Lynch, 1852; Russell 1888). Recent literature showed that the tectonic movements resulted in multiple openings and closing of the sea basins and uplifts that produced the rich fossil fauna of the Eastern Mediterranean region (Lewy 1990; Ben-Avraham et al. 2002). Of the various geologic eras studied in our region, the Mid Cretaceous (particularly Cenomanian 93-100 MYA) provided an interesting assemblage of geological and paleontological material (Braun and Hirsch 1994; Philip 1978).

Most of the outcropping rocks in Bethlehem area were deposited under shallow warm sea conditions in the late Cretaceous times from the Late Cenomanian (95 million years ago) to Late Santonian (82 million years ago). The rock column starts with medium-thick fractured hard dolomitic limestone with thin marl interbreeds that grades upward to be of thick marls and chalks which dominate the whole geologic column with occasional occurrence of medium-hard, thin limestone beds. A major fault directs NE-SW lead to the sinking of the eastern part of the area relative to its western part. The outcropping of these soft and thick rock successions made them target for erosion factors leading to the formation of steep hillsides around the city of Bethlehem, especially in the eastern and northern side. As well-known in geology, these thick limy strata were also suitable sites for karst phenomena and the formation of many caverns and underground caves making the area good as shelter for first man and his cattle (Figure 19).

Figure 19 Fossils are common in the valley. The valley was sea bed for Cenomonian.

Notes on FLORA

For the flora part, please see the separate report by Roubina Ghattas (link https://drive.google.com/file/d/1op6STd7JV4u8QEb2nh9KHZA9MhosWjjg/view?usp=sharing)
In the upcoming analysis of habitats and changes in biodiversity we will relay on plants first of all then selected amnimals (see below) for monitoring over the remaining period of this project. We will also relate to earlier studies (e.g. see map of vegetation cover done five years ago in Figure 20).

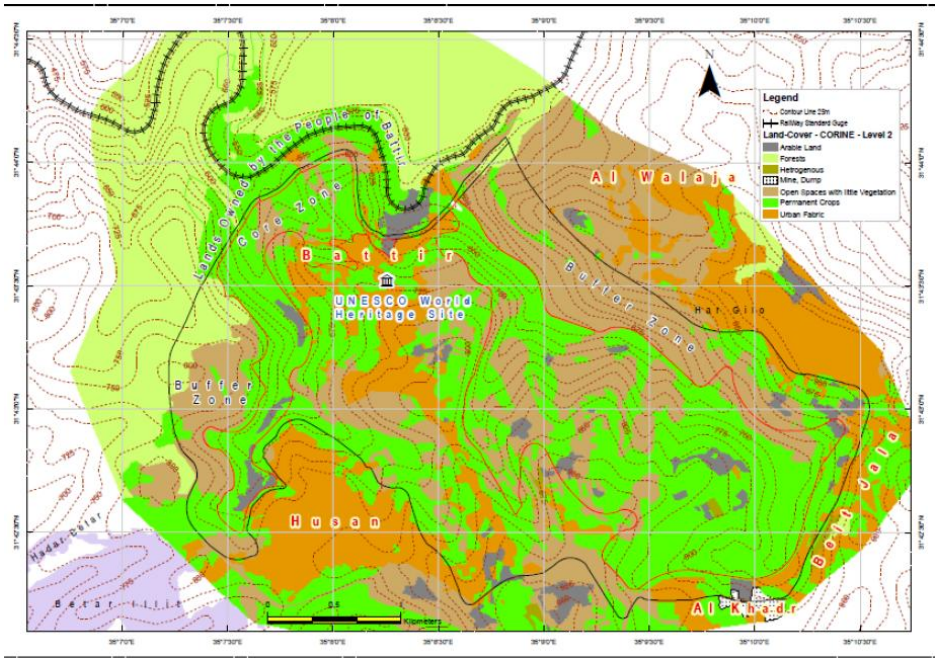

Figure 20 CORINE Classification of Land Cover including "forested" areas in the valley (MOTA 2018).

As a side benefit we emnriched our herbarium collection with some species from Al-Makhtrour (Table 1)

Table 1 selected plant species included and catalogued in the herbarium from Al-Makhrour

Number	Latin Name	Arabic Name
H7	*Trifolium clypeatum*	برسيم ترسي ابيض
H10	*Anthemis pseudocotula*	اقحوان كاذب
H14	*Erodium ciconium*	مسلة العجوز
H15	*Medicago monspeliaca (Trigonella monspeliaca)*	حلبة وحيد السداة
H16	*Anemone coronaria*	شقائق النعمان
H17	*Anagallis arvensis*	عين القط
H18	*Bellevalia flexuosa*	بصيلة الفأر
H19	*Scandix verna*	مشطية ايبيريا
H21	*Hordeum spontaneum*	شعير ابليس/شعير بري
H29	*Silene aegyptiaca*	عين البنت
H30	*Paronychia argentea*	عصا الراعي، رجل الحمامة الصخرية
H31	*Fumana arabica*	فيومانا عربية /دخانية عربية
H32	*Bromus tectorum*	خافورة متدلية
H33	*Cistus salviifolius*	لبيد ابيض
H36	*Calicotome villosa*	قنديل (قندول)
H37	*Prasium majus*	فرسيون كبير
H40	*Muscari neglectum*	بلبوس جميل
H41	*Helichrysum sanguineum*	دم الغزال، دم المسيح
H42	*Erucaria hispanica*	سليح اسباني
H43	*Lamium amplexicaule*	مقاصيص الجارية/رأس المهر
H50	*Lathyrus hierosolymitanus*	سعيسعة مقدسية
H58	*Iris vartanii*	سوسن المسطرة

FAUNA

Three species of **amphibians** were reported: *Pseudepidalea variabilis* found in Beit Jala, Walaja, Battir, *Pelophylax bedriagae* Green Frog found in spring of Al-Walaja, also in Talitha Qumi and Battir. *Hyla savignyi* the Tree Frog was found in Battir. (Figure 21)

Figure 21 Hyla savignyi tree frog a one of the species found in Al-Makhroor area.

Observations of PMNH team increased the number of species of **reptiles** to twelve (from eight reported earlier (Table 2, Figure 22). Amr *et al*., (2016) reported the remains of the *Stellagama stellio* in the diet of an eagle owl found in AL Makhrour.

Table 2 List of Reptiles and Amphibians that found in Al Makhrour Valley.

Group	Family	Scientific Name	Common Name	IUCN Status
Reptiles				
	Testudinidae	Testudo graeca	Mediterranean Spur-Thighed Tortoise	VU
	Phyllodactylidae	Ptyodactylus guttatus	Sinai Fan-Fingered Gecko	LC
	Gekkonidae	Hemidactylus turcicus	Mediterranean House Gecko	LC
	Lacertidae	Phoenicolacerta laevis	Lebanon lizard	LC
		Ophisops elegans elegans	Snake-Eyed lizard	LC
		Chalcides ocellatus		

		Ablepharus kitaibelii		
	Agamidae	Stellagama stellio brachydactyla	Rough-Tail Rock Agama	LC
	Chamaeleonidae	Chamaeleo chamaeleon	Mediterranean Chameleon	LC
	Lamprophiidae	Malpolon monspessulanus	Montpellier Snake	LC
		Hemorrhois nummifer		
		Daboia palestinae		
Amphibians				
	Bufonidae	Bufotes variabilis	Varying Toad	DD
	Ranidae	Rana		

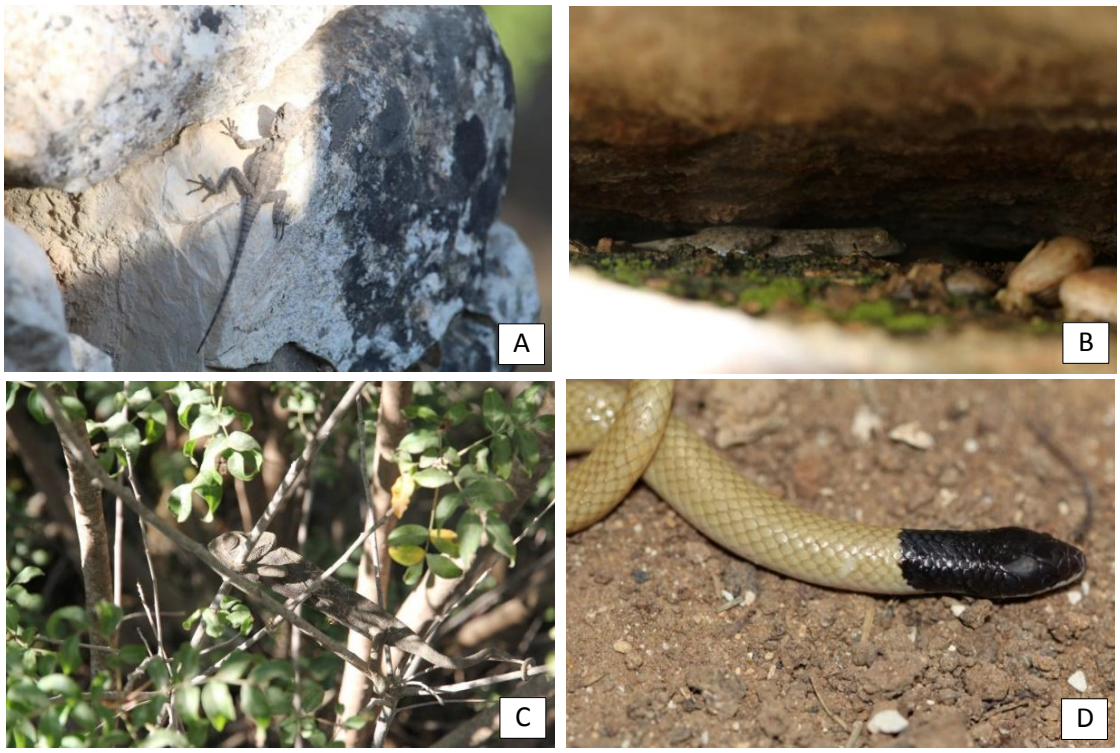

Figure 22 Some reptiles: Agama lizard (A), Gecko (ptyodactylus) (B), Chamelion (C), and Tantilla relicta (D).

Mammals: We recorded 30 species of mammals from the area (Table 3). Bats (recorded mostly via echolocation signals) and rodents were the largest orders of mammals in the area studied (Figure 23 to 26). Much deeper studies are planned for this summer. Two earlier studies done on in Bethlehem area related to Wadi Al Makhrour area with connection to mammals. In Qumsiyeh *et al*., (2014b) they shows the diversity of mammals that exist in Bethlehem district with 31 record of species from 16 family, which includes data from Al Makhrour. In the other hand a study done on the Eagle owl diet from Al Makhrour shows five species of mammals (*Erinaceus europeaus, Rattus rattus, Meriones tristrami*, *Microtus guentheri*, and *Rousettus aegyptiacus*) and a domesticated cat (Amr *et al*. 2016).

Table 3 List of Mammals that found in Al Makhrour Valley.

Family	Scientific Name	Common Name	IUCN Status
Erinacidae	Erinaceus europaeus	European hedgehog	LC
Soricidae	Crocidura leucodon	Bicolored White-toothed Shrew	LC
Pteropodidae	Rousettus aegyptiacus	Egyptian fruit bat	LC
Rhinopomatidae	Rhinopoma hardwicki	Lesser Mouse-tailed Bat	LC
	Rhinopoma microphyllum	Greater Mouse-tailed Bat	LC
Vespertilionidae	Pipistrellus kuhli	Kuhl's Pipistrelle	LC
	Pipistrellus (Hypsugo) savi	Savi's Pipistrelle	LC
	Pipistrellus pipistrellus	Common Pipistrelle	LC
	Otonycteris hemprichi	Hemprich’s long eared bat	LC
	Plecotus christiei	Long-eared plecotine bat	LC
Rhinolophidae	Rhinolophsus ferrumequinum	Greater Horseshoe Bat	LC
	Rhinolophus hipposideros	Lesser Horseshoe Bat	LC
Molossidae	Tadarida teniotis	European Free-tailed Bat	LC
Emballonuridae	Taphozous perforatus	Egyptian Tomb Bat	LC
Muridae	Apodemus mystacinus	Eastern Broad-toothed Field Mouse	LC
	Acomys cahirinus	Spiny Mouse	LC
	Rattus rattus	The Black Rat	LC
	Mus musculus	House Mouse	LC
Gerbillidae	*Meriones tristrami*	Tristram’s jird	LC
Microtinae	*Microtus guentheri*	Gunther’s field mouse	LC
Spalacidae	Nannospalax ehrenbergi	Palestine Mole Rat	DD
Hystricida	Hystrix indica	Porcupine	LC
Bovidae	Gazella gazella	Mountain Gazelle	EN
Suidae	Sus scrofa	Wild boar	LC
Hyaenidae	Hyaena hyaena	The Striped Hyena	NT
Felidae	Felis chaus	Wild Cat	T
Canidae	Canis aureus	Golden Jackal	LC
	Vulpes vulpes	Red Fox	LC
Musatellidae	Martes foina	Beech marten, Stone marten	LC
Procavidae	Procavia capensis	Cape Hyrax, Coney	LC

Figure 23 Gazella gazelle in Al-Makhrour Valley.

Figure 24 Meriones and Microtus rodent skulls in pellets of eagle owl in Al-Makhrour.

Figure 25 Camera trap image of a pack of golden jackals in Al-Makhrour.

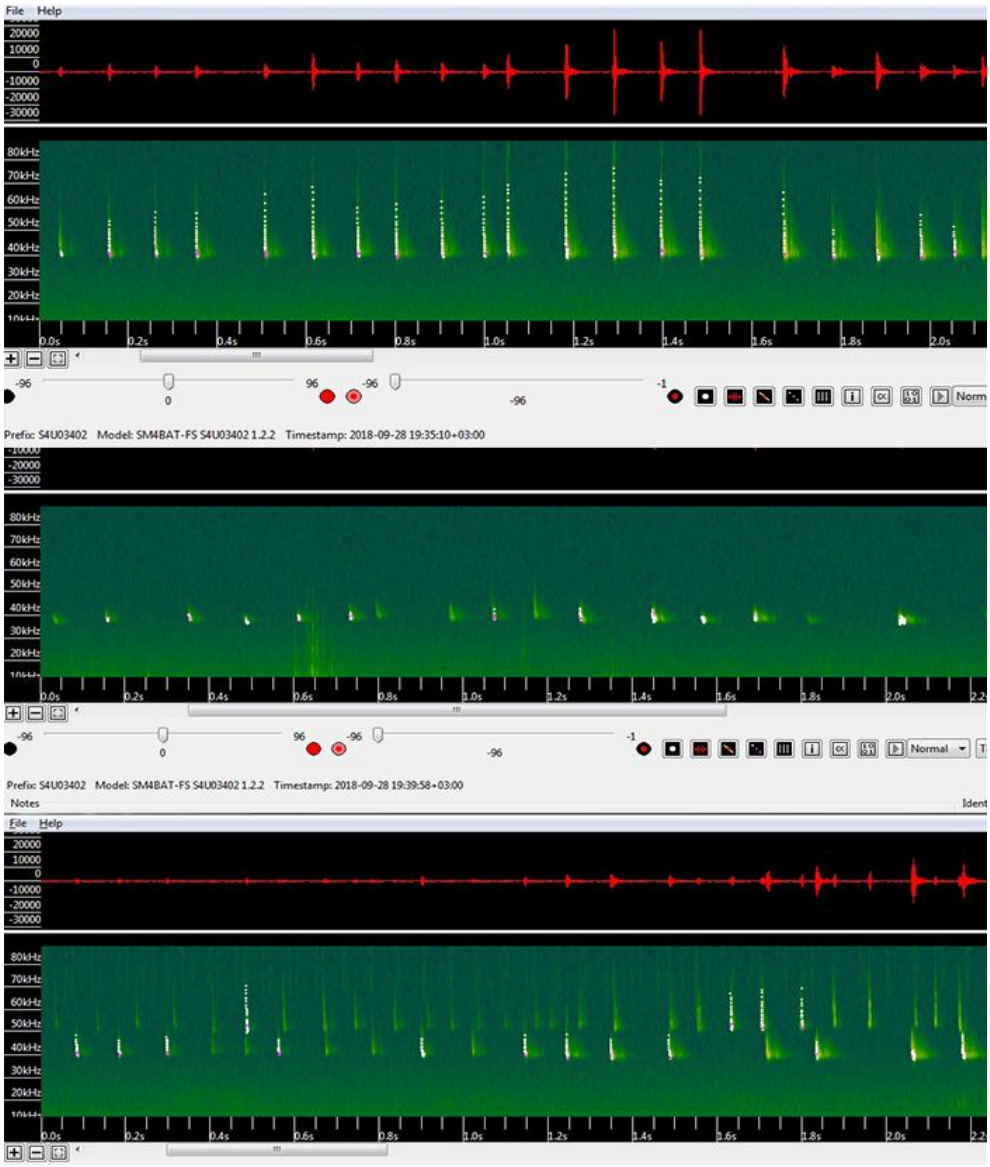

Figure 26 Bat Echolocation records from Al Makhrour Valley.

Birds: Al-Makhrour is considered part of the chain of hills hat go from Jerusalem to the West towards the Mediteranean. This and eastern areas of Jerusalem are considered as Important Bird Areas per international criteria (see Important bird areas http://datazone.birdlife.org/site/results?cty=240&fam=0&gen=0).We published one paper on the diet of the Eagle owl in Wadi Al-Makhrour which included bird species like pigeons and a dove (Amr el. 2016). Environmental Education Center (EEC) is a ringing station for birds located at Taleta Qumi which is near WM, this data could give prediction for the Avifauna that could found in the valley. EEC shows data of more than 70 species of passerine that ringed at the ringing station (Awad *et al*., 2017).

Bird Survey at Al-Makhrour Valley and its vicinity

1) General Introduction: Birds of Palestine

The birds of Palestine can be classified into four main groups. The ***Breeding species (Resident and summer breeders)***, ***The Migrant Species;*** this group of birds regularly migrates through Palestine during the spring (February to mid-may) and autumn (August to end of October) migration seasons. ***The Wintering species;*** this group of bird breeds mainly in Europe and some in Asia. They start to arrive in the second half of the autumn migration season (October-November) and the departure for most of these birds takes place during February and March. ***The last group of bird species are the Vagrants;*** these birds are accidental visitors to Palestine, they are from outside the normal migration range or wintering regions. Some of them are recorded rarely and unexpectedly, others are seen rarely but at predicted times. Consequently, the records of bird species in this group will increase if we create a large scheme of bird ringing, monitoring, and surveys throughout Palestine. However, the total number of bird species that occur in Palestine (West Bank area and Gaza) are not completely know to the Palestinians because a comprehensive bird survey was not conducted by any Palestinian institutes until now. Despite that, the total number of bird species, that belongs to the above mentioned categories can reach up to 370 species, 130 of them considered as resident breeders and/ or summer breeders.

2) Study area: Al-Makhrour Valley and its vicinity:

The study site is located in the western part of Bethlehem district, it is part of a valley system that starts from west-southern part of Beit Jala city and extend to Battir village. The site is declared by the Environmental Quality Authority as a Rich Biodiversity Area and as an Important Bird Area by the Birdlife international. However, no comprehensive data is available about the avifauna of the site that is based on systematic survey. The valley itself is about 5 km length while the total area of the study site is about 5.3 km^2. The general habitat of the site belongs to the Mediterranean mountain range; slopes covered with different size patches of maquis, garrigues, and batha vegetation types (Figure 27), in many cases mixed with orchards (or cultivated areas), and different type of scattered coniferous trees (in one site the coniferous trees form a small patch, close to Battir village). The study area also include exposed rocky sites and cliffs, mainly at the center-northern part of the valley. In addition, several small spring are located at different areas within the site.

Figure 27 Study area. The site is located between several cities and villages. Al Walajeh village, Diar Cremizan, and the Israeli settlement of Har Gilo from the North and northwestern side. Jerusalem and parts of Battir from the west and west southern side. Husan and parts of Battir from the Southern side. The city of Beit Jala, and Al-Khader Village from the east and east-southern side.

3) Recorded bird species:

A total of 63 species of birds were recorded at al Makhrour area and its vicinity, in 6 days of bird survey, during the spring season of 2019 (Table 4). Our focus on this study was to create a better understanding of existing bird species (resident breeders, summer breeders, and passage migrants) and their status. A total of 33 bird species were recorded breeding at the study area, while the other 30 species are classified as migratory species (Figure 29). Out of the recorded breeding birds, 26 of them are considered as resident breeders while the other 7 recorded species are classified as summer breeders. The long legged Buzzard (resident breeder) and the Short-towed Eagle (Summer breeder and passage migrant) were both recorded at the site and both showed breeding signs but non The most abundant breeding species recorded at the site are the (Common) Blackbird, Sardinian Warbler, Spectacled Bulbul, Great Tit, Graceful Prinia, (Eurasian) Collared Dove and Chukar. Five of the recorded birds are classified as threatened species at the national and regional level, which include Long-billed pipit, Black-eared Wheatear, Long-legged Buzzard, Cretzschmar's Bunting and Little Swift.

Species of special concerns and their habitat (Figure 30**):**

Long billed pipit: *Anthus similis*, (Jerdon, 1840). Subspecies in Palestine: *Anthus similis captus*, Harter, 1905, breeds in Palestine, Jordan, Lebanon, and Syria.

In Palestine, it is resident in Mediterranean mountainous region, inhabit rocky and terraced mountain slopes with low vegetation (Batha and Garrigue). At the study site, the bird is located at steep rocky slope at the west-northern parts of the study area (see Figure 28). The habitat of this area is typical for the long-billed pipit, it is characterized by its low vegetation, rocky slopes, and few trees. Several studies showed that the minimum breeding area for this species is about 6 ha, and the distance between nests is about 350 m. The breeding of this species start as early as mid-January and ends as late as beginning of August. The main threats facing this species is habitat fragmentation, eggs collection, and expansion of agricultural areas that change its typical habitat.

Little Swift: *Cypselus affinis* (J. E. Gray, 1830). Subspecies in Palestine: *Apus affinis galilejensis (*Antinori, 1855*).* Breeds NW and C Africa, E to Middle East and Pakistan.

In Palestine, it is resident breeder, to some extent summer breeder. It also recorded during spring and autumn migration seasons in small numbers, usually in mixed flock with other swifts. It usually inhabit mountainous regions, cliff-lined wadis and ravines. At the study area, several birds seen migrating over the site with other swift. Some individuals seen occupying cliff-lined area within the steep rocky slope at the west-northern parts of the study area (Figure 28), during April. This is was an indication that the birds might be breeding in this location. The main threats facing this species is intensive use of pesticides which led to shortage of food (insects) and distraction during breeding season.

Cretzschmar's Bunting: *Emberiza caesia* (Cretzschmar, 1827). Monotypic.

In Palestine, the species is common passage migrant, and summer breeder. At the study area, this species was recorded at different sites, in small numbers, during the spring migration, mainly in areas with scattered low trees, agricultural fields, and rocky hillsides. Breeding birds (3 pairs) were located at the rocky slopes and terraced hillsides, mainly at the south-western part of the study area at the top of the hilly region (Figure 28). The breeding season starts as early as beginning of March, juveniles becomes independent by July, and most birds leave the breeding area by August to mid-September.

Northern Wren: *Motacilla Troglodytes* Linnaeus, 1758,. Subspecies in Palestine: *Troglodytes Troglodytes* cypriotes (Bate, 1903). Breeds Cyprus and North of Middle East (S to N Palestine).

In Palestine, the species is considered as resident breeder, mainly in Mediterranean regions. Its range expanded in the last years to reach Hebron (wadi Al-Quf). Inhabit dense thickets in wooded areas, forested land, and tangled vegetation (mainly maquis) with some source of water (springs). The existence of this species in certain areas reflect the health of the maquis habitat. In the study area, about 8 birds recorded in the valley of Al-Makhrour area, where a total of 8 individuals were recorded. The east central parts of the valley holds the majority of the recorded birds (Figure 28).

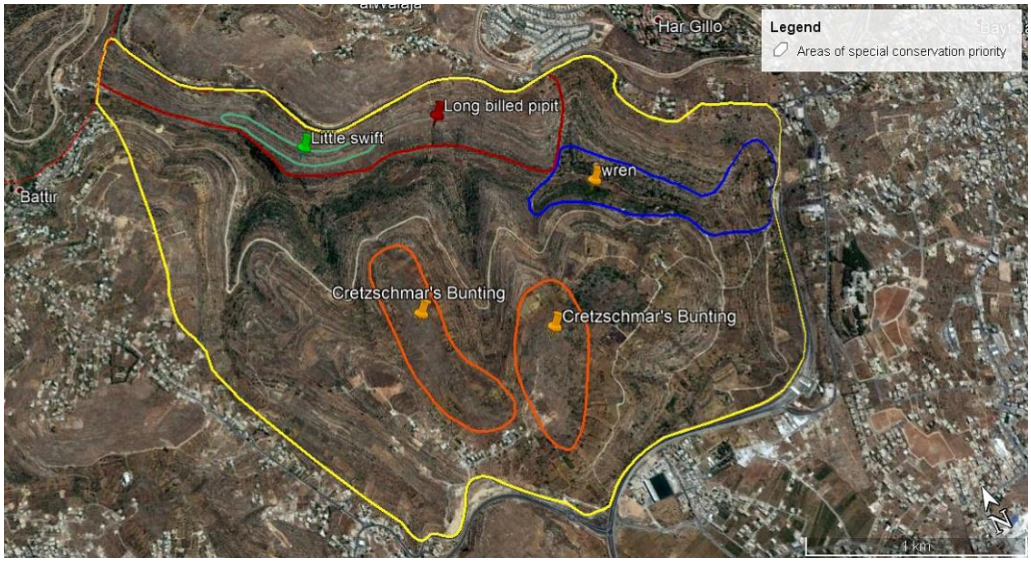

Figure 28 Areas of special conservation priority for flagship and threatened species (Northern Wren, Cretzschmar's Bunting, Little Swift, Long billed pipit)

Figure 29 Migrating birds in Al-Makhrour.

Table 4 Recorded bird species

No	Species	Scientific name	Status	IUCN / National Status	Occurrence	Description
1	(Common) Swift	*Apus apus*	sb, PM	Least Concern/	Abundant	Many birds recorded in large flocks feeding while passing over the site. Few individuals showed signs of breeding in nearby areas (Mainly in buildings-new and old traditional ones.
2	Cretzschmar's Bunting	*Emberiza caesia*	sb, PM	Least Concern/ Vulnerable	Uncommon	5 birds recorded at different locations, a single individual showed breeding signs. Habitat: Bathe and Garrigue, rocky slopes, and terraced hillside.
3	Linnet	*Linaria cannabina*	sb, PM	Least Concern	uncommon	Many birds recorded at different places. Some individuals showed breeding signs. Habitat: clefted/rocky mountainous slopes, and broken hills with scattered trees
4	Little Swift	*Apus affinis*	sb, PM	Least Concern/ Vulnerable	Common	Many birds recorded in small flocks or in singles feeding in the air while passing over the site during migration. Some individuals showed signs of breeding.
5	Masked Shrike	*Lanius nubicus*	sb, PM	Least Concern	Uncommon	Few birds recorded, 2 individuals showed signs of breeding (male and a female)
6	Red-rumped Swallow	*Cecropis daurica*	sb, PM	Least Concern	Uncommon	Several small flock of birds or in singles recorded passing over the site. Three individuals recorded collecting muds to build nest.
7	Short-toed Eagle	Circaetus gallicus	sb, PM	Least Concern	Uncommon	Two individuals recorded at two different occasions mainly perching on cliff-line. No breeding signs recorded in the study area.
8	Long-legged Buzzard	Buteo rufinus	rb, RD	Least Concern/ Near Threatened	Rare	A single individual was recorded perching on a cliff. It might be breeding in nearby area. No breeding signs recorded in the study area.

9	(Common) Blackbird	*Turdus merula*	RB	Least Concern	Abundant	Many birds recorded at different location all over the site. Many of the recorded birds showed breeding signs.
10	(Common) Kestrel	Falco tinnunculus	rb	Least Concern	Uncommon	1 pair recorded nesting in one of the cliffs nearby the jackdaws' colony. In previous survey, 2 pairs recorded breeding.
11	(Eurasian) Collared Dove	Streptopelia decaocto	RB	Least Concern	Common	7 birds recorded at different locations all over the site. Birds showed breeding signs.
12	(Eurasian) Eagle Owl	*Bubo bubo*	rb	Least Concern	Rare	1 pair recorded last year with three checks near Battir. No new records in this survey. More investigation needed.
13	(Eurasian) Hoopoe	*Upupa epops*	Rb, pm	Least Concern	Uncommon	3 individuals recorded, 2 individuals showed breeding signs.
14	(Eurasian) Jay	*Garrulus glandarius*	RB	Least Concern	Common	6 birds recorded at different locations. Several individuals showed signs of breeding
15	(European) Greenfinch	*Carduelis chloris*	rb	Least Concern	Uncommon	3 individuals heard singing, showing breeding signs
16	(Western) Jackdaw	*Corvus monedula*	RB	Least Concern	Common	14 birds were recorded at specific sites (breeding in cliffs). Numbers increased in comparison to previous years. Taking over breeding sites of the common kestrel.
17	(Winter) Wren	*Troglodytes troglodytes*	RB	Least Concern	Common	8 individuals recorded at different locations within the valley area. At least five birds showed signs of breeding.
18	Barn Owl	*Tyto alba*	rb	Least Concern	Rare	A single individual was recorded. More investigation needed.
19	Chukar	*Alectoris chukar*	RB	Least Concern	Common	Recorded all over the area but in low numbers. Recorded birds showed breeding signs.

20	Common Myna	*Acridotheres tristis*	RB	Least Concern	Uncommon	Several birds recorded near urban areas, birds showed breeding signs.
21	Crested Lark	*Galerida cristata*	RB	Least Concern	Uncommon	Several birds recorded at specific sites, birds showed breeding signs.
22	Graceful Prinia	*Prinia gracilis*	RB	Least Concern	Common	Many birds recorded at different locations at several sites. Birds showed breeding signs.
23	Great Tit	*Parus major*	RB	Least Concern	Common	Many birds recorded at different locations. Most birds showed breeding signs.
24	Hooded Crow	*Corvus corone cornix*	RB	Least Concern	Uncommon	5 birds recorded, mainly near urban areas. Some of them showed breeding signs.
25	House Sparrow	*Passer domesticus*	RB	Least Concern	Common	Many individuals recorded near human settlements and showed breeding signs.
26	Black-eared Wheatear	*Oenanthe hispanica*	Sb, pm	Least Concern/ Endangered	Unommon	Few individuals recorded, some showed breeding signs. Most probably breeding in nearby suitable habitat.
27	Laughing Dove	Streptopelia senegalensis	RB	Least Concern	Common	Several individuals recorded all over the site and showed breeding signs.
28	Little Owl	*Athene noctua*	RB	Least Concern	Uncommon	3 pair recorded at different locations. Recorded birds showed breeding signs. Numbers are lower than what have been recorded in previous years.
29	Long-billed Pipit	*Anthus similis*	RB	Least Concern/ Vulnerable	Uncommon	2 birds seen within a steep batha area at the northern side. Birds showed breeding signs. It is a threatened species at the national level.
30	Palestine Sunbird	*Nectarinia osea*	RB	Least Concern	Uncommon	3 singing males were recorded and few females. Birds showed breeding signs

31	Sardinian Warbler	*Sylvia melanocephala*	RB	Least Concern	Abundant	Many birds recorded at different locations all over the site and showed breeding signs.
32	Spectacled Bulbul	*Pycnonotus xanthopygos*	RB	Least Concern	Abundant	Many birds recorded at different locations. Many of the recorded birds showed breeding signs.
33	Syrian Woodpecker	*Dendrocopos syriacus*	RB	Least Concern	Uncommon	3 individual seen near Battir village. This species used to breed in larger numbers in previous years. Birds showed breeding signs.
34	Song Thrush	*Turdus philomelos*	PM, WV	Least Concern	Uncommon	A total of 5 individuals were recorded at different locations
35	(Common) Nightingale	*Luscinia megarhynchos*	PM	Least Concern	Uncommon	Several individuals recorded at many locations at dense maquis.
36	(Common) Redstart	*Phoenicurus phoenicurus*	PM	Least Concern	Uncommon	Few individuals recorded at different locations
37	(Common) Whitethroat	*Sylvia communis*	PM	Least Concern	Uncommon	5 individuals were recorded at different locations
38	(Eurasian) Sparrowhawk	*Accipiter nisus*	PM	Least Concern	Uncommon	Few individuals recorded passing over the site. Some individuals recorded foraging. No breeding signs recorded.
39	(Eurasian) Wryneck	*Jynx torquilla*	PM	Least Concern	Uncommon	Few individuals recorded at different locations
40	(European) Bee-eater	*Merops apiaster*	PM	Least Concern	Common	Many birds recorded in large flock feeding while passing over the site
41	(European) Honey Buzzard	*Pernis apivorus*	PM	Least Concern	uncommon	Several small flocks recorded passing over the site or close to the site. A total of 250 birds recorded.

42	(European) Pied Flycatcher	*Ficedula hypoleuca*	PM	Least Concern	Rare	2 individuals were recorded at different locations. Exceptional year for this species.
43	Alpine Swift	*Apus melba*	PM	Least Concern	Common	Many birds were recorded in large flocks feeding while passing over the site during migration.
44	Barn Swallow	*Hirundo rustica*	PM	Least Concern	Uncommon	Several small flocks or in singles recorded passing over the site.
45	Black Kite	Milvus migrans	PM	Least Concern	Uuncommon	One individual recorded passing over the site
46	Blackcap	*Sylvia atricapilla*	PM	Least Concern	Common	The most common migratory species at the site, recorded almost all over the site
47	Common Cuckoo	*Cuculus canorus*	PM	Least Concern	Uncommon	1 individual recoded. No breeding signs.
48	Eastern Bonelli's Warbler	*Phylloscopus orientalis*	PM	Least Concern	Uncommon	Several individuals recorded at different locations
49	Eastern Orphean Warbler	*Sylvia crassirostris*	PM	Least Concern	Uncommon	Several birds recorded at different locations
50	Garden Warbler	*Sylvia borin*	PM	Least Concern	Uncommon	3 individuals seen at different locations
51	Great Spotted Cuckoo	*Clamator glandarius*	PM	Least Concern	Uncommon	3 individuals recorded, no breeding signs observed
52	Lesser Spotted Eagle	*Aquila pomarina*	PM	Least Concern	Rare	Only a single bird was recorded
53	Lesser Whitethroat	*Sylvia curruca*	PM	Least Concern	Common	Many birds recorded almost all over the site

54	Ortolan Bunting	*Emberiza hortulana*	PM	Least Concern	Uncommon	Several individuals recorded at many locations
55	Pallid Swift	*Apus pallidus*	PM	Least Concern	Common	Many bird recorded in large flocks feeding while passing over the site
56	Semi-collared Flycatcher	*Ficedula semitorquata*	PM	Least Concern	Rare	2 birds' recorded, exceptional year for this species.
57	Spotted Flycatcher	*Muscicapa striata*	PM	Least Concern	Uncommon	Several individuals recorded at different locations.
58	Steppe Buzzard	Buteo buteo vulpinus	PM	Least Concern	Uncommon	27 individual were recorded passing over the area at different days, mostly in small flocks or as individuals
59	Thrush Nightingale	*Luscinia luscinia*	PM	Least Concern	Uncommon	several individuals recorded at different locations
60	Tree Pipit	*Anthus trivialis*	PM	Least Concern	Uncommon	6 individuals were recorded at different locations
61	Willow Warbler	*Phylloscopus trochilus*	PM	Least Concern	Uncommon	Many individuals recorded at different locations
62	Wood Warbler	*Phylloscopus sibilatrix*	PM	Least Concern	Uncommon	4 individuals recorded at different locations
63	Woodchat Shrike	*Lanius senator*	PM	Least Concern	Uncommon	3 individual recorded. No signs of breeding

Figure 30 Little owl, Black kite. Chukar Partridge, wag tail.

Invertebrates

The invertebrates studied in the past few months (up to 31 March) already produced excellent indicators of the rich biodiversity of this area. **Insects** of course where the most numerous in terms of species counts (see Table 5 for preliminary list of identified species, Figure 31). For example, there is over 20 species of butterflies and many other species of moths (difficult group taxonomically, being worked on, some new species). As for Moths there was found 11 families and over 21 species (many yet to be unidentified of the families Erebidae and Noctuidae).

A rather interesting insect finding was noted in this study and resulted in the first publiucation from this project's work in Alk-Makhrour. This is the first report of the invasive Western conifer seed bug *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera, Coreidae) from geographic Palestine representing its Southern Most record in Asia. *L. occidentalis* is a significant pest on pine trees and an invasive species to the Mediterranean region from western North America. (Handal, E.N., and Qumsiyeh, M.B. 2019. First Record of the Western Conifer Seed Bug Leptoglossus occidentalis Heidemann, 1910 (Hemiptera, Coreidae) from Palestine. Jordan Journal of Biological Sciences, 12, In Press) (Figure 32).

Many other groups of Arthropos were noted. The study is ongoing but below is a highlight of some interesting groups.

Figure 31 Some insects in Al-Makhour: Grasshopper, dragonfly, the Red ground bug (Spilostethus pandurus), butterfly , preying mantis, and Asellida (assassin fly).

Table 5 Some identified insect species.

Order	Family	Species
Lepidoptera	Pieridae	Pieris brassicae
		Artogeia rapae
		Pontia daplidice
		Pontia glauconome
		Madais fausta
	Nymphalidae	Limenitis reducta
		Vanessa cardui
		Vanessa atalanta
	Satyridae	Pseudochazara telephassa
		Maniola telmessia
		Lasiommata maera
	Lycaenidae	Lycaena thersamon
		Polyommatus Icarus
		Aricia agestis
		Freyria trochylus
	Hesperiidae	Carcharodus alceae
		Spialia orbifer
		Gegenes gambica
	Lasiocampidae	Lasiocampa grandis
	Erebidae (moths)	Utetheisa pulchella + over 10

		other sepecies
	Geometridae (moths)	Gnophos sartata + over 20 others species yet to be identified
Heteroptera	Reduviidae	Rhynocoris punctiventris
	Lygaeidae	Spilostethus pandurus
	Coreidae	Phyllomorpha laciniata
		Leptoglossus occidentalis
		+ 3 unknown species
	Pentatomidae	Graphosoma semipunctatum
		Stenozygum coloratum
	Scutelleridae	1 unknown species
Mantodea	Mantidae	Ameles syriensis
		Mantis religosa
	Empusidae	Blepharopsis mendica
		Empusa fasciata
Orthoptera (grasshoppers, locusts)	Acrididae	Oedipoda aurea
		Acrotylus insubricus
	Over 12 other species	
	Gryllidae	Gryllodes sp.
	Tettigoniidae	1 unknown species
Diptera	Culicidae	Culex lticinictus
Coleoptera	Most numerous group with over 45 species noted	
	Coccinellidae	*Adalia (Adalia) decempunctata*
		Coccinella (Coccinella) septempunctata
		Hippodamia (Adonia) variegate
		Oenopia conglobate
		Chilocorus bipustulatus
		Exochomus quadripustulatus
		Platynaspis luteorubra
		Nephus (Nephus) quadrimaculatus
		Scymnus (Pullus) suturalis
		Stethorus gilvifrons
		Pharoscymnus fleischeri
		Rhyzobius (Lindorus) lophanthae
	Tenebrionidae	Over 20 species (still being worked on)
Odonata		*Trithemis arteriosa*
		Trithemis annulata
		Orthetrum chrysostigma
Dermeptera	2 Species	
Hemiptera (true bugs)	>11 species	
Neuroptera (netwing insects)	5 species	
Blattoida (Roaches)	4 species	

Figure 32 Adult of Leptoglossus occidentalis, A: Dorsal view, B: Ventral view, Scale Bar = 10mm.

Arachnida: Of a total of four species of scorpions, Mt. Nebo scorpion *Nebo hierichonticus* was the largest and the smallest was *Scorpio maurus* in the valley. The most impressive was Androctonus (Figure 33) and the most poisonous the Palestine yellow scorpion known also as "deathstalker" (*Leiurus quinquestriatus).* We also got some species identification on some pseudoscorpions: Chithonius jonicus, Cardiolphum stupidium, and Ephippiochthonius sp. Also two species of camel spiders. The difficult group was the regular spiders (Order Araneae). Which has two dozen species in at least 8 families and were collected in several trips and identified by Dr. Qumsiyeh.

Figure 33 Androctonus scorpion.

Five species of **centipedes**, one woodlouse (Isopoda), and the very common Syrian **Millipede** (Order Diplopoda, Figure 34) round the arthropods (joint legged animals).

Figure 34 Two millipedes, a spider and slug.

Land Snails: Sixteen species of land snails are recorded from the study site: Granopupa granum, Buliminus labrosus, Paramastus episomus, Pene bulimoides, Euchondrus septemdentatus, Euchondrus chondriformis, Eopolita protensa jebusitica, Sphincterochila fimbriata, Monacha obstructa, Monacha syriaca, Monaca crispulata, Metafruticicola fourousi, Xeropicta krynickii, Levantina caesareana, Levantina lithophaga, and Helix (Pelasga) engaddensis (Figure 35).

Figure 35 Pene bulimoides and Helix engedensis from Al-Makhrour.

Mushrooms/Fungi

19 species were definetly identified

Family *Polyporaceae* Fr. ex Corda (1839)

Lentinus arcularius (Batsch) Zmitr. (2010)

Saprobic, grows on decaying deciduous wood, often oak. Sometimes these mushrooms grow from buried wood and appear terrestrial (Emberger 2008b). Our samples appeared terrestrial and were found near live oak. This is a common species found in many parts of the world from India to the Americas but to our knowledge this is the first report from this region. *Lentinus arcularius* is thought to have medicinally relevant compounds (Petre et al. 2017).

Trametes hirsuta (Wulfen) Pilát (1939)

Grows on stumps and fallen hardwood (Kuo 2010). Our samples were found on fallen hardwood (likely almond) in an olive grove. This species is fairly common, and Puri, et al. (2006) found that it could be utilized as a novel source of aryl tetralin lignans, which are important compounds used for the synthesis of topoisomerase inhibitors. Habitats containing *Trametes hirsuta* are thus of notable biomedical importance

Figure 36 Trametes hirsuta

Family *Suillaceae* Besl & Bresinsky (1997)

Suillus collinitus (Fr.) Kuntze (1898)

Family *Boletaceae* Chevall. (1828)

Xerocomellus redeuilhii Simonini, Gelardi & Vizzini (2016) Mycorrhizal, associated with hardwoods, often oaks.

Family *Tapinellaceae* C. Hahn (1999)

Tapinella panuoides (Batsch) E.-J. Gilbert (1931): Saprotrophic, grows on conifers (Kuo 2015a). Our samples were found at the base of fallen pine. This species is fairly common, and an occasional subject of biomedical research. Schneider et al (2008) have isolated atromentin compounds, and their associated genes from this species. These compounds have been shown to have antibiotic and anti-cancer properties (Zheng et al. 2006, Kim & Lee 2009). Thus ecosystems containing *Tapinella panuoides* are of notable biomedical importance.

Figure 37 Tapinella panuoides

Family *Psathyrellaceae* Vilgalys, Moncalvo & Redhead (2001)

Psathyrella bipellis (Quél.) A.H.Sm. (1946): Saprotrophic; grows in groups on lawns or in decaying plant matter (Kuo 2011). Our samples were found in damp decaying leaves, mostly olive and oak. *Psathyrella bipellis* has been found throughout Europe and North America (Smith & Hessler 1946).

Coprinopsis friesii (Quél.) P. Karst. (1872)

Coprinellus micaceus (Bull.:Fr.) Vilgalys, Hopple & Jacq. Johnson (2001) Saprotrophic, grows in clusters on decaying wood. Its substrate is often buried, causing the mushrooms to appear terrestrial (Kuo 2008a). Our samples were found in grass at the base of an almond tree.

Figure 38 Coprinellus micaceus

Family *Pluteaceae* Kotl. & Pouzar (1972)

Volvopluteus gloiocephalus (DC.) Vizzini, Contu & Justo (2011) Saprotrophic, terrestrial, in grassy areas or composting organic matter. Our samples were found in thick grass.

Family *Marasmiaceae* Roze ex Kühner (1980)

Omphalotus olearius (DC.) Sing. (1948) Saprotrophic; grows on stumps, buried roots, or on the base of hardwoods, especially oaks and olive (Kuo, 2015b). This sample was found growing at the base of olive.

Figure 39 Omphalotus olearius

Family *Mycenaceae* Overeem (1926)

Sarcomyxa serotina (Pers.) P. Karst. (1891) Our samples were found at the base of live oak.

Family *Physalacriaceae* Corner (1970)

Cryptomarasmius corbariensis (Roum.) T.S. Jenkinson & Desjardin (2014) Saprotrophic, grows on rotting leaves of olive and other trees (Bozok et al 2017). Our samples were found growing on damp olive leaves.

Family *Amanitaceae* E.J. Gilbert (1940)

Amanita ovoidea (Bull.) Link (1833) Ectomycorrhizal; found under deciduous trees, notably oaks, sometimes olive, on lime or alkaline soil. Our samples were found in a recently plowed olive grove.

Family *Tricholomataceae* R. Heim ex Pouzar (1983)

Lepista sordida (Schumach.) Singer (1951) Our samples were found at the base of olive and oak.

Figure 40 Lepista sordida

Family *Agaricaceae* Chevall. (1826)

Lycoperdon perlatum Pers. (1797)

Coprinus comatus (O.F.Müll.) Pers. (1797)

Figure 41 Coprinus comatus

Family *Hygrophoraceae* Lotsy (1907)

Arrhenia rickenii (Hora) Watling (1989) Our samples were found on moss-covered limestone gravel. Originally described in Europe, the range of this species was first recorded in Turkey by Kaya (2009). This is the first record of this species in Palestine.

Figure 42 Arrhenia rickenii

Family *Pyronemataceae* Corda (1842)

Geopora arenosa (Fuckel) S. Ahmad (1978). Our samples were found closely associated with moss, on limestone soils.

Family *Helellevaceae* Fr. (1822)

Helvella lacunosa Afzel (1783) Our samples were found near live oak.

Figure 43 Arrhenia rickenii

Indicator development

We took time to develop indicators for M&E activities using standard international guidelines (e.g. Biodiversity Indicator Development Framework, 2011 Biodiversity Indicators Partnership, found at https://www.bipindicators.net/national-indicator-development/bidf, Figure 44)

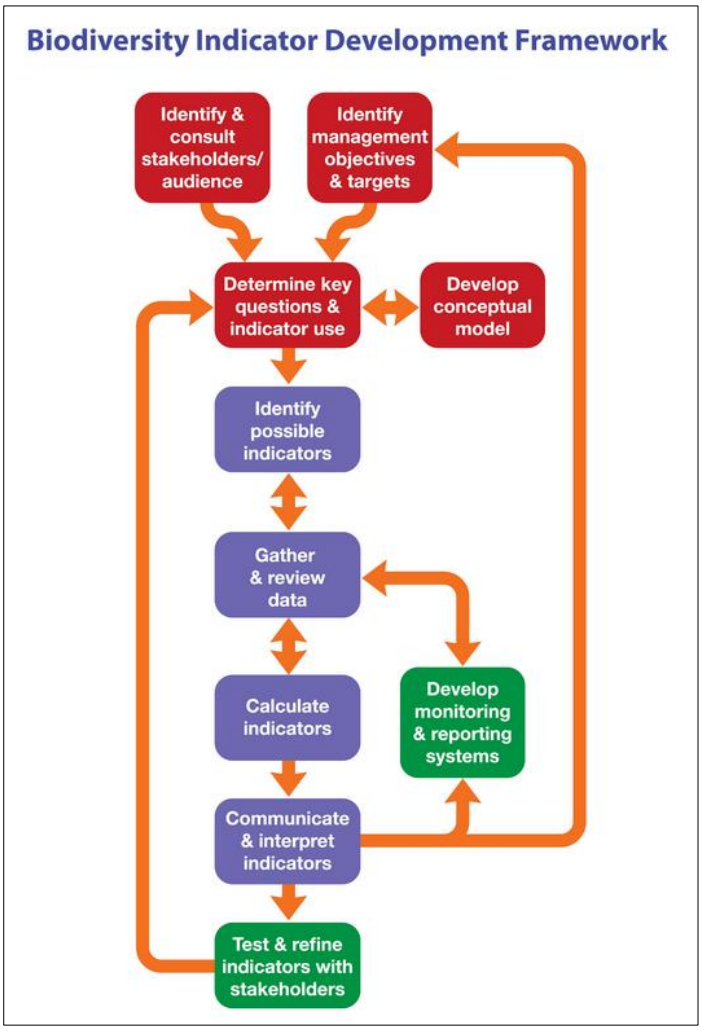

Figure 44 Indicator development

The indicators varied by group. The best developed indicators we decided to incorporate are selective and focused on key issues:

1. Plant biodiversity will be our primatry biodiversity indicator because animals also depend on plants sto the study done now (see the plant report separately for these indicators) will be repeated after two years to check for changes

2. Birds and Bats: These two groups are related to plant and animal biodiversity and are excellent indicators of changes. Due to limited resources only presence absence of species now and two years from now is included

3. Threats to biodivedrsity: Threats were monitored over the poat few months and will be monitored in all subsequent trips over two years. This includes habitat destruction, pollution, solid waste, water issues, and presence of invasive Fauna (so far we noted *Acrdiotheres*, Starling, *Rattus norvegicus & R. rattus*) and Flora (see report of flora)

Threats

In our visit to Al Makhrour Valley, the Palestine Museum of Natural History researcher team and volunteers collected different information related to fauna, flora, macro-fauna, geology, ecology, and threats that could affect the biodiversity and the environment in the future of affecting it in the time.

A list of threats were observed in the valley and take under consecration and documented to be studied more and understand better for it consciousness by doing a SWOT analysis for the Management plan in the end of the project. Our researchers documented many threats to valley ecosystem (Table 6 and Figure 45 Figure 46).

Table 6 Threats that researchers found in the valley.

#	Threats
1	Overgrazing
2	Cutting trees
3	Burning
4	Solid wastes
5	Plowing the land in destructive ways
6	Farming infrastructure (stone walls and farm roads)
7	Use of insecticides/pesticides
8	People digging for heritage stuff
9	Too mamny unregulated visitors to the area
10	Stray dogs
11	Invasive species
12	Occupation activities: walls around Al-Walaja and Khader
13	Occupation activities: residential Jewish settlements and their attendant infrastructure

Figure 45 Threats: three photos of infrastructure for destructive farming and one for trash dumping.

Figure 46 Habitat destruction from Israeli settlement activities, overgrazing, stray dogs, and burning.

Though the dangers facing the Palestinian environment were articulated nearly seven decades ago (Ives 1950), are few studies of threats effecting the biodiversity in the West Bank (e.g. Abdallah & Swaileh 2011; Hosh et al. 1992; Obeidi 2001; Weizman 2012' Qumsiyeh 2013; Qumsiyeh & Amr 2017). Solid waste issues (Abu Thaher, 2005; Al-Khatib et al. 2007; Dudeen 2012). It is difficult to manage our nature reserves when most of them are nder direct Israeli rule (ARIJ 2005; Garstecki et al. 2010). The biggest threat to human and biodiversity (fauna and flora) sustainability in Palestine is the issue of water (Tamimi 1996; Daibes & Daibes-Murad 2003; Gasteyer et al., 2012). There are many other threats including hunting (Helal & Khalilieh 2005; Yom-Tov 2003), climate change (Lautze and

Kirshen 2009; Verner 2012), excessive use of pesticides (Sa'ed et al. 2010), colonial activities (Amr et al. 2016; Qumsiyeh et al. 2014, 2017), and pollution (Tal 2002).

Religious attitudes can be of potential use to promote environmental awareness and conservation. Religious clerks (Moslem and Christian) can introduce many concepts of conservation and environmental practices in the Friday and Sunday sermons. Several authors dealt with the ethical and divine relation of Islam to environment conservation (Amr & Quatrameez, 2002). Islamic teachings are full of orders and events that encourage conservation as the concept of "Al Himma", to save water, clean environment and many others. Similarly in Christianity, basic teachings include many environmentally friendly practices. In Palestine, The Holy Land, with so many religious connections and about a million devout pilgrims per year, it is incumbent upon policy makers and stakeholders to research ways to reach out to those who are religious with the message of environmental conservation.

Wadi Al-Makhrour area under study here faces many threats. In its management plan of this world heritage site, MOTA (2018) stated some of these and suggested that there are certain Corrective Measures that can/should be adopted:

- Agreement to dismiss plans to build a "Wall" along the property, or within its surroundings,
- Implementation of projects to restore an appropriate state of conservation for the agricultural terraces and their components, including the watchtowers and dry stone walls throughout the property,
- Implementation of a project to restore traditional irrigation systems,
- Implementation of a project to put in place an adequate sewage system to protect water quality on the property,
- Preparation, approval, and implementation of a Conservation and a Management Plan for the property,
- Development and implementation of an active system of management that involves local communities and stakeholders,
- Preparation of a set of indicators for monitoring the property and implementation of a monitoring system,
- Development of protection methods for the property and its buffer zone.
- Urban encroachment on the World Heritage site area including Al-Makhrour (MOTA 208).

Biodiversity as a concept in biology evolved in the 20th century as we started to understand the threats faced by ecosystems (Wilson & Peter 1988). International treaties after WWII started to address the needs for ecosystem maintenance / biodiversity conservation. We in Palestine as a nascent state need to ensure not only that we have signed all the relevant treaties but that we actually implement them. An excellent review entitled "Legal implications of accession of the State of Palestine to international conventions on resources and protection of natural resources" was published (Jaradat and Awad Allah, 2015). Joining international agreements consolidates the legal, political and international personality of the newly formed Palestinian State. In addition, it promotes momentum of the international solidarity, the sovereignty of the Palestinian State over its natural resources and geographical boundaries. These conventions and treaties are excellent podiums to address the world the Israeli occupation violations on all aspects of Palestinian people rights. Here are some relevant agreements either signed or that Palestine tries to relate to on issues of the environment.

Convention on Biological Diversity (CBD): This is an international legal instrument for the conservation and sustainable use of biological diversity that came into effect in December 1993. It has

been an important instrument to set goals and priorities to preserve biodiversity. The State of Palestine singed the agreement 2 April 2015. However, the agreement is not ratified yet and still in the stage of accession. To comply with the convention, EQA is looking to update the national biodiversity strategy and action plan. This includes preparing lists of endangered species and to build its capacities and the national stakeholders capacities in the field of biodiversity. The Palestinian Authority submitted its fifth report in 2015 (EQA, 2015a). In 2012, the EQA published the report "The National Strategy, Action Programme and Integrated Financial Strategy to Combat Desertification in the Occupied Palestinian Territories". It laid out plans and sough funding for many projects to educate about and combat desertification. However, lack of funding and other challenges impede compliance and implementation.

Basel Convention Controlling Trans-boundary Movement of Hazardous Wastes and their Disposal: The convention was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad. The State of Palestine accessed this agreement in 2.1.2015 and entered in force in 2.4.2015. In the past, it participated in meetings of the Arab States related to the Convention. Articles 12-13 of the Palestinian Environment Law are the legislative basis to prevent the entry of waste and hazardous substances to the Palestinian Territories. The EQA has also prepared a master plan for the management of hazardous materials and wastes and prepared as well a draft list of hazardous substances and wastes. Accession to this Agreement constitutes a fulcrum for Palestine to prevent waste and hazardous materials smuggled from Israel to Palestine. But waste continues to flow into the Palestinian areas from Israel (e.g. electronic waste from Israel recycled in Idhna near Hebron causes genotoxic damage (Khlaif and Qumsiyeh, 2016).

Cartagena Protocol: The Cartagena Protocol is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. It was adopted on 29 January 2000 as a supplementary agreement to the Convention on Biological Diversity and entered into force on 11 September 2003. Palestine is listed on Accession in Cartagena protocol, and was entered into force on April 2, 2015. This could be beneficial to Palestine though as of now no studies exist on LMOs coming into the Palestinian territories (data needed).

United Nations Framework Convention on Climate Change (UNFCC): This treaty was negotiated at the earth summit in Rio de Janeiro in 1992 and aims to address the threat to human life and life on earth caused by climate change. Palestine accessed the UNFCC in 18.12.2015. The EQA prepared the national strategy to adapt to climate change and the formation of a national committee on Climate Change and the establishment of a unit for climate change within EQA. There are no direct materials in Environmental Law addressing the issue of climate change. And little is being done for example to curb amount of hydrocarbon energy use in the OPTs. It is essential to deal with this issue.

United Nations Convention to Combat Desertification: This legally binding international agreement links environment and development to sustainable land management in order to combat desertification. The State of Palestine is not a member of this agreement. The EQA was the national focal point, and then transferred to Ministry of Agriculture. Efforts were made to prepare a national strategy to combat desertification and its action plan. Besides, EQA initiated the formation of a National Committee to Combat Desertification and in the process to host international experts to assist Palestine scientist in this sector, and to draft project proposals in sustainable management of

arid land. It is worth mentioning that the articles 16-18 of the Environment Act form the basis of legislation.

Unsinged Agreements but have Active Role: Palestine accession to the above and other conventions is listed here http://www.birdlife.org/datazone/country/palestinian-authority-territories/policy. The State of Palestine, even not a signatory, is active in a number of other international treaties that are not directly concerned with conservation and biodiversity, but related to other environmental issue.

The Barcelona Convention for the Protection of the Mediterranean Sea Against Pollution adopted in 1976 includes legal protocols on Dumping Protocol (from ships and aircraft), Prevention and Emergency Protocol (pollution from ships and emergency situations), Land-based Sources and Activities Protocol, Specially Protected Areas and Biological Diversity Protocol, Offshore Protocol (pollution from exploration and exploitation), Hazardous Wastes Protocol, and Protocol on Integrated Coastal Zone Management (ICZM). Even though Palestine is not a member of this agreement, the EQA is involved in some of the meetings and programs related to this Agreement, such a plan and program of the Mediterranean Action (MAP) and ICZM. The EQA have prepared a national plan for the protection of the marine environment and coastal areas. Some articles in the Environmental Law related to the marine environment constitute a national legislative basis for this agreement.

Two other important international treaties are the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Migratory Species (CMS). CITES would be highly beneficial in curbing trade in endangered species even though now Palestine has no control of its ports of entry (still done by Israel). The potentiality of independence would make it more urgent to do this and prepare to implement our national strategy relating to the environment (EQA 2010). CMS should likewise be joined because 500 million birds migrate through Palestine (on annual migrations between Eurasia and Africa). This would ensure protection of this important migratory site.

We can do some things to conserve nature in Palestine despite these persistent threats discussed above and thus also begin to comply with International treaties signed like those listed above (Qumsiyeh et al. 2017). For example ethnical consumption can be encouraged (Dajani and Isma'il 2014). Another area of significant work already done in other parts of Palestine (not Al-Makhrour) is to use systems of enhancing socio-economic value for local people from conservation (see Slocombe 1993; Görlach et al. 2011). The current project will address this need in Al-Makhrour Valley. We also have some partners like the UNEP which already funded many conservation projects under its small grants program of the Global Environment Facility (GEF 2012, 2013). For example they funded one of our (PMNH/PIBS-BU) projects that dealt with a buffer Zone for the Wadi Qana protected area. Similar study is envisioned for the buffer zones of Wadi Al-Makhrour which is of significant ecological value (EQA 2017)

Palestinian national legislation is also needed to protect the traditional resource knowledge rights of local villagers and farmers as well as the rights of sovereignty over their cultural and genetic property. Thus, PGRs' collectors, cultivators and protectors, who work in this sector after their fathers and grand- fathers and are going to teach their skills to their children (especially those living under poverty line, without employment), and utilize the wild PGRs from generation to generation should have the priority to be protected and their knowledge since they are the closet to nature. The indigenous knowledge forms the main reference on which Palestinians mainly rural communities rely while implementing conservation and production activities (ARIJ 2011). There has been little in depth

participatory research into plant and animal indigenous knowledge in the West Bank and Gaza strip; for instance those of the Palestinian Bedouins.

It is also necessary to strengthen taxonomic and systematic research, ecology, habitats and wildlife population studies, indigenous genetic resources, GIS and remote sensing, and popular knowledge assessments. Implementing field measurement and assessment surveys to get a grip on existing biodiversity and the identification of those under threat or are presumed lost or extinct is a first step that should be taken. The results of the Palestinian research should also be used as an incentive to aware the public towards the secure measures while utilizing PGRs and emphasizing the importance of such resources and their methods of conservation. In addition, the Palestinian species lists and research findings should be documented and interlinked to the international databases, reports and/ or lists. There is a necessity to enhance the level of cooperation and coordination among academic and research institutions whether they are governmental or non-governmental organizations that work in the field of biodiversity and to set out participatory investment in relevant projects, plans, and actions at international and national levels to raise quality of Palestinian biological resources at its different components.

We share the vision of MOTA (2018) that includes a "well-managed, conserved and protected property, its Outstanding Universal Value and the conditions of authenticity and integrity of supporting attributes, socioeconomic status of the local community, presentation and interpretation are sustainably conserved, improved and enhanced enabling present and future generations to enjoy and appreciate it."

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http://www.environment.pna.ps/ar/files/Third_national_Report_On_Biodiversity.pdf (page 57)
https://www.unrwa.org/userfiles/2011081763638.pdf (more about the political situation of Al Walaja but also good one)
http://www.bic.com.ps/bcc/images/BaNF%20Final.pdf

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