

Vegetation and Grazing in the St. Katherine Protectorate, South Sinai, Egypt

Report on plant surveys done during Operation Wallacea expeditions during 2005

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ABSTRACT

Plants were surveyed in the St. Katherine Protectorate of South Sinai, Egypt. The most commonly recorded plant species include: *Artemisia herba-alba*, *Artemisia judaica*, *Fagonia arabica*, *Fagonia mollis*, *Schismus barbatus*, *Stachys aegyptiaca*, *Tanacetum sinaicum*, *Teucrium polium* and *Zilla spinosa*. Dominant plant families were Compositae, Graminae, Labiatae, and Leguminosae. Communities with a high grazing pressure had a lower overall plant health. A strong negative correlation was found between plant health and grazing pressure. Twelve plant families showed heavy grazing pressure, including Resedaceae, Caryophyllaceae, Polygalaceae, Juncaceae, Solanaceae, Geraniaceae, Ephedraceae, Globulariaceae, Urticaceae, Moraceae, Plantaginaceae, and Salicaceae.

INTRODUCTION

The Sinai Peninsula has geographical importance in that it is where the continents of Africa and Asia meet. The St. Katherine Protectorate covers the mountainous region of Southern Sinai. It was declared as a protected area in 1996 due to its immense biological and cultural interest. It has been recognized by the IUCN as one of the most important regions for floral diversity in the Middle East, containing 30% of the entire flora of Egypt and a great proportion of its endemic species. Within the Protectorate, more than 400 species of higher plants have been recorded, of which 19 species are endemic, 10 are extremely endangered and 53 are endangered. Localized overgrazing, uprooting of plants for fuel or camel fodder, and over-collection of medicinal and herbal plants are greatly threatening the floral diversity of the Protectorate.

The management of the Protectorate was established under a project funded by the European Union that concluded in December 2002. Arrangements for sustainable funding of the Protectorate activities were delayed, and have yet to be fully realised; this has caused a current funding gap. The management plan called for a number of monitoring tasks, but with the reduction in support, the rangers are unable to achieve them without assistance in terms of manpower. Operation Wallacea was established in order to try to help, harnessing the enthusiasm and dedication of Biology undergraduates from the UK.

The aim of this part of the work is to monitor particular plants in the different wadi systems in St. Katherine's Protectorate, to assess how plant species are distributed, and to determine if grazing is affecting the health of these communities.

MATERIALS & METHODS

Study Area

Twenty-nine wadis and farsh (=open areas) systems were surveyed in and around St. Katherine Protectorate. As Fig 1 demonstrates, the surveyed wadis can be divided into three geographical areas:

- Ring Dyke wadis, situated in and around the Ring Dyke, consisting of two subgroups, the high-mountain wadis (Shraig, Arbain, Itlah, Tella[°]ah, Ferah, Naqb Hawa, Farsh El Roumana, Tynia, Ahmar, Farsh El Luz, Shaq Musa, Gebel Safsafa, Wadi Gebal, Farsh Mesaila) and those just outside the wall of the Ring Dyke (Souria, Koria Shamoun, Gharaba, Erdasia and Esh Shaik)
- [°]Ain Hudra wadis (Elwadi, Abu Matier, Ain Hudra, Kiri and Legaibi)
- Wadi Feiran wadis (Alberegga, Emrair, Rem, Ertama, and Eleiqat).

Sampling

Vegetation was sampled using a transect/quadrat method. In such sparsely vegetated habitats, there is little point in randomising the positions of samples, because most of them will contain nothing. We therefore adopted stratified sampling, using areas with some vegetation to record. A 25-m transect rope was established along a wadi bed that contained some vegetation, and five quadrats, each 5 x 5 m (25 m²), were placed along its length on alternating sides of the rope (Fig 2).

For each plant species present within a quadrat, the following data were recorded: the species concerned, percentage cover, total number of individuals, plant stage, overall health, level of grazing, and the presence or absence of vehicle tracks. Plant health was assessed over all individuals within the quadrat on a 5-point scale from Excellent (5) to Very Poor (1). This scale was recorded based on the following criteria: (a) amount of reproduction of individuals (flowering and fruiting), (b) overall vigour and vitality of individuals, and (c) plant height and cover. The level of grazing was also averaged over all individuals within the quadrat and recorded along a similar 5-point scale from Heavy (5) to None (1), using the following criteria: (a) number of grazed

individuals, (b) number of browsed branches, and (c) plant height and cover. Plant stage was recorded using a 3-point scale: Fruiting (3), Flowering (2) and Vegetative (1).

In addition to data from plants, mammal dung was also surveyed by recording the species concerned (mainly camel, donkey, rabbit, sheep, ibex, and fox), the number of droppings, and the age category of the droppings on a 5-point scale: fresh (1), less than one week old (2), over one week old (3), less than one year old (4), and over one year old (5). The main criteria of this scale (see AlQamy 2005) were the dryness and the colour of the dung: dry, white dung was the oldest. The dung of ibex and goats are hard to tell apart, and discrimination is likely to be poor; others are very characteristic.

Analysis

Species diversities were calculated using Simpson's Diversity Index (Lande 1993) and analysed for differences among wadis, or among groups of wadis, using Anova.

For each wadi, the Importance Value Index for each species was calculated (Curtis & McIntosh 1950) by expressing its frequency, density and cover relative to the totals for all species (as a percentage). The Importance Value Index for each species is then calculated as $300 - (\text{relative frequency} + \text{relative density} + \text{relative cover})$: this scale of the species importance value here runs from 0 to 300.

The recorded plant species along with their importance values in all the studied stands were used in constructing a data matrix for use in classification and ordination. Classification of stands was assessed using two-way indicator species analysis (TWINSPAN: Hill 1979), based on the species' importance values. Correspondence analysis (Ter Braak 1986) was used to ordinate stands, implemented by the Multivariate Statistical Analysis Package of Kovach Computing Services (www.kovcomp.co.uk).

RESULTS

I attach my own SWOT analysis of the operation of the programme in Appendix 1.

Plants and wadis

The plant species recorded during these surveys (Appendices 2-5) show remarkably different habitat features between high and low elevational sites. In the high-elevation sites surrounding the ring dyke, dominant plant species include *Peganum harmala*, *Artemisia herba-*

alba, *Zilla spinosa*, *Matthiola arabica*, *Phlomis aurea*, *Achillea fragrantissima* and *Pulicaria undulata*. Overall, these sites have high plant diversity, with a high number of species recorded and a relatively high plant cover. The low-elevation sites (Ain Hudra and Wadi Feiran areas) have a completely different set of dominant plants, including *Retama raetam*, *Hamada elegans*, *Heliotropium digynum*, *Artemisia judaica* and *Neurada procumbens*. Overall, these sites have low plant diversity, with relatively low vegetation cover and a low number of species recorded.

The following plants were recorded as being heavily affected by grazing: *Ochradenus baccatus*, *Bufonia multiceps*, *Juncus rigidus*, *Galium sinaica*, *Plantago sinaica*, *Polygala sp.*, *Globularia arabica*, *Ephedra alata*, *Ballota undulata*, *Zilla spinosa*, *Reseda pruinoso* and *Caylusea hexagyna*. It was observed that these plant species were commonly grazed to the plant base, affecting the plant's reproductive health. Some species were found to be abundant, such as *Zilla spinosa*, *Ballota undulata* and *Caylusea hexagyna*. However, *Ochradenus baccatus*, *Bufonia multiceps*, *Globularia arabica* and *Ephedra alata* were rarely encountered.

Classification and ordination

The twenty-nine sites were separated into seven groups according to the TWINSpan analysis of their importance values (Fig 3). The resultant groupings relate mostly to the elevation of the sites along with the vegetation composition and structure.

Group I wadi's (Elwadi, Abu Matier, Ain Hudra, Kiri, Legaibi) are characterized by their sandstone geology. They are lowest in elevation, at approximately 600-800 m. Plant cover and richness is noticeably lower in this group. Vegetation cover ranges from 2-15% overall. The indicator species identified by TWINSpan of this group are *Acacia tortilis* and *Arthrocnemum macrostachyum*, and the associated species are *Hamada elegans*, *Retama raetam*, *Aerva javanica*, *Ochradenus baccatus*, and *Anarrhinum pubescens*. The communities in this group are 95% similar to one another, and have an overall Simpson's diversity index of 0.947 ± 0.005 .

Group II wadi's (Eleiqat and Ertama) are near Wadi Feiran, the westernmost of the surveyed sites. They are at a moderate elevation (697-754 m), and are characterized by both granitic and sandstone geology. Vegetation cover ranges from 4-11%, and plant species richness and total cover is low. The sole indicator species identified by TWINSpan is *Heliotropium digynum*, and the associated species include *Anabasis sp.*, *Hamada elegans*, *Retama raetam*, and *Lotononis platycarpa*. The communities are 93% similar, and have an overall Simpson's diversity index of 0.844 ± 0.011 .

Group III wadi's (Albarega, Souria, Emrair, Rem, Koria Shamoun, Gharaba) are also in close proximity to Wadi Feiran. They differ from the sites in group II in having a slightly higher elevation (780-1180 m). The group is characterized as having primarily sandstone and granitic geology. Vegetation cover ranges from 5-12%, with a higher plant richness than Group II, and moderate plant cover. The indicator species identified by TWINSPAN is *Scrophularia libanotica*, and the associated species include *Artemisia judaica*, *Reseda pruinoso*, *Gymnocarpos decandrus*, and *Ochradenus baccatus*. The communities in this group are rather less similar than the previous ones (72%), and have an overall Simpson's diversity index of 0.741 ± 0.009 .

Group IV (Esh Shaik, Erdasia) are mid-elevation wadi's (1143-1421 m) dominated by primarily granitic geology with high slopes and a well-defined wadi bed composed of a high-sand component leading into highly sloped habitats. Vegetation cover ranges from 12-18% with a relatively high species richness and high plant cover. Plant species richness increases significantly with an increase in slope within the habitat. The indicator species identified by TWINSPAN is *Scrophularia libanotica*, and the associated species include *Artemisia herba-alba*, *Ochradenus baccatus*, *Juncus rigidus*, *Teucrium polium*, and *Chiliadenus montanus*. The communities in this group are very similar (91%), and have an overall Simpson's diversity index of 0.807 ± 0.028 .

Group V (Arbain, Itlah, Ferah, Naqb Hawa, El Roumana, Tynia, Ahmar, Shraig, Tella^cah) are high-elevation (1385-1859 m) wadis with a varied geology (granite, sandstone, and basalt). Vegetation richness is typically quite high, along with plant cover, perhaps because of the higher moisture availability throughout this group of wadi's. The indicator species identified by TWINSPAN of this group is *Panicum turgidum*. Associated species include *Bufoia multiceps*, *Phlomis aurea*, *Matthiola arabica*, *Alkanna orientalis*, and *Andrachne aspera*. The communities in this group are 70% similar, and have an overall Simpson's diversity index of 0.809 ± 0.007 .

Group VI (Farsh El Luz, Shaq Musa) can be characterized as having primarily granitic geology with sporadic sandstone features. It is evident that there is a high moisture regime in these wadis, resulting in a different vegetation structure from the wadis in Group V. The elevations of this group range from 1892-1996 m. The indicator species identified by TWINSPAN of this group is *Mentha longifolia*, well known in the region to signify abundant water resources. The associated species include *Artemisia herba-alba*, *Ballota undulata*, *Tanacetum sinaicum*, *Teucrium polium*, and *Origanum syriacum sinaicum*. The communities are very similar (96%), and have an overall Simpson's diversity index of 0.928 ± 0.004 .

The high-elevation (1763-2004 m) wadis of Group VII (Safsafa, Gebal, Farsh Mesaila) have granitic geology with some sandstone features, and very similar vegetation structure and density. The indicator species identified by TWINSPAN are *Cynodon dactylon* and *Alkanna orientalis*, and

associated species include *Artemisia herba-alba*, *Deverra triradiata*, *Astragalus sp.*, *Plantago sinaica*, and *Tanacetum sinaicum*. The communities in this group are 82% similar, and have an overall Simpson's diversity index of 0.897 ± 0.007 .

A two-way analysis of variance of importance values, including grouping and plant-species identity (but not their interaction, since many plants do not occur in all wadi's) was conducted. This indicates that there are no significant differences among the TWINSPAN clusters (Fig 4), after allowing for differences in species importance values among plant species. This implies that all the wadis surveyed have, on average, similar vegetation structure in the relative density, relative frequency, and relative cover of their plants. There were, of course, highly significant differences in importance values among plant species ($F_{107,330}=2.1$, $p<0.001$), as there must inevitably be.

The Correspondence Analysis (Figs 8 & 9) shows much the same thing as the TWINSPAN classification. The first axis (12% of the variation) contrasts the Ain Hudra wadis with those of the Ring Dyke, on the basis of plants such as *Hamada elegans*, *Retama raetam*, *Neurada procumbens*, *Crotalaria aegyptiaca* and *Arthocnemum macrostachyum*. The second axis (8% of the variation) contrasts Wadi Eliqat with Wadis Gebal and Abu Matir, on the basis of plants such as *Chrozophora oblongifolia*, *Forsskaolea tenacissima* and *Lycium shawii*. The simplicity of the 2-dimensional TWINSPAN clusters hides complex multidimensional relationships that appear in the Correspondence Analysis, where 12 axes together account for 70% of the variation, but the 12th axis still contains a reasonable amount of the variation (3.5%).

Plant health and grazing pressure

Grazing pressure was highest in wadi groups VII, IV, and III, and overall there were significant differences in grazing pressure among the wadi groups (Fig 7). There were significant differences among wadi groups in plant health (Fig 8), which had its lowest mean values in wadi groups III, II, and IV. Overall, the clusters with high grazing pressure have a lower overall plant health; this impression is underlined by the fact that, using a Spearman's rank correlation, a strong negative relationship was found between overall plant health and grazing pressure (Fig 9).

An analysis of variance for grazing by plant families demonstrated highly significant differences among their mean values (Fig 10), showing that certain plant families are grazed intensely while others are grazed less frequently, i.e. some plant families are more palatable to grazing animals than others. Of the thirty-three families, moderate grazing (score of 3) was found in the following eight plant families: Capparaceae, Asclepiadaceae, Scrophulariaceae, Euphorbiaceae, Chenopodiaceae, Umbelliferae, Graminae and Cruciferae. There are twelve plant

families that showed heavy grazing (score of 4 or 5), including: Resedaceae, Caryophyllaceae, Polygalaceae, Juncaceae, Solanaceae, Geraniaceae, Ephedraceae, Globulariaceae, Urticaceae, Moraceae, Plantaginaceae, and Salicaceae. It was observed that the following plants within those families are being negatively affected by heavy grazing: *Ochradenus baccatus*, *Bufonia multiceps*, *Juncus rigidus*, *Galium sinaica*, *Plantago sinaica*, *Polygala sp.*, *Globularia arabica*, *Ephedra alata*, *Ballota undulata*, *Zilla spinosa*, *Reseda pruinosa* and *Caylusea hexagyna*.

Further experiments and research is necessary to determine if heavy grazing is the real cause of poor health in these plant species; however, our current findings suggest such relationship. The single most effective way of improving plant communities in the St. Katherine Protectorate may be to control levels of grazing.

The abundance of dung

We calculated the average number of droppings per mammalian species over all the sites within each of the TWINSPAN clusters (Fig 11). The vast majority of the dung recorded was either class 4 (less than 1 year but more than 1 month) or 5 (greater than 1 year), suggesting nearly all the dung was greater than a month old; because of this, the age categorization was ignored. There was a significant difference in the average dung droppings ($F_{7,88}=3.303$, $p<0.005$) found within the TWINSPAN clusters, along with a highly significant difference for the mammalian species status, whether it is wild or domestic, ($F_{7,88}=127.153$, $p<0.001$) in the surveyed sites (Figures 12 & 13). This suggests that domestic animals, rather than wild animals, are more abundant in the wadi system. However, it also suggests that these domestic animals are using the wadis with different regularity.

There were large numbers of camel droppings recorded in the Ain Hudra and Wadi Feiran wadis (groups I, II, III, and IV): these low-elevation sites are easily accessible and used heavily by tourists and camels. Wadis in Feiran and around St Katherine (Clusters II, III, IV, V, and VI) contained the highest amounts of goat dung, indicating that goats are intensely grazing the majority of these sites. Ain Hudra (I) and high-elevation wadis (VII) showed low amounts of goat dung, which corresponded to the low density of palatable plant species to goats. The frequency of donkey dung was low and rarely encountered in most of the surveyed sites: only around St Katherine (V) and the high elevation wadis (VII) showed a substantial amounts of donkey dung. Ibex dung was found in low quantities in the low- and mid-elevation wadis (I, II, III, IV, and V) during the surveys: wadis near Feiran (II) showed the highest amounts at approximately two pieces per quadrat. Fox dung was recorded in many of the low- and mid-elevation wadis (I, II, IV, and V), the

highest densities around St. Katherine (V). No gazelle or hyena dung was encountered during the surveys. Overall, wadi clusters II, III, and IV have the largest amounts of dung from domestic grazing animals (camels, goats, and donkeys), while clusters I, II, IV and V have moderate amounts of dung from native animals (ibex and fox). There was significantly more domestic mammal dung encountered than native mammal dung.

DISCUSSION

The aim of this project was to monitor vegetation in the different wadi systems in the St. Katherine Protectorate, to assess how plant species are distributed, and to determine if grazing is affecting the health of the plant communities. The results indicate that the different wadi systems have notably different vegetation components depending on their elevation. Low elevational wadis were dominated by *Retama raetam*, *Hamada elegans*, and *Heliotropium digynum* with low plant coverage and low species richness. High elevation sites were dominated by *Artemisia herba-alba*, *Zilla spinosa*, *Matthiola arabica*, *Achillea fragrantissima* and *Pulicaria undulata* with considerably higher plant coverage and species richness. However, all the wadis surveyed have, on average, similar vegetation structure in the relative density, relative frequency, and relative cover of their plants. This indicates that although the different sites have different vegetation components, their vegetation structure is similar.

The grazing analysis indicated that sites with a high grazing pressure have a lower overall plant health. A strong negative relationship was found between overall plant health and grazing pressure. The grazing analysis also indicated that certain plant families are grazed intensely while others are grazed less frequently.

When the dung data was analysed, it was found that camel droppings were recorded in low elevation sites that are easily accessible and are used heavily by tourists and camels. Goats are intensely grazing the majority of the sites surveyed. Fox dung was recorded in moderate amounts at a variation of sites. Ibex dung was recorded very rarely, and is easily confused with goat dung. No gazelle or hyena dung was encountered during this survey. Overall, low elevation sites had the largest amount of dung from domestic grazing animals, while dung from native mammals was encountered rarely.

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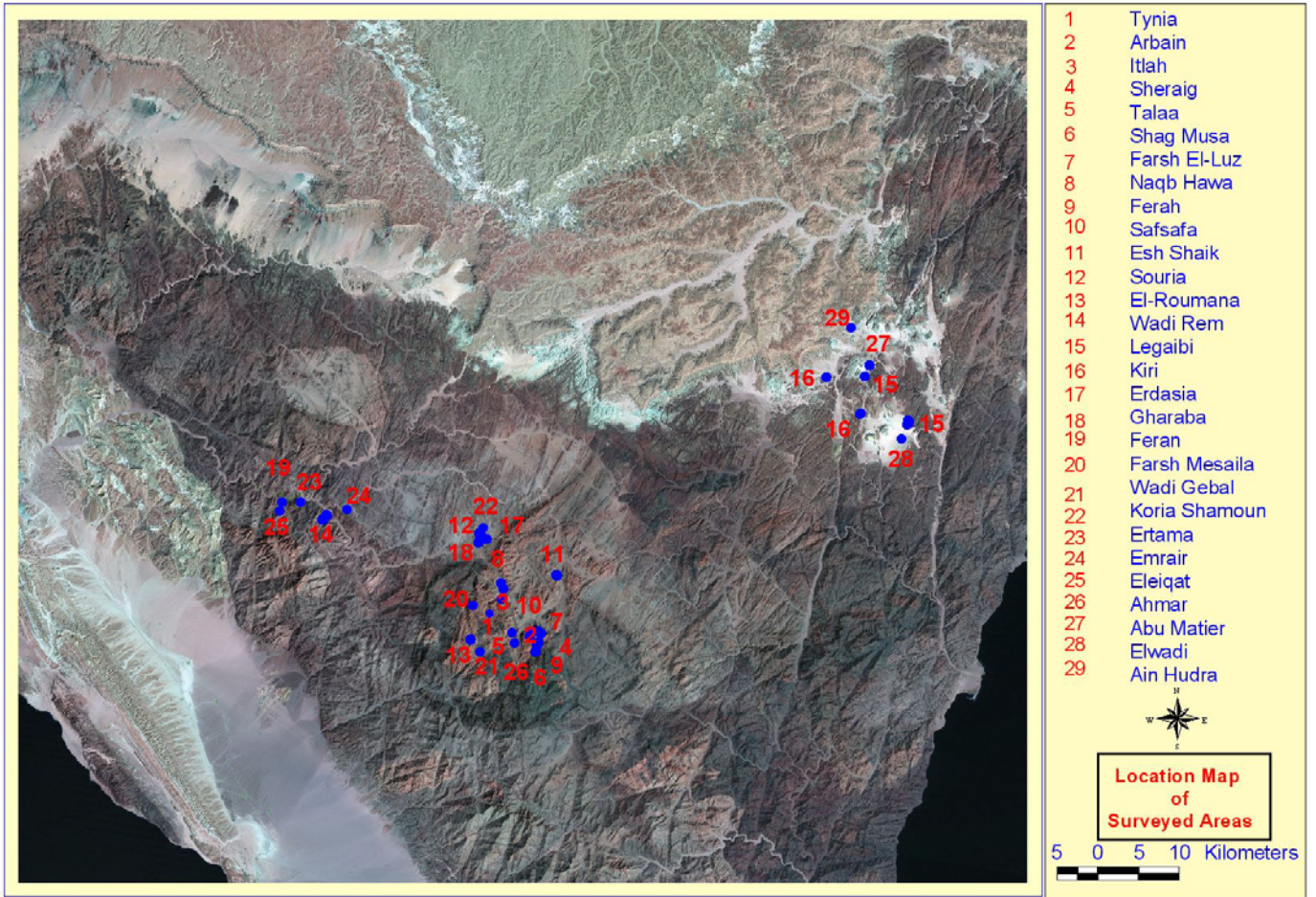


Figure 1
Map of the localities studied in the northern part of the St Katherine Protectorate. The boundary of the Protectorate more or less follows the edge of mountain massif.

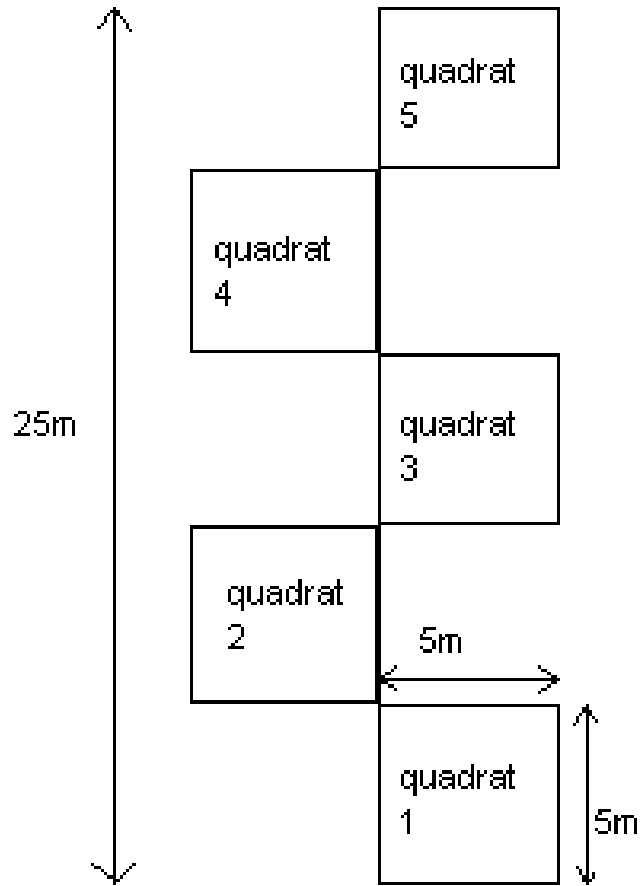


Figure 2
Diagram of the transect and sampling quadrats

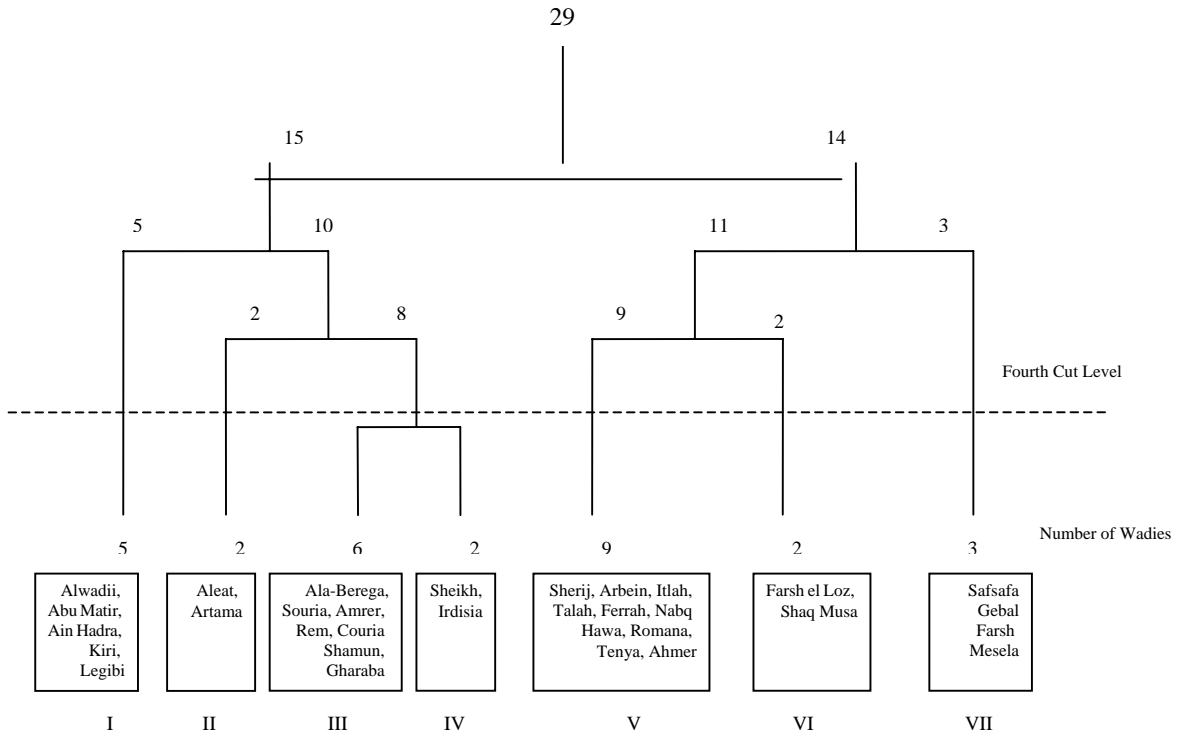


Figure 3
Dendrogram illustrating the relationships among wadis, clustered using TWINSpan

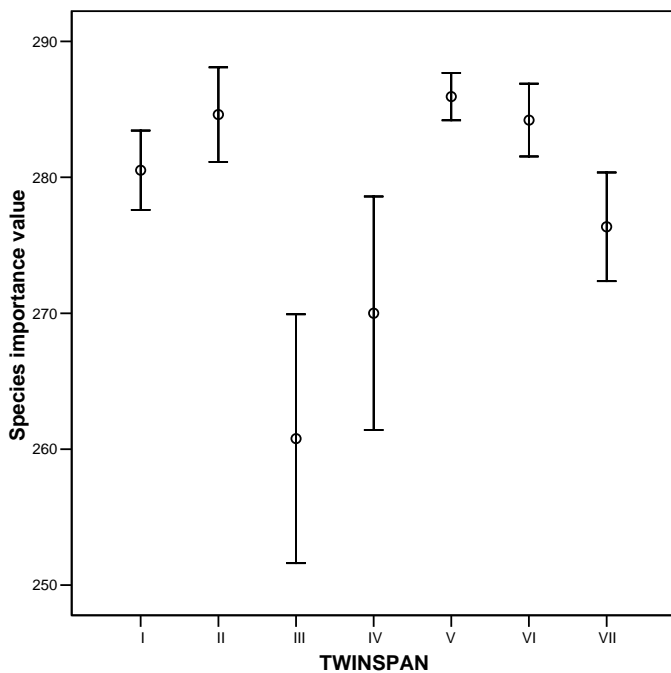


Figure 4
Mean species importance values (\pm S.E.) for the groupings of wadis identified by the TWINSpan analysis. There is no evidence for significant different among the groups ($F_{6,330} = 1.19$, n.s.).

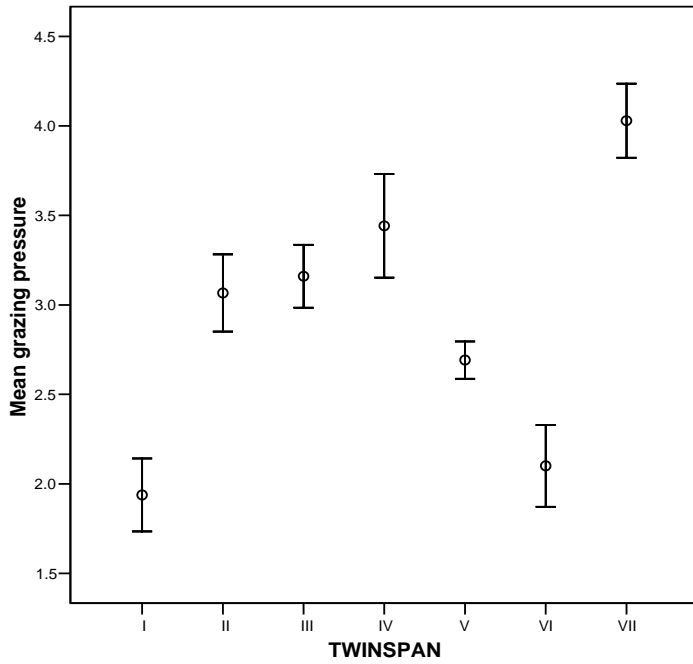


Figure 7
Mean grazing pressure (\pm S.E.) in the wadi groupings identified by TWINSPAN. There are highly significant differences among these mean values ($F_{6, 330}=5.3$, $p<0.001$).

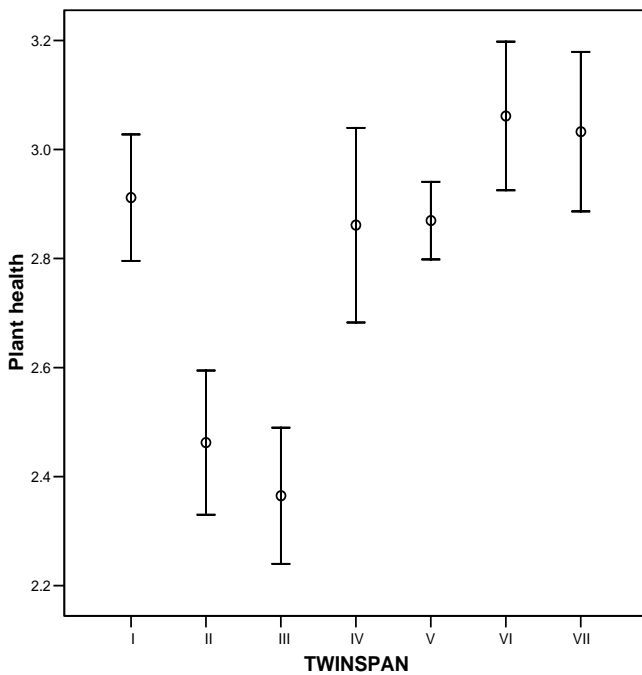


Figure 8
Mean plant health (\pm S.E.) in the wadi groupings identified by TWINSPAN. There are highly significant differences among these mean values ($F_{6, 330}=8.8$, $p<0.001$).

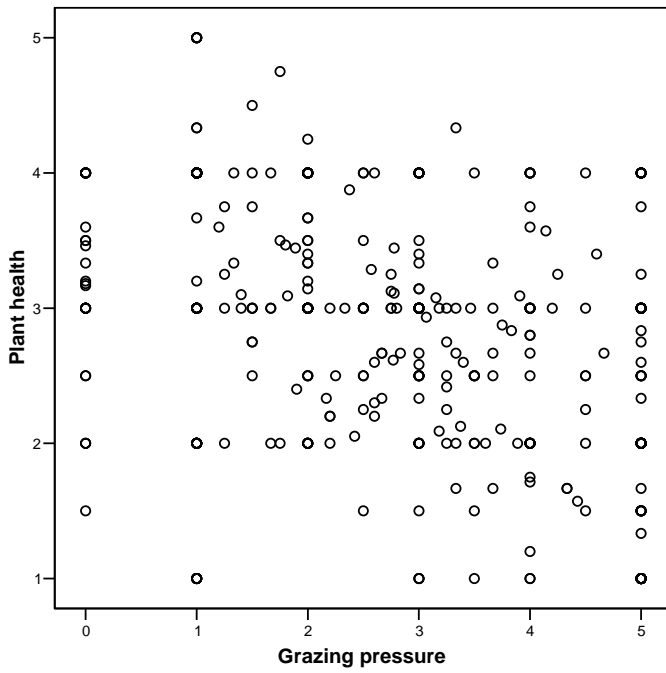


Figure 9
 Relationship between grazing pressure and plant health, for all the recorded plant species in the wadis surveyed. There is a highly significant negative relationship ($r_s = -0.454$, $n=445$, $p<0.001$). If causal, this implies that grazing is currently having a significant impact on plant condition.

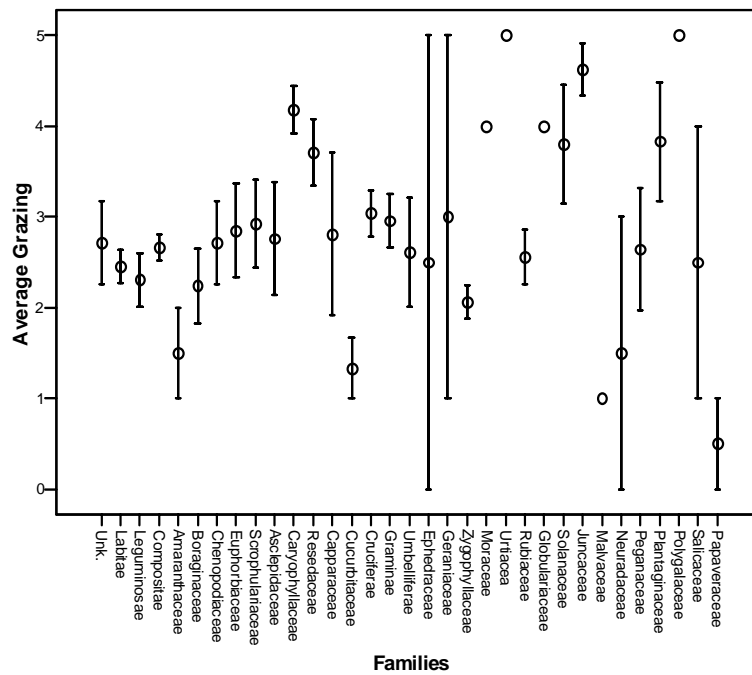
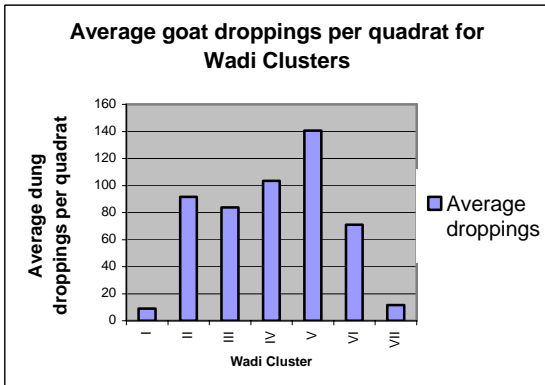
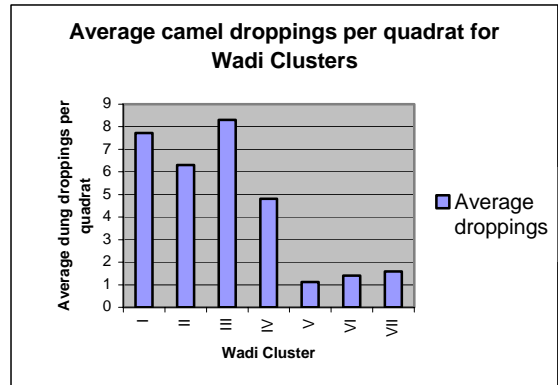


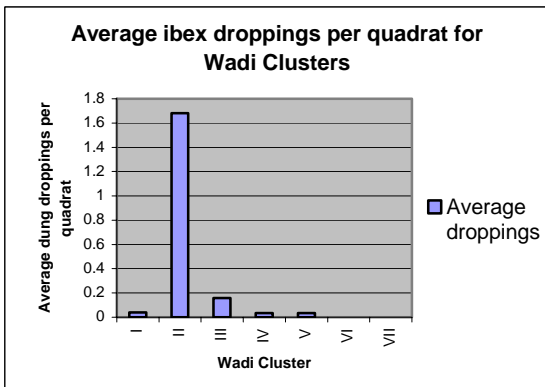
Figure 10
 Mean grazing pressure (\pm S.E.) for plant families encountered during 2005 surveys of St. Katherine Protectorate. There are highly significant differences among these mean values ($F_{32,412}=2.060$, $n=33$, $p=0.001$).



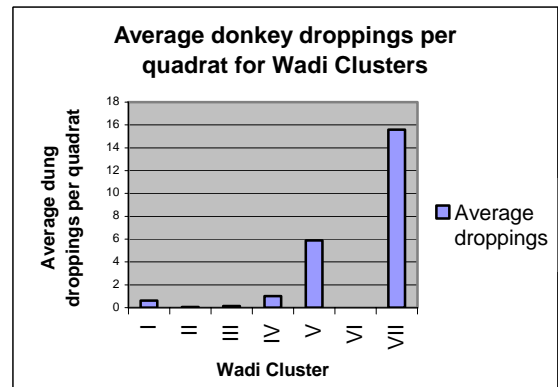
(b)



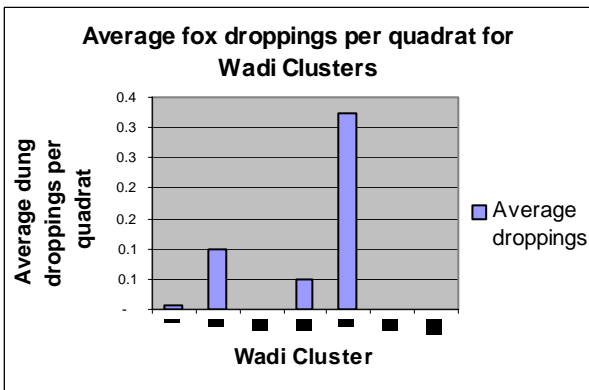
(a)



(d)



(c)



(e)

Figure 11

Average number of dung droppings per quadrat for (a) camel, (b) goat, (c) donkey, (d) ibex, (e) fox, grouped by TWINSpan wadi clusters.

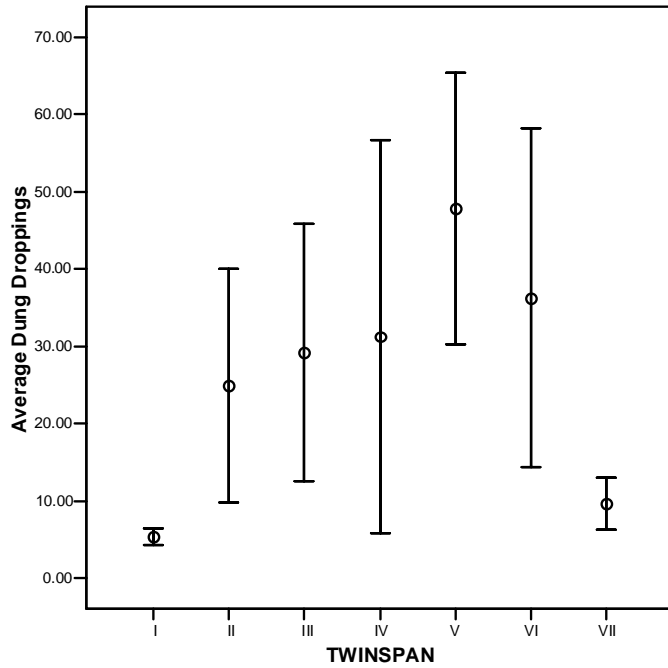


Figure 12
 Mean dung droppings (\pm S.E.) for TWINSPAN clusters encountered during 2005 surveys of St. Katherine Protectorate. There are significant differences among these mean values ($F_{7,88}=3.3$, $p<0.005$).

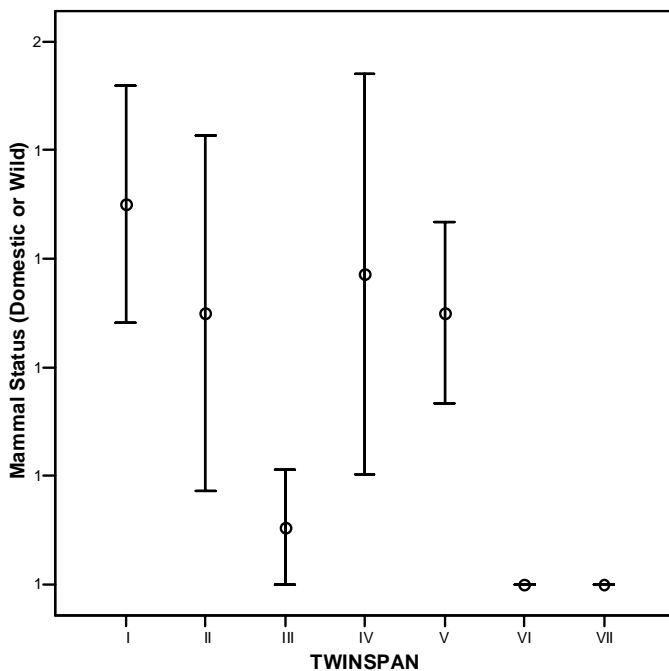


Figure 13
 Mean differences in mammalian species status (\pm S.E.) for TWINSPAN clusters during 2005 dung surveys of St. Katherine Protectorate. There are highly significant differences in the mammalian species status ($F_{7,88}=127.2$, $p<0.001$).

Appendices

Appendix 1: SWOT ANALYSIS

Strengths & Opportunities

St. Katherine Protected Area was declared in 1996 and was given financial assistance from the European Union to develop a management program. Therefore, the protectorate is well staffed with a management program in place. They enforce the rules of the protected area and concern themselves with unauthorized collecting and also with graffiti within the protectorate. The rangers know the flora and fauna of the area extremely well. They have established walking trails with guides to provide to tourists for a cost of 5 EP. They greatly assisted in this study by providing transport and rangers to accompany the research groups on the mobile treks.

There were also Bedouin guides accompanying groups on the mobile treks. They are well experienced in wadi travel and proved to be excellent guides. They are also knowledgeable about the flora and fauna of the protectorate and proved to be helpful in the identification of plant species.

Although tourism has been increasing in St. Katherine Protectorate in recent years, more can be done to attract tourists to the area. Most tourists come to St. Katherine only to see the monastery and Mt. Sinai. Very few tourists penetrate the remote areas of the Protectorate. However, if tourists had better access to guides they may be inclined to stay in the Sinai for longer periods of time.

There is also an opportunity to increase medicinal plant production within the Sinai. There are many gardens already in place throughout the protectorate. These gardens range from the production of fruit to illegal drugs and are owned by Bedouin landowners. It would be advantageous if it were economical for these gardens to produce medicinal plants, possibly along with food production. However, the illegal drug fields need to be eliminated.

Weaknesses & Threats

Since the funding from the European Union ran out, the protectorate has struggled to get the funds they need to run the management program. The previous funding has provided a management program with the proper facilities and equipment. However, they need continued funding for the upkeep and maintenance of vehicles and equipment. They also need funding to maintain an appropriate amount of staff within the protectorate. Continued funding could also ensure forward movement of the management program. For example, detailed topographic maps of the wadi system could be provided to local researchers.

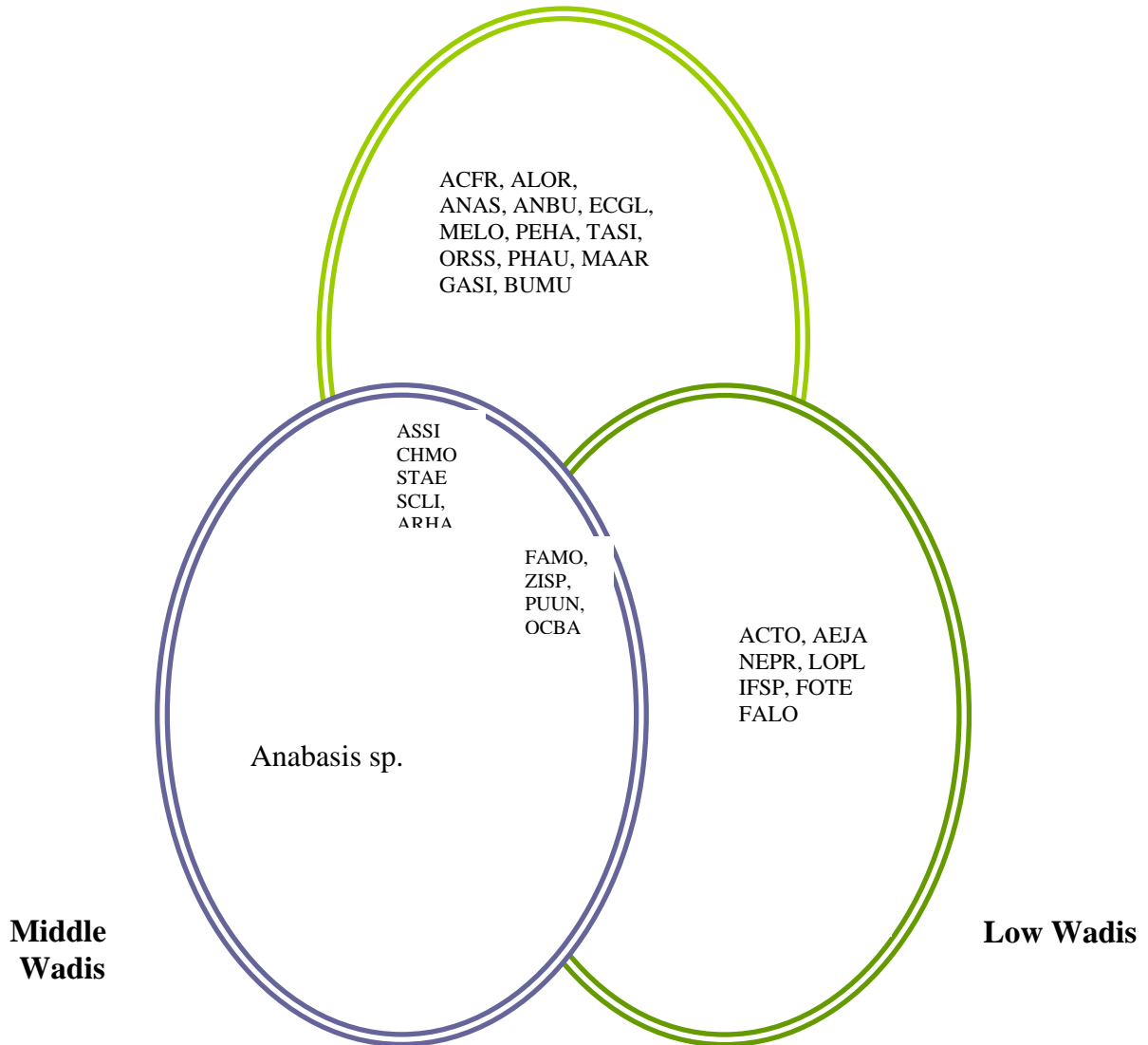
The Bedouin guides are excellent in navigation through the wadis. However, the time and distance measurements that they provided proved to be different than what we expected. Quite often, we were told that the next area was two hours away when, in fact, it was four or five hours away. The Bedouin guides need to account for our slower pace and adjust their time and distance measurements.

Threats to the protectorate include the over collection, overgrazing, and uprooting of plants for medicinal purposes and for camel fodder. There is also a substantial amount of grazing occurring by feral donkeys, goats, and sheep. There is also a fair amount of water exploitation going on within the wadi system. Wells are being dug and water is being extracted from the groundwater system, which threatens the plant communities of the area.

Another threat that was observed is the occurrence of illegal drug fields within the protectorate. A reasonable alternative needs to be provided to the owners of these fields in order to phase them out completely.

Appendix 2: Diagram representing overlapping plant species along elevational gradients

High Wadis



Legend of Plant Codes:

ACFR=*Achillea fragrantissima*
 ALOR=*Alkanna orientalis*
 ANAS=*Andrachne aspera*
 ANBU=*Anarrhinum pubescens*
 ECGL=*Echinops glaberrimus*
 MELO=*Mentha longifolia*
 PEHA=*Peganum harmala*
 TASI=*Tanacetum sinaicum*
 ORSS=*Origanum syriacum-sinaicum*
 PHAU=*Phlomis aurea*
 MAAR=*Matthiola arabica*

GASI=*Galium sinaica*
 BUMU=*Bufonia multiceps*
 ASSI=*Asclepias sinaica*
 CHMO=*Chiliadenus montanus*
 STAE=*Stachys aegyptiaca*
 SCLI=*Scrophularia libanotica*
 ARHA=*Artemisia herba-alba*
 FAMO=*Fagonia mollis*
 ZISP=*Zilla spinosa*
 PUUN=*Pulicaria undulata*
 OCBA=*Ochradenus baccatus*

ACTO=*Acacia tortilis*
 AEJA=*Aerva javanica*
 NEPR=*Neurada procumbens*
 LOPL=*Lotononis platycarpa*
 IFSP=*Ifloga spicata*
 FOTE=*Forsskaolea tenacissima*
 FALO=*Farsetia longisiliqua*

Appendix 3: Mean Importance Values for plant species

| Plant Species | Group I | Group II | Group III | Group IV | Group V | Group VI | Group VII |
|-----------------------------------|----------------|-----------------|------------------|-----------------|----------------|-----------------|------------------|
| <i>Acacia tortilis</i> | 114.91 | 130.57 | - | - | - | - | - |
| <i>Achillea fragrantissima</i> | - | - | - | - | 210.18 | - | 88.73 |
| <i>Aerva japonica</i> | 59.14 | 133.04 | - | - | - | - | - |
| <i>Alkanna orientalis</i> | - | - | - | - | 216.35 | 274.67 | - |
| <i>Anabasis sp.</i> | - | - | 48.67 | 139.04 | - | - | - |
| <i>Andrachne aspera</i> | - | - | - | - | 131.7 | - | - |
| <i>Anarrhinum pubescens</i> | - | - | - | - | 33.01 | 147.79 | - |
| <i>Arthrocnemum macrostachyum</i> | 117.41 | - | - | - | - | - | - |
| <i>Artemisia herba-alba</i> | - | - | - | - | 172.45 | 131 | 261.35 |
| <i>Artemisia judaica</i> | 55.77 | 249.08 | 142.47 | 102.89 | 30.74 | - | 97.41 |
| <i>Asclepias sinaica</i> | - | - | 48.05 | - | 161.57 | - | - |
| <i>Astragalus sp.</i> | 58.6 | - | - | - | 31.63 | - | 195.86 |
| <i>Astragalus spinosus</i> | - | - | 98.39 | - | - | - | - |
| <i>Ballota kaiseri</i> | - | - | - | - | - | 140.97 | - |
| <i>Ballota undulata</i> | - | 147.7 | - | - | 98.06 | - | - |
| <i>Bufonia multiceps</i> | - | - | - | - | 163.98 | - | 99.09 |
| <i>Caylusea hexagyna</i> | - | 292.64 | 97.5 | - | 33.11 | 147.79 | - |
| <i>Capparis sinaica</i> | - | 113.97 | - | - | 33.11 | - | - |
| <i>Capparis spinosa</i> | - | 148.68 | - | - | 32.27 | - | - |
| <i>Hinaba Caylusea hexagyna?</i> | - | - | 49.34 | - | - | - | - |
| <i>Chiliadenus montanus</i> | - | - | - | 135.91 | 157.63 | 294.71 | 99.09 |
| <i>Chrozophora oblongifolia</i> | - | 149.02 | - | - | - | - | - |
| <i>Citrullus colocynthis</i> | 59.14 | 147.51 | - | - | - | - | - |
| <i>Crepis sp.</i> | - | - | - | - | 33.19 | - | - |
| <i>Crotalaria aegyptiaca</i> | 53.34 | - | - | - | - | - | - |
| <i>Cucumis prophetarum</i> | - | 147.3 | - | - | - | - | - |
| <i>Cynodon dactylon</i> | - | - | - | - | 97.79 | 147.48 | - |
| <i>Deverra triradiata</i> | 231.77 | - | - | - | 33.11 | - | 286.55 |
| <i>Deverra sp.</i> | - | - | - | - | 33.1 | - | - |
| <i>Echinops glaberrimus</i> | - | - | - | - | 196.16 | 140.11 | 97.41 |
| <i>Ephedra alata</i> | 58.6 | - | - | - | - | - | 94.81 |
| <i>Ephedra aphylla</i> | 58.4 | - | - | - | - | - | - |
| <i>Erodium sp.</i> | - | - | 49.57 | - | - | - | 97.41 |
| <i>Euphorbia pepelis</i> | - | - | - | - | 88.14 | - | 82.76 |
| <i>Fagonia arabica</i> | 59.45 | 137.35 | 193.96 | 128.86 | 160.96 | - | - |
| <i>Fagonia mollis</i> | 157.82 | 282.41 | 234.13 | 215.7 | 150.85 | - | - |
| <i>Fagonia sp.</i> | 278.38 | 146.11 | - | - | - | - | - |
| <i>Farsetia longisiliqua</i> | 167.12 | - | - | - | - | - | 98.43 |
| <i>Ficus carica</i> | - | - | - | - | 32.11 | - | - |
| <i>Filago sp.</i> | 58.34 | - | - | - | - | - | - |
| <i>Forsskaolea tenacissima</i> | - | 149.34 | - | - | - | - | - |
| <i>Galium sinaica</i> | - | - | - | - | 225.6 | - | - |
| <i>Globularia arabica</i> | - | - | - | - | - | - | 93.27 |
| <i>Gymnocarpus decandrus</i> | - | - | 49.37 | 145.6 | 32.85 | - | - |
| <i>Hamada elegans</i> | 170.57 | 147.08 | 80.75 | - | - | - | - |
| <i>Heliotropium digynum</i> | 175.18 | 140.63 | 48.73 | - | - | - | - |
| <i>Hyoscyamus muticus</i> | - | 276.02 | - | - | - | - | - |
| <i>Ifloga spicata</i> | - | 148.68 | - | - | - | - | - |
| <i>Ipheion scabra</i> | 175.62 | - | - | - | 33.19 | - | - |
| <i>Juncus rigidus</i> | - | - | - | 88.56 | - | - | - |
| <i>Juncus sp.</i> | - | - | - | 147.38 | 65.53 | 282.73 | - |

Rebecca Guenther: OpWall Plant Report

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|--|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| <i>Kickxia aegyptiaca</i> | 58.53 | - | - | - | 32.37 | - | - |
| <i>Launaea nudicaulis</i> | - | - | - | 147.38 | - | - | - |
| <i>Launaea spinosa</i> | 118.6 | 148.36 | 48.67 | 138.23 | 32.7 | - | - |
| <i>Lavandula coronopifolia</i> | - | 149.34 | - | - | 33.11 | - | - |
| <i>Lolium sp.</i> | - | - | - | - | - | 145.58 | - |
| <i>Lotononis platycarpa</i> | 116.11 | - | - | - | - | - | - |
| <i>Lotus sp.</i> | 59.49 | - | - | 147.38 | 97.88 | - | - |
| <i>Lycium shawii</i> | - | 148.57 | - | - | - | - | - |
| <i>Malva sp.</i> | - | - | - | - | - | 147.79 | - |
| <i>Matthiola arabica</i> | - | - | - | - | 163.8 | - | 93.7 |
| <i>Mentha longifolia</i> | - | - | - | - | 97.82 | 128.21 | - |
| <i>Nepeta septemcrenata</i> | - | - | - | - | - | 278.89 | - |
| <i>Neurada procumbens</i> | 117.79 | - | - | - | - | - | - |
| <i>Ochradenus baccatus</i> | 56.78 | - | 144.84 | 146.1 | - | - | - |
| <i>Onopordum ambiguum</i> | - | - | - | - | 33.02 | - | - |
| <i>Origanum syriacum sinaicum</i> | - | - | - | - | 161.33 | 279.36 | - |
| <i>Panicum turgidum</i> | 175.44 | - | - | - | - | - | - |
| <i>Peganum harmala</i> | - | - | - | - | 130.66 | 296.23 | 99.09 |
| <i>Pennisetum sp.</i> | - | - | - | - | 32.9 | - | - |
| <i>Pergularia tomentosa</i> | 58.27 | - | - | - | - | - | - |
| <i>Phlomis aurea</i> | - | - | - | - | 124.9 | 292.45 | - |
| <i>Plantago sinaica</i> | - | - | 49.37 | 147.38 | 98.65 | - | 84.06 |
| <i>Polygala sp.</i> | - | - | - | - | 32.85 | - | - |
| <i>Polypogon sp.</i> | - | - | - | - | - | 286.31 | - |
| <i>Pulicaria undulata</i> | - | 295.3 | - | - | 152.9 | 135.56 | - |
| <i>Reseda pruinosa</i> | 58.6 | 270.31 | 147.8 | - | - | - | - |
| <i>Reseda sp.</i> | - | - | - | - | 65.96 | - | - |
| <i>Retama raetam</i> | 189.33 | - | 139.23 | - | - | - | - |
| <i>Salix sp.</i> | - | - | - | - | - | - | 85.81 |
| <i>Salix subserrata</i> | - | - | - | - | 32.35 | - | - |
| <i>Schismus barbatus</i> | - | 273.82 | 87.18 | 146.03 | 163.79 | 147.79 | 191.08 |
| <i>Scrophularia libanotica</i> | - | - | 49.02 | - | 163.56 | - | 85.07 |
| <i>Stachys aegyptiaca</i> | - | - | - | 283.68 | 224 | 148.44 | 94.06 |
| <i>Stipagrostis ciliata</i> | 51.28 | - | - | - | 32.81 | - | 97.41 |
| <i>Stipagrostis obtusa</i> | - | - | - | 147.38 | - | - | - |
| <i>Stipagrostis sp.</i> | 113.36 | 145.81 | - | - | 65.89 | - | - |
| <i>Tanacetum sinaicum</i> | - | - | - | - | 193.55 | 258.25 | 148.66 |
| <i>Teucrium polium</i> | 59.51 | 148.68 | - | - | 254.32 | 292.02 | 180.3 |
| <i>Thymus decussates</i> | - | - | - | - | - | 120.91 | - |
| <i>Verbascum sinaicum</i> | - | 149.34 | - | - | 63.82 | 296.04 | - |
| <i>Zilla spinosa</i> | 270.25 | 2.62 | 192.2 | 292.48 | 284.07 | - | 257.07 |
| Asteraceae sp | - | - | - | - | 163.59 | - | - |
| Chenopodiaceae sp | - | - | - | - | - | 145.58 | - |
| Compositae sp | 58.6 | - | - | - | - | - | - |
| Cruciferae sp | 59.04 | - | - | - | 124.34 | - | 187.48 |
| Graminae sp | 58.88 | - | - | - | - | - | - |
| Papaveraceae sp. | 58.6 | - | - | - | 32.92 | - | - |
| <i>Spergula/Minuartia?</i> | - | 147.67 | - | - | - | - | - |
| Unknown 1 | - | - | - | - | 32.11 | - | 185.04 |
| Unknown 2 | - | 149.34 | - | - | - | - | - |
| Unknown 3 | 293.77 | 296.12 | - | - | 130.8 | - | - |
| Number of Species | 39 | 31 | 20 | 17 | 57 | 25 | 26 |
| Number of Wadis | 5 | 2 | 6 | 2 | 9 | 2 | 3 |
| Simpson Diversity Index | 0.95 | 0.84 | 0.74 | 0.81 | 0.81 | 0.93 | 0.9 |
| % Similarity among communities of wadis | 95.4 | 93.3 | 72.2 | 91.1 | 70.2 | 95.6 | 82 |

Appendix 4: Plant species recorded from the surveyed wadis

| Plant Name | Class | Family |
|-----------------------------------|------------------|------------------|
| <i>Acacia tortilis</i> | Dicotyledoneae | Leguminosae |
| <i>Achillea fragrantissima</i> | Dicotyledoneae | Compositae |
| <i>Aerva javanica</i> | Dicotyledoneae | Amaranthaceae |
| <i>Alkanna orientalis</i> | Dicotyledoneae | Boraginaceae |
| <i>Anabasis</i> sp. | Dicotyledoneae | Chenopodiaceae |
| <i>Andrachne aspera</i> | Dicotyledoneae | Euphorbiaceae |
| <i>Anarrhinum pubescens</i> | Dicotyledoneae | Scrophulariaceae |
| <i>Artemisia herba-alba</i> | Dicotyledoneae | Compositae |
| <i>Artemisia judaica</i> | Dicotyledoneae | Compositae |
| <i>Arthrocnemum macrostachyum</i> | Dicotyledoneae | Chenopodiaceae |
| <i>Asclepias sinaica</i> | Dicotyledoneae | Asclepiadaceae |
| <i>Astragalus</i> sp. | Dicotyledoneae | Leguminosae |
| <i>Astragalus spinosus</i> | Dicotyledoneae | Leguminosae |
| <i>Ballota kaiseri</i> | Dicotyledoneae | Labiatae |
| <i>Ballota undulata</i> | Dicotyledoneae | Labiatae |
| <i>Bufonia multiceps</i> | Dicotyledoneae | Caryophyllaceae |
| <i>Capparis sinaica</i> | Dicotyledoneae | Capparaceae |
| <i>Capparis spinosa</i> | Dicotyledoneae | Capparaceae |
| <i>Caylusea hexagyna</i> | Dicotyledoneae | Resedaceae |
| <i>Chiliadenus montanus</i> | Dicotyledoneae | Compositae |
| <i>Chrozophora oblongifolia</i> | Dicotyledoneae | Euphorbiaceae |
| <i>Citrullus colocynthis</i> | Dicotyledoneae | Cucurbitaceae |
| <i>Crepis</i> sp. | Dicotyledoneae | Leguminosae |
| <i>Crotalaria aegyptiaca</i> | Dicotyledoneae | Leguminosae |
| <i>Cruciferae</i> sp. | Dicotyledoneae | Cruciferae |
| <i>Cruciferae/ legume</i> | Dicotyledoneae | Leguminosae |
| <i>Cucumis prophetarum</i> | Dicotyledoneae | Cucurbitaceae |
| <i>Cynodon dactylon</i> | Monocotyledoneae | Gramineae |
| <i>Deverra tortuosa</i> | Dicotyledoneae | Umbelliferae |
| <i>Deverra triradiata</i> | Dicotyledoneae | Umbelliferae |
| <i>Echinops glaberrimus</i> | Dicotyledoneae | Compositae |
| <i>Ephedra alata</i> | Gymnospermae | Ephedraceae |
| <i>Erodium</i> sp. | Dicotyledoneae | Geraniaceae |
| <i>Euphorbia peplis</i> | Dicotyledoneae | Euphorbiaceae |
| <i>Fagonia arabica</i> | Dicotyledoneae | Zygophyllaceae |
| <i>Fagonia mollis</i> | Dicotyledoneae | Zygophyllaceae |
| <i>Fagonia</i> sp. | Dicotyledoneae | Zygophyllaceae |
| <i>Farsetia longisiliqua</i> | Dicotyledoneae | Cruciferae |
| <i>Ficus carica</i> | Dicotyledoneae | Moraceae |
| <i>Filago</i> sp. | Dicotyledoneae | Compositae |
| <i>Forsskaolea tenacissima</i> | Dicotyledoneae | Urticaceae |
| <i>Galium sinaicum</i> | Dicotyledoneae | Rubiaceae |
| <i>Globularia arabica</i> | Dicotyledoneae | Globulariaceae |
| <i>Gymnocarpus decandrus</i> | Dicotyledoneae | Caryophyllaceae |
| <i>Haloxylon salicornicum</i> | Dicotyledoneae | Chenopodiaceae |
| <i>Heliotropium digynum</i> | Dicotyledoneae | Boraginaceae |
| <i>Hyoscyamus muticus</i> | Dicotyledoneae | Solanaceae |
| <i>Ifloga spicata</i> | Dicotyledoneae | Compositae |
| <i>Iphiaea scabra</i> | Dicotyledoneae | Compositae |
| <i>Juncus rigidus</i> | Monocotyledoneae | Juncaceae |
| <i>Juncus</i> sp. | Monocotyledoneae | Juncaceae |
| <i>Kickxia aegyptiaca</i> | Dicotyledoneae | Scrophulariaceae |
| <i>Launaea nudicaulis</i> | Dicotyledoneae | Compositae |

| | | |
|-----------------------------------|------------------|------------------|
| <i>Launaea spinosa</i> | Dicotyledoneae | Compositae |
| <i>Lavandula coronopifolia</i> | Dicotyledoneae | Labiatae |
| <i>Lolium</i> sp. | Monocotyledoneae | Gramineae |
| <i>Lotononis platycarpa</i> | Dicotyledoneae | Leguminosae |
| <i>Lotus</i> sp. | Dicotyledoneae | Leguminosae |
| <i>Lycium shawii</i> | Dicotyledoneae | Solanaceae |
| <i>Malva</i> sp. | Dicotyledoneae | Malvaceae |
| <i>Matthiola arabica</i> | Dicotyledoneae | Cruciferae |
| <i>Mentha longifolia</i> | Dicotyledoneae | Labiatae |
| <i>Nepeta septemcrenata</i> | Dicotyledoneae | Labiatae |
| <i>Neurada procumbens</i> | Dicotyledoneae | Neuradaceae |
| <i>Ochradenus baccatus</i> | Dicotyledoneae | Resedaceae |
| <i>Onopordum ambiguum</i> | Dicotyledoneae | Compositae |
| <i>Origanum syriacum sinaicum</i> | Dicotyledoneae | Labiatae |
| <i>Panicum turgidum</i> | Monocotyledoneae | Gramineae |
| <i>Peganum harmala</i> | Dicotyledoneae | Peganaceae |
| <i>Pennisetum</i> sp. | Monocotyledoneae | Gramineae |
| <i>Pergularia tomentosa</i> | Dicotyledoneae | Asclepiadaceae |
| <i>Phlomis aurea</i> | Dicotyledoneae | Labiatae |
| <i>Plantago sinaica</i> | Dicotyledoneae | Plantaginaceae |
| <i>Polygala</i> sp. | Dicotyledoneae | Polygalaceae |
| <i>Polypogon</i> sp. | Monocotyledoneae | Gramineae |
| <i>Pulicaria undulata</i> | Dicotyledoneae | Compositae |
| <i>Reseda pruinosa</i> | Dicotyledoneae | Resedaceae |
| <i>Reseda</i> sp. | Dicotyledoneae | Resedaceae |
| <i>Retama raetam</i> | Dicotyledoneae | Leguminosae |
| <i>Salix subserrata</i> | Dicotyledoneae | Salicaceae |
| <i>Schismus barbatus</i> | Monocotyledoneae | Gramineae |
| <i>Scrophularia libanotica</i> | Dicotyledoneae | Scrophulariaceae |
| <i>Stachys aegyptiaca</i> | Dicotyledoneae | Labiatae |
| <i>Stipagrostis ciliata</i> | Monocotyledoneae | Gramineae |
| <i>Stipagrostis obtusa</i> | Monocotyledoneae | Gramineae |
| <i>Stipagrostis</i> sp. | Monocotyledoneae | Gramineae |
| <i>Tanacetum sinaicum</i> | Dicotyledoneae | Compositae |
| <i>Teucrium polium</i> | Dicotyledoneae | Labiatae |
| <i>Thymus decussatus</i> | Dicotyledoneae | Labiatae |
| <i>Verbascum sinaiticum</i> | Dicotyledoneae | Scrophulariaceae |
| <i>Zilla spinosa</i> | Dicotyledoneae | Cruciferae |

Appendix 5: Recorded plant species, number of sites recorded in, and their percent presence

| Plant Species | # Stands | % | Plant Species | # Stands | % |
|------------------------------------|-------------|--------------|------------------------------------|-------------|--------------|
| <i>Acacia tortilis</i> | 2 | 6.90 | <i>Juncus rigidus</i> | 1 | 3.45 |
| <i>Achillea fragrantissima</i> | 7 | 24.14 | <i>Juncus</i> sp. | 5 | 17.24 |
| <i>Aerva javanica</i> | 1 | 3.45 | <i>Kickxia aegyptiaca</i> | 2 | 6.90 |
| <i>Alkanna orientalis</i> | 9 | 31.03 | <i>Launaea nudicaulis</i> | 1 | 3.45 |
| <i>Anabasis</i> sp. | 2 | 6.90 | <i>Launaea spinosa</i> | 6 | 20.69 |
| <i>Andrachne aspera</i> | 4 | 13.79 | <i>Lavandula coronopifolia</i> | 2 | 6.90 |
| <i>Anarrhinum pubescens</i> | 2 | 6.90 | <i>Lolium</i> sp. | 1 | 3.45 |
| <i>Arthrocnemum macrostachyum</i> | 2 | 6.90 | <i>Lotononis platycarpa</i> | 2 | 6.90 |
| <i>Artemisia herba-alba</i> | 10 | 34.48 | <i>Lotus</i> sp. | 5 | 17.24 |
| <i>Artemisia judaica</i> | 12 | 41.38 | <i>Lycium shawii</i> | 1 | 3.45 |
| <i>Asclepias sinaica</i> | 6 | 20.69 | <i>Malva</i> sp. | 1 | 3.45 |
| <i>Astragalus</i> sp. | 4 | 13.79 | <i>Matthiola arabica</i> | 6 | 20.69 |
| <i>Astragalus spinosus</i> | 2 | 6.90 | <i>Mentha longifolia</i> | 4 | 13.79 |
| <i>Ballota kaiseri</i> | 1 | 3.45 | <i>Nepeta septemcrenata</i> | 2 | 6.90 |
| <i>Ballota undulata</i> | 4 | 13.79 | <i>Neurada procumbens</i> | 2 | 6.90 |
| <i>Bufonia multiceps</i> | 6 | 20.69 | <i>Ochradenus baccatus</i> | 5 | 17.24 |
| <i>Caylusea hexagyna</i> | 6 | 20.69 | <i>Origanum syriacum</i> | 7 | 24.14 |
| <i>Capparis sinaica</i> | 2 | 6.90 | <i>Panicum turgidum</i> | 3 | 10.34 |
| <i>Capparis spinosa</i> | 2 | 6.90 | <i>Peganum harmala</i> | 7 | 24.14 |
| <i>Chiliadenus montanus</i> | 9 | 31.03 | <i>Pennisetum</i> sp. | 1 | 3.45 |
| <i>Chrozophora oblongifolia</i> | 1 | 3.45 | <i>Pergularia tomentosa</i> | 1 | 3.45 |
| <i>Citrullus colocynthis</i> | 2 | 6.90 | <i>Phlomis aurea</i> | 6 | 20.69 |
| <i>Crepis</i> sp. | 1 | 3.45 | <i>Plantago sinaica</i> | 6 | 20.69 |
| <i>Crotalaria aegyptiaca</i> | 1 | 3.45 | <i>Polygala</i> sp. | 1 | 3.45 |
| <i>Cruciferae</i> sp. | 1 | 3.45 | <i>Polypogon</i> sp. | 2 | 6.90 |
| <i>Cruciferae/ legume</i> | 1 | 3.45 | <i>Pulicaria undulata</i> | 8 | 27.59 |
| <i>Cucumis prohetarum</i> | 1 | 3.45 | <i>Reseda pruinosa</i> | 6 | 20.69 |
| <i>Cynodon dactylon</i> | 4 | 13.79 | <i>Reseda</i> sp. | 2 | 6.90 |
| <i>Deverra triradiata</i> | 8 | 27.59 | <i>Retama raetam</i> | 7 | 24.14 |
| <i>Deverra tortuosa</i> | 1 | 3.45 | <i>Salix subserrata</i> | 1 | 3.45 |
| <i>Echinops glaberrimus</i> | 8 | 27.59 | <i>Schismus barbatus</i> | 13 | 44.83 |
| <i>Ephedra alata</i> | 2 | 6.90 | <i>Scrophularia libanotica</i> | 8 | 27.59 |
| <i>Erodium</i> sp. | 2 | 6.90 | <i>Stachys aegyptiaca</i> | 11 | 37.93 |
| <i>Euphorbia peplis</i> | 4 | 13.79 | <i>Stipagrostis ciliata</i> | 3 | 10.34 |
| <i>Fagonia arabica</i> | 12 | 41.38 | <i>Stipagrostis obtusa</i> | 1 | 3.45 |
| <i>Fagonia mollis</i> | 19 | 65.52 | <i>Stipagrostis</i> sp. | 5 | 17.24 |
| <i>Fagonia</i> sp. | 6 | 20.69 | <i>Tanacetum sinaicum</i> | 10 | 34.48 |
| <i>Farsetia longisiliqua</i> | 4 | 13.79 | <i>Teucrium polium</i> | 14 | 48.28 |
| <i>Ficus carica</i> | 1 | 3.45 | <i>Thymus decussatus</i> | 1 | 3.45 |
| <i>Filago</i> sp. | 1 | 3.45 | unknown Asteraceae | 5 | 17.24 |
| <i>Forsskaolea tenacissima</i> | 1 | 3.45 | unknown Chenopodiaceae | 1 | 3.45 |
| <i>Galium sinaicum</i> | 7 | 24.14 | unknown Compositae | 1 | 3.45 |
| <i>Globularia arabica</i> | 1 | 3.45 | unknown Cruciferae | 7 | 24.14 |
| <i>Gymnocarpus decandrus</i> | 3 | 10.34 | unknown Graminae | 1 | 3.45 |
| <i>Haloxylon salicornicum</i> | 7 | 24.14 | <i>Onopordum ambiguum</i> | 1 | 3.45 |
| <i>Heliotropium digynum</i> | 5 | 17.24 | unknown Papaveraceae | 2 | 6.90 |
| <i>Hyoscyamus muticus</i> | 2 | 6.90 | unknown <i>Spergula/Minuartia?</i> | 1 | 3.45 |
| <i>Ifloga spicata</i> | 1 | 3.45 | <i>Verbascum sinaicum</i> | 5 | 17.24 |
| <i>Iphiaea scabra</i> | 4 | 13.79 | <i>Zilla spinosa</i> | 24 | 82.76 |

Appendix 6: Recorded families

| Family | # Species | % |
|--------------------------------|-----------|---------------|
| Amaranthaceae | 1 | 1.02 |
| Asclepiadaceae | 2 | 2.04 |
| Boraginaceae | 2 | 2.04 |
| Capparaceae | 2 | 2.04 |
| Caryophyllaceae | 3 | 3.06 |
| Chenopodiaceae | 4 | 4.08 |
| Compositae | 15 | 15.31 |
| Cruciferae | 5 | 5.10 |
| Cucurbitaceae | 2 | 2.04 |
| Ephedraceae | 1 | 1.02 |
| Euphorbiaceae | 3 | 3.06 |
| Geraniaceae | 1 | 1.02 |
| Globulariaceae | 1 | 1.02 |
| Gramineae | 10 | 10.20 |
| Juncaceae | 2 | 2.04 |
| Labiatae | 10 | 10.20 |
| Leguminosae | 9 | 9.18 |
| Malvaceae | 1 | 1.02 |
| Moraceae | 1 | 1.02 |
| Neuradaceae | 1 | 1.02 |
| Papaveraceae | 1 | 1.02 |
| Peganaceae | 1 | 1.02 |
| Plantaginaceae | 1 | 1.02 |
| Polygalaceae | 1 | 1.02 |
| Resedaceae | 4 | 4.08 |
| Rubiaceae | 1 | 1.02 |
| Salicaceae | 1 | 1.02 |
| Scrophulariaceae | 4 | 4.08 |
| Solanaceae | 2 | 2.04 |
| Umbelliferae | 2 | 2.04 |
| Urticaceae | 1 | 1.02 |
| Zygophyllaceae | 3 | 3.06 |
| Total number of species | 98 | 100.00 |

Appendix 7: Summation of recorded families, genera, and species

| | |
|---------------------|----|
| Number of Families | 32 |
| Gymnosperm Family | 1 |
| Angiosperm Families | 31 |
| Monocot Families | 2 |
| Dicot Families | 29 |
| Number of Genera | 86 |
| Number of Species | 98 |

Appendix 8: Stages of plant species in the surveyed sites

Wadi Abu Matir

Acacia tortilis
Cruciferae sp.
Deverra triradiata
Fagonia sp.
Filago sp.
Kickxia aegyptiaca
Launea spinosa
Neurada procumbens
Panicum turgidum
Retama raetam
Stipagrostis ciliata
Zilla spinosa

Wadi Ain Hudra

Astragalus sp.
Ephedra alata
Fagonia mollis
Fagonia sp.
Farsetia longisiliqua
Hamada elegans
Heliotropium digynum
Iphiona scabra
Reseda pruinosa
 unknown Compositae
 unknown Papaveraceae
Zilla spinosa

Wadi Elwadii

Acacia tortilis
Arthrocnemum macrostachyum
Artemisia judaica
Crotalaria aegyptiaca
Deverra triradiata
Fagonia sp.
Hamada elegans
Retama raetam
Zilla spinosa

Wadi Kiri

Aerva javanica
Citrullus colocynthis
Deverra triradiata
Fagonia arabica
Fagonia mollis
Fagonia sp.
Farsetia longisiliqua
Hamada elegans
Heliotropium digynum
Iphiona scabra
Leguminosae sp.
Lotononis platycarpa
Lotus sp.
Panicum turgidum

Stage

Flowering
 Vegetative
 Fruiting
 Flowering
 Flowering
 Flowering
 Vegetative
 Vegetative
 Fruiting
 Vegetative
 Fruiting
 Vegetative

Fruiting

Vegetative
 Flowering
 Flowering
 Vegetative
 Vegetative
 Vegetative
 Vegetative
 Vegetative
 Fruiting
 Vegetative

Stage

Vegetative
 Vegetative
 Fruiting
 Vegetative
 Vegetative
 Vegetative
 Vegetative
 Vegetative
 Vegetative
 Fruiting
 Fruiting

Stage

Flowering
 Fruiting
 Vegetative
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Vegetative
 Vegetative
 Fruiting
 Fruiting
 Dormant
 Flowering
 Flowering
 Fruiting

Albarega

Artemisia judaica
Asclepias sinaica
Astragalus spinosus
Caylusea hexagyna
Fagonia arabica
Fagonia mollis
Reseda pruinosa
Scrophularia libanotica
Zilla spinosa

Koria Shamoun

Artemisia judaica
Fagonia mollis
Retama raetam

Gharaba

Artemisia judaica
Fagonia mollis

Erdasia

Anabasis sp.
Fagonia mollis
Juncus rigidus
Stachys aegyptiaca
Zilla spinosa

Wadi Souria

Anabasis sp.
Artemisia judaica
Astragalus spinosus
Fagonia arabica
Fagonia mollis
Gymnocarpus decandrus
Heliotropium digynum
Launea spinosa
Ochradenus baccatus
Plantago sinaica
Reseda pruinosa
Retama raetam
Zilla spinosa

Farsh El Luz

Alkanna orientalis
Anarrhinum pubescens
Caylusea hexagyna
Chiliadenus montanus
Juncus sp.
Lolium sp.
Malva sp.
Matthiola arabica
Nepeta septemcrenata
Origanum syriacum sinaicum
Peganum harmala
Phlomis aurea
Polypogon sp.

Stage

Vegetative
 Vegetative
 Vegetative
 Vegetative
 Vegetative
 Fruiting
 Dormant
 Vegetative
 Vegetative

Stage

Fruiting
 Fruiting
 Vegetative

Stage

Fruiting
 Fruiting

Flowering
 Fruiting
 Vegetative
 Vegetative
 Fruiting

Stage

Vegetative
 Fruiting
 Flowering
 Fruiting
 Fruiting
 Fruiting
 Vegetative
 Flowering
 Vegetative
 Fruiting
 Vegetative
 Fruiting

Stage

Fruiting
 Fruiting
 Flowering
 Fruiting
 Vegetative
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting
 Fruiting

| | | | |
|-----------------------------------|--------------|-----------------------------------|--------------|
| <i>Pergularia tomentosa</i> | Fruiting | <i>Pulicaria undulata</i> | Fruiting |
| <i>Retama raetam</i> | Vegetative | <i>Schismus barbatus</i> | Fruiting |
| <i>Stipagrostis</i> sp. | Fruiting | <i>Scrophularia libanotica</i> | Fruiting |
| <i>Zilla spinosa</i> | Vegetative | <i>Tanacetum sinaicum</i> | Fruiting |
| <u>Wadi Legaibi</u> | Stage | <i>Teucrium polium</i> | Fruiting |
| <i>Neurada procumbens</i> | Dormant | <i>Thymus decussatus</i> | Fruiting |
| <i>Arthrocnemum macrostachyum</i> | Vegetative | Chenopodiaceae | Fruiting |
| <i>Deverra triradiata</i> | Fruiting | <i>Verbascum sinaiticum</i> | Vegetative |
| <i>Fagonia mollis</i> | Fruiting | <u>Wadi Emrair</u> | Stage |
| <i>Fagonia</i> sp. | Vegetative | <i>Artemisia judaica</i> | Fruiting |
| <i>Farsetia longisiliqua</i> | Fruiting | <i>Fagonia arabica</i> | Dormant |
| <i>Hamada elegans</i> | Vegetative | <i>Fagonia mollis</i> | Fruiting |
| <i>Heliotropium digynum</i> | Fruiting | <i>Hamada elegans</i> | Vegetative |
| <i>Iphiaona scabra</i> | Fruiting | <i>Caylusea hexagyna</i> | Fruiting |
| <i>Launaea spinosa</i> | Vegetative | <i>Ochradenus baccatus</i> | Vegetative |
| <i>Lotononis platycarpa</i> | Flowering | <i>Schismus barbatus</i> | Fruiting |
| <i>Ochradenus baccatus</i> | Flowering | <i>Zilla spinosa</i> | Fruiting |
| <i>Panicum turgidum</i> | Fruiting | <u>Wadi Ertama</u> | Stage |
| <i>Retama raetam</i> | Vegetative | <i>Aerva javanica</i> | Flowering |
| <i>Stipagrostis</i> sp. | Fruiting | <i>Artemisia judaica</i> | Flowering |
| <i>Teucrium polium</i> | Flowering | <i>Caylusea hexagyna</i> | Vegetative |
| <i>Zilla spinosa</i> | Fruiting | <i>Capparis sinaica</i> | Flowering |
| <u>Wadi Rem</u> | Stage | <i>Citrullus colocynthis</i> | Vegetative |
| <i>Artemisia judaica</i> | Fruiting | <i>Cucumis prophetarum</i> | Fruiting |
| <i>Caylusea hexagyna</i> | Fruiting | <i>Fagonia mollis</i> | Fruiting |
| <i>Erodium</i> sp. | Vegetative | <i>Fagonia</i> sp. | Fruiting |
| <i>Fagonia arabica</i> | Fruiting | <i>Hamada elegans</i> | Vegetative |
| <i>Fagonia mollis</i> | Fruiting | <i>Hyoscyamus muticus</i> | Fruiting |
| <i>Hamada elegans</i> | Vegetative | <i>Pulicaria undulata</i> | Vegetative |
| <i>Ochradenus baccatus</i> | Fruiting | <i>Reseda pruinosa</i> | Fruiting |
| <i>Reseda pruinosa</i> | Dormant | <i>Schismus barbatus</i> | Vegetative |
| <i>Retama raetam</i> | Vegetative | <u>Wadi Shaq Musa</u> | Stage |
| <i>Schismus barbatus</i> | Dormant | <i>Alkanna orientalis</i> | Flowering |
| <i>Zilla spinosa</i> | Fruiting | <i>Artemisia herba-alba</i> | Flowering |
| <u>Wadi Eliqat</u> | Stage | <i>Ballota kaiserii</i> | Fruiting |
| <i>Acacia tortilis</i> | Vegetative | <i>Chiliadenus montanus</i> | Vegetative |
| <i>Artemisia judaica</i> | Vegetative | <i>Cynodon dactylon</i> | Vegetative |
| <i>Ballota undulata</i> | Fruiting | <i>Echinops glaberrimus</i> | Fruiting |
| <i>Caylusea hexagyna</i> | Fruiting | <i>Juncus</i> sp. | Vegetative |
| <i>Capparis spinosa</i> | Vegetative | <i>Mentha longifolia</i> | Flowering |
| <i>Chrozophora oblongifolia</i> | Fruiting | <i>Nepeta septemcrenata</i> | Fruiting |
| <i>Fagonia arabica</i> | Fruiting | <i>Origanum syriacum sinaicum</i> | Flowering |
| <i>Fagonia mollis</i> | Fruiting | <i>Peganum harmala</i> | Vegetative |
| <i>Forsskaolea tenacissima</i> | Vegetative | <i>Phlomis aurea</i> | Vegetative |
| <i>Heliotropium digynum</i> | Vegetative | <i>Polypogon</i> sp. | Fruiting |
| <i>Hyoscyamus muticus</i> | Fruiting | <i>Stachys aegyptiaca</i> | Flowering |
| <i>Ifloga spicata</i> | Dormant | <i>Tanacetum sinaicum</i> | Fruiting |
| <i>Launaea spinosa</i> | Flowering | <i>Teucrium polium</i> | Fruiting |
| <i>Lavandula coronopifolia</i> | Vegetative | <i>Verbascum sinaiticum</i> | Vegetative |
| <i>Lycium shawii</i> | Fruiting | <u>Wadi Shraiq</u> | Stage |
| <i>Pulicaria undulata</i> | Fruiting | <i>Achillea fragrantissima</i> | Flowering |
| <i>Reseda pruinosa</i> | Fruiting | <i>Alkanna orientalis</i> | Fruiting |
| <i>Schismus barbatus</i> | Fruiting | <i>Andrachne aspera</i> | Fruiting |
| <i>Stipagrostis</i> sp. | Fruiting | <i>Artemisia herba-alba</i> | Fruiting |
| <i>Teucrium polium</i> | Fruiting | <i>Ballota undulata</i> | Fruiting |

| | | | |
|-----------------------------------|--------------|-----------------------------------|--------------|
| <i>Verbascum sinaiticum</i> | Vegetative | <i>Chiliadenus montanus</i> | Vegetative |
| <i>Zilla spinosa</i> | Fruiting | <i>Echinops glaberrimus</i> | Vegetative |
| Wadi Talaah | Stage | <i>Fagonia arabica</i> | Flowering |
| <i>Achillea fragrantissima</i> | Fruiting | <i>Fagonia mollis</i> | Vegetative |
| <i>Alkanna orientalis</i> | Vegetative | <i>Galium sinaicum</i> | Fruiting |
| <i>Andrachne aspera</i> | Flowering | <i>Lotus sp.</i> | Fruiting |
| <i>Artemisia herba-alba</i> | Vegetative | <i>Origanum syriacum sinaicum</i> | Flowering |
| <i>Calyusea hexagyna</i> | Vegetative | <i>Phlomis aurea</i> | Fruiting |
| <i>Capparis sinaica</i> | Vegetative | <i>Scrophularia libnotica</i> | Vegetative |
| <i>Cynodon dactylon</i> | Fruiting | <i>Stachys aegyptiaca</i> | Fruiting |
| <i>Deverra triradiata</i> | Fruiting | <i>Tanacetum sinaicum</i> | Fruiting |
| <i>Echinops glaberrimus</i> | Flowering | <i>Teucrium polium</i> | Fruiting |
| <i>Euphorbia peplis</i> | Vegetative | unknown <i>Papaveraceae</i> | Vegetative |
| <i>Fagonia arabica</i> | Flowering | <i>Zilla spinosa</i> | Vegetative |
| <i>Fagonia mollis</i> | Fruiting | Farsh Roumana | Stage |
| <i>Ficus carica</i> | Vegetative | <i>Achillea fragrantissima</i> | Flowering |
| <i>Galium sinaica</i> | Vegetative | <i>Alkanna orientalis</i> | Vegetative |
| <i>Juncus sp.</i> | Vegetative | <i>Artemisia herba-alba</i> | Fruiting |
| <i>Lavandula coronopifolia</i> | Fruiting | <i>Asclepias sinaica</i> | Fruiting |
| <i>Matthiola arabica</i> | Flowering | <i>Astragalus sp.</i> | Fruiting |
| <i>Origanum syriacum sinaicum</i> | Fruiting | <i>Bufonia multiceps</i> | Flowering |
| <i>Pennisetum sp.</i> | Fruiting | <i>Cynodon dactylon</i> | Vegetative |
| <i>Phlomis aurea</i> | Fruiting | <i>Echinops glaberrimus</i> | Vegetative |
| <i>Plantago sinaica</i> | Vegetative | <i>Euphorbia peplis</i> | Fruiting |
| <i>Pulicaria undulata</i> | Fruiting | <i>Mentha longifolia</i> | Flowering |
| <i>Reseda sp.</i> | Vegetative | <i>Phlomis aurea</i> | Fruiting |
| <i>Scrophularia libanotica</i> | Vegetative | <i>Plantago sinaica</i> | Fruiting |
| <i>Stachys aegyptiaca</i> | Flowering | <i>Pulicaria undulata</i> | Fruiting |
| <i>Tanacetum sinaicum</i> | Flowering | <i>Schismus barbatus</i> | Fruiting |
| <i>Teucrium polium</i> | Fruiting | <i>Scrophularia libanotica</i> | Vegetative |
| <i>Zilla spinosa</i> | Vegetative | <i>Stipagrostis ciliata</i> | Vegetative |
| Wadi Ahmar | Stage | <i>Tanacetum sinaicum</i> | Flowering |
| <i>Achillea fragrantissima</i> | Fruiting | <i>Teucrium polium</i> | Flowering |
| <i>Artemisia herba-alba</i> | Fruiting | unknown <i>Asteraceae</i> | Dormant |
| <i>Ballota undulata</i> | Fruiting | unknown <i>Cruciferae</i> | Vegetative |
| <i>Bufonia multiceps</i> | Fruiting | <i>Deverra sp.</i> | Vegetative |
| <i>Chiliadenus montanus</i> | Fruiting | <i>Verbascum sinaiticum</i> | Vegetative |
| <i>Cynodon dactylon</i> | Vegetative | <i>Zilla spinosa</i> | Fruiting |
| <i>Echinops glaberrimus</i> | Flowering | Wadi Tynia | Stage |
| <i>Euphorbia peplis</i> | Fruiting | <i>Achillea fragrantissima</i> | Flowering |
| <i>Galium sinaica</i> | Flowering | <i>Alkanna orientalis</i> | Vegetative |
| <i>Mentha longifolia</i> | Fruiting | <i>Bufonia multiceps</i> | Flowering |
| <i>Origanum syriacum-sinaicum</i> | Fruiting | <i>Chiliadenus montanus</i> | Vegetative |
| <i>Phlomis aurea</i> | Fruiting | <i>Echinops glaberrimus</i> | Vegetative |
| <i>Plantago sinaica</i> | Flowering | <i>Fagonia arabica</i> | Fruiting |
| <i>Pulicaria undulata</i> | Flowering | <i>Fagonia mollis</i> | Vegetative |
| <i>Salix subserrata</i> | Fruiting | <i>Origanum syriacum sinaicum</i> | Flowering |
| <i>Schismus barbatus</i> | Flowering | <i>Pulicaria undulata</i> | Flowering |
| <i>Stachys aegyptiaca</i> | Flowering | <i>Scrophularia libanotica</i> | Fruiting |
| <i>Tanacetum sinaicum</i> | Fruiting | <i>Stachys aegyptiaca</i> | Fruiting |
| <i>Teucrium polium</i> | Fruiting | Unknown <i>Asteraceae</i> | Vegetative |
| unknown <i>Asteraceae</i> | Flowering | Unknown <i>Cruciferae</i> | Vegetative |
| unknown <i>Cruciferae</i> | Dormant | <i>Zilla spinosa</i> | Fruiting |
| <i>Onopordum ambiguum</i> | Dormant | Wadi Ferah | Stage |
| <i>Verbascum sinaiticum</i> | Flowering | <i>Artemisia herba-alba</i> | Flowering |

| | | | |
|--------------------------------|--------------|-----------------------------------|--------------|
| <i>Zilla spinosa</i> | Fruiting | <i>Asclepias sinaica</i> | Vegetative |
| Wadi Gebal | Stage | <i>Bufonia multiceps</i> | Flowering |
| <i>Artemisia herba-alba</i> | Flowering | <i>Galium sinaica</i> | Fruiting |
| <i>Artemisia judaica</i> | Vegetative | <i>Matthiola arabica</i> | Flowering |
| <i>Deverra triradiata</i> | Fruiting | <i>Peganum harmala</i> | Flowering |
| <i>Echinops glaberrimus</i> | Vegetative | <i>Stachys aegyptiaca</i> | Flowering |
| <i>Ephedra alata</i> | Flowering | <i>Stipagrostis sp.</i> | Fruiting |
| <i>Erodium sp.</i> | Vegetative | <i>Tanacetum sinaicum</i> | Fruiting |
| <i>Euphorbia peplis</i> | Flowering | <i>Teucrium polium</i> | Fruiting |
| <i>Schismus barbatus</i> | Fruiting | <i>Zilla spinosa</i> | Vegetative |
| <i>Stipagrostis ciliata</i> | Flowering | Wadi Itlah | Stage |
| Unknown Cruciferae | Dormant | <i>Achillea fragrantissima</i> | Fruiting |
| <i>Zilla spinosa</i> | Fruiting | <i>Alkanna orientalis</i> | Fruiting |
| Farsh Meseila | Stage | <i>Andrachne aspera</i> | Vegetative |
| <i>Achillea fragrantissima</i> | Flowering | <i>Asclepias sinaica</i> | Fruiting |
| <i>Artemisia herba-alba</i> | Fruiting | <i>Capparis spinosa</i> | Vegetative |
| <i>Astragalus sp.</i> | Vegetative | <i>Chiliadenus montanus</i> | Fruiting |
| <i>Bufonia multiceps</i> | Vegetative | <i>Fagonia mollis</i> | Fruiting |
| <i>Chiliadenus montanus</i> | Fruiting | <i>Galium sinaica</i> | Fruiting |
| <i>Deverra triradiata</i> | Flowering | <i>Matthiola arabica</i> | Vegetative |
| <i>Farsetia longisiliqua</i> | Fruiting | <i>Origanum syriacum sinaicum</i> | Fruiting |
| <i>Globularia arabica</i> | Fruiting | <i>Peganum harmala</i> | Vegetative |
| <i>Peganum harmala</i> | Fruiting | <i>Pulicaria undulata</i> | Fruiting |
| <i>Plantago sinaica</i> | Flowering | <i>Schismus barbatus</i> | Fruiting |
| <i>Schismus barbatus</i> | Fruiting | <i>Scrophularia libanotica</i> | Vegetative |
| <i>Scrophularia libanotica</i> | Fruiting | <i>Teucrium polium</i> | Fruiting |
| <i>Stachys aegyptiaca</i> | Fruiting | unknown Asteraceae | Vegetative |
| <i>Tanacetum sinaicum</i> | Fruiting | <i>Zilla spinosa</i> | Fruiting |
| <i>Teucrium polium</i> | Fruiting | Wadi Naqb Hawa | Stage |
| Unknown Cruciferae | Dormant | <i>Alkanna orientalis</i> | Fruiting |
| <i>Zilla spinosa</i> | Fruiting | <i>Artemisia judaica</i> | Flowering |
| Wadi Arbain | Stage | <i>Asclepias sinaica</i> | Flowering |
| <i>Achillea fragrantissima</i> | Fruiting | <i>Fagonia arabica</i> | Fruiting |
| <i>Alkanna orientalis</i> | Fruiting | <i>Fagonia mollis</i> | Fruiting |
| <i>Andrachne aspera</i> | Fruiting | <i>Galium sinaica</i> | Fruiting |
| <i>Anarrhinum pubescens</i> | Fruiting | <i>Gymnocarpus decandrus</i> | Vegetative |
| <i>Artemisia herba-alba</i> | Flowering | <i>Juncus sp.</i> | Vegetative |
| <i>Asclepias sinaica</i> | Fruiting | <i>Kickxia aegyptiaca</i> | Fruiting |
| <i>Ballota undulata</i> | Fruiting | <i>Lotus sp.</i> | Fruiting |
| <i>Bufonia multiceps</i> | Flowering | <i>Matthiola arabica</i> | Flowering |
| <i>Chiliadenus montanus</i> | Flowering | <i>Peganum harmala</i> | Fruiting |
| <i>Crepis sp.</i> | Fruiting | <i>Polygala sp.</i> | Flowering |
| <i>Echinops glaberrimus</i> | Vegetative | <i>Reseda sp.</i> | Vegetative |
| <i>Fagonia arabica</i> | Fruiting | <i>Schismus barbatus</i> | Dormant |
| <i>Fagonia mollis</i> | Fruiting | <i>Stachys aegyptiaca</i> | Vegetative |
| <i>Galium sinaica</i> | Fruiting | <i>Teucrium polium</i> | Vegetative |
| <i>Iphiona scabra</i> | Flowering | unknown Cruciferae | Vegetative |
| <i>Launaea spinosa</i> | Vegetative | <i>Zilla spinosa</i> | Vegetative |
| <i>Lotus sp.</i> | Fruiting | <i>Teucrium polium</i> | Vegetative |
| <i>Mentha longifolia</i> | Fruiting | unknown Cruciferae | Vegetative |
| <i>Matthiola arabica</i> | Fruiting | <i>Zilla spinosa</i> | Vegetative |
| <i>Peganum harmala</i> | Flowering | Gebal Safsafa | Stage |
| <i>Schismus barbatus</i> | Fruiting | <i>Artemisia herba-alba</i> | Fruiting |
| <i>Stachys aegyptica</i> | Fruiting | <i>Astragalus sp.</i> | Fruiting |
| <i>Stipagrostis sp.</i> | Vegetative | <i>Deverra triradiata</i> | Fruiting |

| | | | |
|------------------------------|--------------|---------------------------|------------|
| <i>Tanacetum sinicum</i> | Fruiting | <i>Matthiola arabica</i> | Fruiting |
| <i>Teucrium polium</i> | Fruiting | <i>Tanacetum sinaicum</i> | Fruiting |
| Unknown Asteraceae | Fruiting | <i>Teucrium polium</i> | Fruiting |
| <i>Zilla spinosa</i> | Vegetative | <i>Zilla spinosa</i> | Vegetative |
| <u>Wadi Esh Shaik</u> | Stage | | |
| <i>Artemisia judaica</i> | Fruiting | | |
| <i>Chiliadenus montanus</i> | Fruiting | | |
| <i>Fagonia arabica</i> | Fruiting | | |
| <i>Fagonia mollis</i> | Fruiting | | |
| <i>Gymnocarpos decandrus</i> | Fruiting | | |
| <i>Launaea nudicaulis</i> | Fruiting | | |
| <i>Launaea spinosa</i> | Flowering | | |
| <i>Lotus</i> sp. | Flowering | | |
| <i>Ochradenus baccatus</i> | Fruiting | | |
| <i>Plantago sinaica</i> | Fruiting | | |
| <i>Schismus barbatus</i> | Fruiting | | |
| <i>Stachys aegyptiaca</i> | Fruiting | | |
| <i>Stipagrostis obtusa</i> | Fruiting | | |
| unknown <i>Juncus</i> | Flowering | | |
| <i>Zilla spinosa</i> | Fruiting | | |

Appendix 9: Descriptions of wadis surveyed

Farsh El Loz

Date: 28/7/05 **Location:** 28.54821N, 33.96869, 1996 meters

Coverages: Large Rock: 20% Small Rock: 69% Bare/Fine: 4% Vegetation: 7%

Description:

Farsh habitat located on Safsafa Mountain. Pink granite geological features. Wadi narrow, approximately 6 meters in width. Wadi bed consisting of gravel with some large boulders. High moisture regime evident. High human impacts from litter are present. Dominating plant species include: *Tanacetum sinaicum* and *Pulicaria undulata*.

Plant List:

| | |
|-----------------------------|-----------------------------------|
| <i>Alkanna orientalis</i> | <i>Nepeta septemcrenata</i> |
| <i>Anarrhinum pubescens</i> | <i>Malva sp.</i> |
| <i>Artemisia herba-alba</i> | <i>Matthiola arabica</i> |
| <i>Caylusea hexagyna</i> | <i>Mentha longifolia</i> |
| <i>Chenopodiaceae sp.</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Cretaegus sinaica</i> | <i>Phlomis aurea</i> |
| <i>Deverra sp.</i> | <i>Polypogon sp.</i> |
| <i>Echinops glaberrimus</i> | <i>Pulicaria undulata</i> |
| <i>Fagonia arabica</i> | <i>Schismus barbatus</i> |
| <i>Fagonia mollis</i> | <i>Scrophularia libanotica</i> |
| <i>Galium sinaica</i> | <i>Tanacetum sinaicum</i> |
| <i>Hordeum sp.</i> | <i>Teucrium polium</i> |
| <i>Juncus sp.</i> | <i>Thymus decussatus</i> |
| <i>Lolium sp</i> | <i>Zilla spinosa</i> |
| <i>Plantago sinaica</i> | |

Farsh Mesela

Date: 21/7/05 **Location:** 28.57514N, 33.88812E, 1843 meters

Coverages: Large Rock: 20% Small Rock: 65% Bare/Fine: 3% Vegetation: 12%

Description:

Open farsh habitat with granitic rock formations. There is good vegetation cover although some species are dead/dormant (phenology/grazing). Undulating ground with some rock outcrops. Transects (2) placed randomly throughout farsh to get coverage of the differing vegetation types. High grazing activity from donkey and goat. Foot path found through center of farsh with moderate use. Dominate plant species: *Achillea fragrantissima*, *Globularia arabica*, and *Plantago sinaica*.

Plant List:

| | |
|--------------------------------|--------------------------------|
| <i>Achillea fragrantissima</i> | <i>Phlomis aurea</i> |
| <i>Alkanna orientalis</i> | <i>Plantago sinaica</i> |
| <i>Artemisia herba-alba</i> | <i>Pterocephalus sanctus</i> |
| <i>Asclepias sinaica</i> | <i>Pulicaria undulata</i> |
| <i>Astragalus sp.</i> | <i>Scrophularia libanotica</i> |
| <i>Chiliadenus montanus</i> | <i>Stachys aegyptiaca</i> |
| <i>Deverra sp.</i> | <i>Tanacetum sinaica</i> |
| <i>Farsetia longisiliqua</i> | <i>Teucrium polium</i> |
| <i>Globularia arabica</i> | <i>Zilla spinosa</i> |

Farsh Romana

Date: 21/7/05 **Location:** 28.54286N, 33.88080E, 1835 meters
Coverages: Large Rock: <1% Small Rock: 70% Bare/Fine: 9% Vegetation: 20%

Description:

Open, farsh habitat with granitic and sandstone geological features. Wadi bed consisting of a high small rock and bare/fine component along with a high plant cover. The slope is low, at approximately 5%, with a higher rock component. Moderate grazing pressure by donkeys, camels, and goats. Heavy human use evident with a highly used foot trail. Bedouin gardens found nearby. Wadi bed dominated by: *Achillea fragrantissima* and *Teucrium polium*. Slope dominated by: *Euphorbia peplis*, *Achillea fragrantissima*, and *Asclepias sinaica*.

Plant List:

| | |
|--------------------------------|--------------------------------|
| <i>Achillea fragrantissima</i> | <i>Peganum harmala</i> |
| <i>Alkanna orientalis</i> | <i>Phlomis aurea</i> |
| <i>Asclepias sinaica</i> | <i>Plantago sinaica</i> |
| <i>Astragalus sp.</i> | <i>Pulicaria undulata</i> |
| <i>Bufoia multiceps</i> | <i>Schismus barbatus</i> |
| <i>Crataegus sinaica</i> | <i>Scrophularia libanotica</i> |
| <i>Ephedra alata</i> | <i>Stachys aegyptiaca</i> |
| <i>Euphorbia peplis</i> | <i>Teucrium polium</i> |
| <i>Hyoscyamus muticus</i> | <i>Verbascum sinaiticum</i> |

Safsafa Mountain

Date: 5/7/05 **Location:** 28.33'03.14N, 33.58'00.70E, 2004 meters
Coverages: Large Rock: 19% Small Rock: 48% Bare/Fine: <1% Vegetation: 15%

Description:

Transect located near walking trail which creates some trampling effects by humans and domestic animals. Grazing activity is moderate with *Matthiola arabica* being heavily impacted. Wadi width is approximately 35 meters. There is a high vegetation cover and plant diversity for the area. Plant cover continues up mountain slope of wadi. Dominating plant species include: *Tanacetum sinaicum* and *Artemisia herba-alba*. Below transect, wadi widens into an open basin with a higher amount of vegetation cover due to higher moisture availability.

Date: 28/7/05 **Location:** 28.55136N, 33.96465E, 1981 meters
Coverages: Large Rock: 35% Small Rock: 42% Bare/Fine: 5% Vegetation: 18%

Description:

Farsh type habitat at base of Safsafa Mountain. Substrate composed of volcanic rocks. Area has granitic and sandstone geological features. Foot trail near transect which creates grazing and trampling impacts on vegetation. Heavy grazing by camel and goat. Number of plant species increases away from the trail. Transect done in open, flat area. Dominating plant species include: *Tanacetum sinaicum* and *Artemisia herba-alba*. Gazelle skull found in area.

Plant List:

| | |
|--------------------------------|-----------------------------------|
| <i>Achillea fragrantissima</i> | <i>Matthiola arabica</i> |
| <i>Alkanna orientalis</i> | <i>Nepeta septemcrenata</i> |
| <i>Artemisia herba-alba</i> | <i>Origanum syriacum-sinaicum</i> |

Astragalus sp.
Ballota undulata
Bufonia multiceps
Centaurea scoparia
Chiliadenus montanus
Crataegus sinaica
Deverra triradiata
Echinops glaberrimus
Fagonia arabica
Fagonia mollis
Gymnocarpos decandrus
Juncus sp.
Launea spinosa

Phlomis aurea
Pterocephalus sanctus
Pulicaria undulata
Reseda sp.
Schismus barbatus
Scrophularia libanotica
Stachys aegyptiaca
Tanacetum sinaicum
Teucrium polium
Thymus decussatus
Verbascum sinaiticum
Zilla spinosa

Wadi Ain Hodra

Date: 14/7/05 **Location:** 28.54'57.05N, 34.25'56.50E, 631 meters
Coverages: Large Rock: 6% Small Rock: 9% Bare/Fine: 82% Vegetation: 3%

Description:

Wadi consists of a sandy substrate with sandstone geology. The sandstone is wind weathered, creating canyon habitats in the area. Wadi is heavily impacted by grazing of camels along with heavy vehicle use. Wadi is approximately 200 meters wide. Vegetation cover is sparse and fairly monotypic. Dominate plant species include: *Hamada elegans* and *Retama raetam*.

Plant List:

| | |
|------------------------------|-----------------------------|
| <i>Astragalus sp.</i> | <i>Heliotropium digynum</i> |
| <i>Ephedra alata</i> | <i>Iphiona scabra</i> |
| <i>Fagonia mollis</i> | <i>Reseda pruinosa</i> |
| <i>Farsetia longisiliqua</i> | <i>Retama raetam</i> |
| <i>Hamada elegans</i> | <i>Zilla spinosa</i> |

Wadi Abu Sayla

Date: 6/7/05 **Location:** 28.35'38.26N, 33.55'26.57E, 1484 meters
Coverages: Large Rock: 15% Small Rock: 72% Bare/Fine: 7% Vegetation: 6%

Description:

Wadi is located near the small village of Abu Sayla and is in close proximity to Wadi Itlah. There is a steep drop off just below the transect. Vegetation cover is low with a low plant diversity. Heavy grazing activity is evident in the wadi, mostly by goats and camels. Dominant plant species include: *Peganum harmala*, *Hyoscyamus muticus*, and *Fagonia arabica*.

Plant List:

| | |
|------------------------------|---------------------------|
| <i>Citrullus colocynthus</i> | <i>Peganum harmala</i> |
| <i>Fagonia arabica</i> | <i>Schismus barbatus</i> |
| <i>Fagonia mollis</i> | <i>Stachys aegyptiaca</i> |
| <i>Hyoscyamus muticus</i> | <i>Zilla spinosa</i> |
| <i>Matthiola arabica</i> | |

Wadi Aleat

Date:12/8/05 **Location:**28.69566N, 33.64386E, 697 meters; 28.68856N, 33.64843, 741 meters

Coverages:

| | |
|-----------------|-----------------|
| Large Rock: 85% | Large Rock: 72% |
| Small Rock: 9% | Small Rock: 12% |
| Bare/Fine: 2% | Bare/Fine: 4% |
| Vegetation: 4% | Vegetation: 12% |

Description:

Transects done in two areas that differ greatly in vegetation composition and health. In the first area, the wadi bed is lowly vegetated. The main channel of wadi is very narrow, only about 7 meters wide. The entire wadi is wide, approximately 250 meters wide. The main channel consists of a sandy substrate while the remainder of the wadi is very rocky. There is heavy grazing activity in the area by goats, especially on *Reseda pruinoso* and *Heliotropium digynum*. Dominate plant species: *Acacia tortilis*, *Hyoscyamus muticus*, and *Reseda pruinoso*. In the second area (further up the wadi), the vegetation diversity dramatically increases and the overall health of the plants increases as well. The water channels are deeply cut. There is less grazing evident in the area but seen mainly on: *Lavendula coronopifolia*, *Reseda pruinoso*, *Ballota undulata*, *Scrophularia libanotica*, and *Zilla spinosa*. Noticably less grazing on: *Heliotropium digynum* and *Reseda pruinoso*.

Plant List:

| | |
|---------------------------------|-------------------------------|
| <i>Acacia tortilis</i> | <i>Ifloga spicata</i> |
| <i>Chrozophora oblongifolia</i> | <i>Iphiona scabra</i> |
| <i>Fagonia arabica</i> | <i>Reseda pruinoso</i> |
| <i>Fagonia mollis</i> | <i>Spergula/Minuartia sp.</i> |
| <i>Heliotropium digynum</i> | <i>Teucrium polium</i> |
| <i>Hyoscyamus muticus</i> | <i>Zilla spinosa</i> |

Plant Species Added in second transect:

| | |
|--------------------------------|-----------------------------------|
| <i>Aerva japonica</i> | <i>Moricandia tomentosa</i> |
| <i>Artemisia herba-alba</i> | <i>Ochradenus baccatus</i> |
| <i>Astragalus sp.</i> | <i>Onopordum sp.</i> |
| <i>Ballota undulata</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Caylusea hexagyna</i> | <i>Pergularia tomentosa</i> |
| <i>Capparis spinosa</i> | <i>Pulicaria undulata</i> |
| <i>Citrullus colocynthis</i> | <i>Retama raetam</i> |
| <i>Echinops glaberrimus</i> | <i>Scrophularia libanotica</i> |
| <i>Hamada elegans</i> | <i>Stipagrostis sp.</i> |
| <i>Launea spinosa</i> | <i>Verbascum sinaiticum</i> |
| <i>Lavendula coronopifolia</i> | |

Wadi Alwadii

Date: 4/8/05 **Location:** 28.75283N, 33.41966E, 742 meters
Coverages: Large Rock: <1% Small Rock: 12% Bare/Fine: 55% Vegetation: 32%

Description:

Wadi highly vegetated with a moderate species richness and plant coverage. Wadi consists of a sand substrate, due to sandstone geology. Wadi bed approximately 50 meters wide. Wadi widens further up to approximately 150 meters with the vegetation cover decreasing somewhat. Heavy grazing and vehicle tracks present. Dominating species include: *Retama raetam* and *Crotalaria aegyptiaca*

Plant List:

| | |
|-----------------------------------|------------------------------|
| <i>Hamada elegans</i> | <i>Citrullus colocynthis</i> |
| <i>Crotalaria aegyptiaca</i> | <i>Zilla spinosa</i> |
| <i>Artemisia judaica</i> | <i>Deverra triradiata</i> |
| <i>Ochradenus baccatus</i> | <i>Neurada procumbens</i> |
| <i>Fagonia mollis</i> | <i>Heliotropium digynum</i> |
| <i>Arthrocnemum macrostachyum</i> | <i>Acacia tortilis</i> |

Wadi Amrer

Date: 13/8/05 **Location:** 28.68537N, 33.72082E, 807 meters
Coverages: Large Rock: 23% Small Rock: 45% Bare/Fine: 23% Vegetation: 9%

Description:

Wadi intersects with Wadi Feiran. Wadi bed rocky, cobbles approximately 3cm to 10 cm in size. Wadi bed lowly vegetated with low species richness but high percentage cover of these species. There is a moderate amount of grazing and vehicle tracks throughout wadi. Vegetation restricted to the edges of wadi. Dominating plant species: *Hamada elegans*, *Fagonia mollis*.

Plant List:

| | |
|-----------------------------|----------------------------|
| <i>Artemisia herba-alba</i> | <i>Ochradenus baccatus</i> |
| <i>Artemisia judaica</i> | <i>Schismus barbatus</i> |
| <i>Hamada elegans</i> | <i>Zilla spinosa</i> |

Wadi Arbaein

Date: 8/7/05 **Location:** 28.54540N, 33.95536E, 1718 meters
Coverages: Large Rock: 44% Small Rock: 41% Bare/Fine: 3% Vegetation: 12%

Description:

Wadi bed moderately vegetated with a rocky substrate. Plant richness relatively high with a high vegetation coverage. Rock sizes range from 5 cm to 60 cm. Large boulders found near edges of wadi. Granitic geology. Trail heavily used by tourists and camels (route to Mt. Sinai and Mt. St. Katherine). Wadi bed covered by small gravel (<5cm). Dominating species include: *Fagonia mollis*, *Asclepias sinaica*, *Peganum harmala*, *Artemisia herba-alba*. Grazing heavy on: *Stachys aegyptiaca*, *Ballota undulata*, *Arteisia herba-alba*.

Plant List:

Achillea fragrantissima
Alkanna orientalis
Anarrhinum pubescens
Andrachne aspera
Artemisia herba-alba
Asclepias sinaica
Ballota kaiseri
Ballota undulata
Capparis spinosa
Caylusea hexagyna
Chiliadenus montanus
Echinops glaberrimus
Fagonia arabica
Fagonia mollis

Galium sinaica
Kickxia aegyptica
Lotus sp.
Matthiola arabica
Origanum syriacum-sinaicum
Peganum harmala
Phlomis aurea
Pulicaria undulata
Scrophularia libanotica
Stachys aegyptica
Teucrium polium
Verbascum sinaiticum
Zilla spinosa

Wadi Artama

Date: 11/8/05 **Location:** 28.69597N, 33.67186E, 754 meters
Coverages: Large Rock: 32% Small Rock: 51% Bare/Fine: 3% Vegetation: 14%

Description:

Wadi intersects with Wadi Feiran and is in close proximity to Wadi Rem. Wadi bed is composed of rock, sizes ranging from 5 cm to 40 cm. The bare/fine component is small. Sandstone and granitic geology with some basalt. Wadi leads into a farsh habitat close to the main road (Wadi Feiran). There is high grazing activity in the area by camel and goat. Ibex dung was also recorded in the area but it was aged to be over a year old. *Capparis sinaica* growing on rock walls in good health. Dominating plant species of wadi bed: *Hamada elegans*, *Retama raetam*, and *Fagonia mollis*.

Plant List:

| | |
|-----------------------------|---------------------------|
| <i>Aerva japonica</i> | <i>Hyoscyamus muticus</i> |
| <i>Artemisia judaica</i> | <i>Iphiona scabra</i> |
| <i>Capparis sinaica</i> | <i>Moricandia sinaica</i> |
| <i>Calotropis procera</i> | <i>Pulicaria undulata</i> |
| <i>Cucumis prophetarum</i> | <i>Reseda pruinosa</i> |
| <i>Fagonia mollis</i> | <i>Retama raetam</i> |
| <i>Hamada elegans</i> | <i>Schismus barbatus</i> |
| <i>Heliotropium digynum</i> | |

Wadi Couria Shamun

Date: 18/8/05 **Location:** 28.65404N, 33.89600E, 1155 m; 28.65785N, 33.89656E, 1151 m
Coverages: Large Rock: 1% Small Rock: 83% Bare/Fine: 5% Vegetation: 11%

Description:

Wadi proximal to the Al Karm Eco-lodge. Wadi width is approximately 250 meters, consisting mainly of small rocks, lacking large rocks or boulders. Low to moderate grazing activity. Moderate to high number of vehicle tracks in the wadi bed. Sandstone and granitic geology. Vegetation restricted to wadi bed with slopes unvegetated. Dominating plants include: *Artemisia*

judaica and *Fagonia mollis*. Heavily grazed plants include: *Ochradenus baccatus* and *Gymnocarpos decandrus*.

Plant List:

| | |
|----------------------------|------------------------------|
| <i>Artemisia judaica</i> | <i>Fagonia arabica</i> |
| <i>Fagonia mollis</i> | <i>Anabasis sp.</i> |
| <i>Retama raetam</i> | <i>Citrullus colocynthis</i> |
| <i>Ochradenus baccatus</i> | <i>Gymnocarpos decandrus</i> |
| <i>Zilla spinosa</i> | <i>Chiliadenus montanus</i> |

Wadi Ferrah

Date: 28/7/05 **Location:** 28.53904N, 33.96555E, 1859 meters
Coverages: Large Rock: 30% Small Rock: 50% Bare/Fine: 5% Vegetation: 15%

Description:

The area consists of a farsh habitat with high vegetation cover, but mostly monotypic. Plant cover was higher on slope at the edges of the farsh. Therefore, the transect was done on this slight slope. The foot path in the area comes down from Safsafa Mountain and leads down to Wadi Arbaein, near Ramadan's garden. There seems to be heavy use of this trail which creates trampling and litter impacts. There are also moderate grazing impacts. Dominating plant species include: *Artemisia herba-alba* and *Fagonia mollis*.

Plant List:

| | |
|--------------------------------|--------------------------------|
| <i>Achillea fragrantissima</i> | <i>Galium sinaica</i> |
| <i>Alkanna orientalis</i> | <i>Lotus sp.</i> |
| <i>Artemisia herba-alba</i> | <i>Peganum harmala</i> |
| <i>Asclepias sinaica</i> | <i>Scrophularia libanotica</i> |
| <i>Bufonia multiceps</i> | <i>Stachys aegyptiaca</i> |
| <i>Chiliadenus montanus</i> | <i>Stipagrostis sp.</i> |
| <i>Fagonia arabica</i> | <i>Teucrium polium</i> |
| <i>Fagonia mollis</i> | |

Wadi Gharaba

Date: 19/8/05 **Location:** 28.64888N, 33.89124E, 1093 meters
Coverages: Large Rock: 7% Small Rock: 83% Bare/Fine: 6% Vegetation: 8%

Description:

Wadi approximately 150 meters wide. Grazing activity is moderate, mostly by goats. High levels of vehicle tracks found in wadi bed. Dominating species include: *Artemisia judaica* and *Fagonia mollis*. Grazing heavily on: *Artemisia judaica* and *Ochradenus baccatus*.

Plant List:

| | |
|--------------------------------|----------------------------|
| <i>Acacia tortilis</i> | <i>Fagonia mollis</i> |
| <i>Achillea fragrantissima</i> | <i>Hyoscyamus muticus</i> |
| <i>Anabasis sp.</i> | <i>Ochradenus baccatus</i> |
| <i>Artemisia judaica</i> | <i>Peganum harmala</i> |
| <i>Capparis spinosa</i> | <i>Retama raetam</i> |

Wadi Irdisia

Date: 18/8/05 **Location:** 28.65322N, 33.90166E, 1143 meters
Coverages: Large Rock: 13% Small Rock: 52% Bare/Fine: 27% Vegetation: 8%

Description:

Wadi narrow, approximately 25 meters, with large rock outcroppings. Wadi consists of a high amount of small rock. Sandstone, Pink Granite and Basalt geology. High plant cover and also high plant richness. Dominating plant species include: *Fagonia mollis*, *Juncus rigidus*, and *Anabasis sp.*

Plant List:

| | |
|--------------------------|---------------------------|
| <i>Anabasis sp.</i> | <i>Retama raetam</i> |
| <i>Caylusea hexagyna</i> | <i>Stachys aegyptiaca</i> |
| <i>Fagonia mollis</i> | <i>Stipagrostis sp.</i> |
| <i>Juncus rigidus</i> | <i>Zilla spinosa</i> |
| <i>Launea spinosa</i> | |

Wadi Isla

Date: 2\7\05 **Location:** 28.24339N, 33.87537E, 461 meters
Coverages: Large Rock: 80% Small Rock: 7% Bare/Fine: 11% Vegetation: 2%

Description:

Wadi bed lowly vegetated, with a low species richness and plant cover. Wadi consists of a high large rock component. Wadi approximately 65 meters wide. Low grazing and human disturbance. Dominating plant species include: *Fagonia mollis* and *Artemisia herba-alba*

Plant List:

| | |
|------------------------------|-----------------------------|
| <i>Zygophyllum coccineum</i> | <i>Reseda sp.</i> |
| <i>Lindenbergia indica</i> | <i>Fagonia mollis</i> |
| <i>Hyoscyamus muticus</i> | <i>Artemisia herba-alba</i> |
| <i>Ballota undulata</i> | <i>Capparis sinaica</i> |
| <i>Juncus sp.</i> | <i>Cleome droserifolia</i> |
| <i>Iphiona scabra</i> | <i>Acacia tortilis</i> |

Wadi Itlah

Date: 9/8/05 **Location:** 28.58723N, 33.92017E, 1385 meters
Coverages: Large Rock: 40% Small Rock: 52% Bare/Fine: 2% Vegetation: 6%

Description:

Wadi heavily used for gardening by Bedouin. Wadi consists of sporadic large boulders scattered throughout wadi bed. Wadi approximately 30 meters wide. Pink granite geology. Heavy grazing activity by goat, donkey, and camel. There is also a high amount of litter in the wadi. There is a high plant diversity despite the disturbances found. This is possibly because of a higher moisture regime. Dominating plant species include: *Chiliadenus montanus*, *Peganum harmala*, *Asclepias sinaica*, and *Alkanna orientalis*.

Plant List:

| | |
|--------------------------------|-----------------------------------|
| <i>Achillea fragrantissima</i> | <i>Matthiola arabica</i> |
| <i>Alkanna orientalis</i> | <i>Mentha longifolia</i> |
| <i>Andrachne aspera</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Artemisia herba-alba</i> | <i>Peganum harmala</i> |

Asclepias sinaica
Ballota undulata
Capparis spinosa
Chiliadenus montanus
Echinops glaberrimus
Fagonia mollis
Hyoscyamus boveanus

Phlomis aurea
Phoenix dactylifera
Scrophularia libanotica
Stachys aegyptiaca
Teucrium polium
Verbascum sinaiticum
Zilla spinosa

Wadi Kiri

Date: 15/7/05 **Location:** 28.82843N, 34.37665E, 818 meters
Coverages: Large Rock: 45% Small Rock: 20% Bare/Fine: 30% Vegetation: 4%

Description:

Wadi has a high bare/fine (sand) component with low vegetation cover. However, vegetation diversity is moderately high for the area. Dominant plant species include: *Fagonia mollis*, *Hamada elegans*, and *Retama raetam*. The wadi bed is approximately 300 meters wide with several side tributaries. The geology of the wadi is different on the edges of the wadi. One side is sandy from the sandstone formations while the other side has a substrate consisting of volcanic rocks (basalt). High grazing impacts in the area. There is some evidence of vehicle disturbance.

Plant List:

| | |
|------------------------------|-----------------------------|
| <i>Aerva japonica</i> | <i>Iphiona scabra</i> |
| <i>Citrullus colocynthis</i> | <i>Lotononis playcarpa</i> |
| <i>Deverra triradiata</i> | <i>Lotus sp.</i> |
| <i>Fagonia arabica</i> | <i>Panicum turgidum</i> |
| <i>Fagonia mollis</i> | <i>Pergularia tomentosa</i> |
| <i>Farsetia longisiliqua</i> | <i>Retama raetam</i> |
| <i>Hamada elegans</i> | <i>Stipagrostis sp.</i> |
| <i>Heliotropium digynum</i> | <i>Zilla spinosa</i> |

Wadi Legibi

Date: 16/7/05 **Location:** 28.84143N, 34.38284E, 828 meters
Coverages: Large Rock: <1% Small Rock: 24% Bare/Fine: 75% Vegetation: 1%

Description:

Extremely wide wadi, approximately 800 meters. Similar to a farsh habitat. Wadi is lowly vegetated with most vegetation being dead/dormant. Wadi consists of volcanic rocks (basalt) mixed with sand. Some sandstone outcrops are also present. High grazing activity. Modertate to low vehicle impacts in middle of wadi. Dominate plant species include: *Hamada elegans* and *Retama raetam*

Plant List:

| | |
|-----------------------------------|-----------------------------|
| <i>Arthrocnemum macrostachyum</i> | <i>Lotononis platycarpa</i> |
| <i>Deverra triradiata</i> | <i>Neurada procumbens</i> |
| <i>Fagonia arabica</i> | <i>Ochradenus baccatus</i> |
| <i>Fagonia mollis</i> | <i>Panicum turgidum</i> |
| <i>Farsetia longisiliqua</i> | <i>Retama raetam</i> |
| <i>Hamada elegans</i> | <i>Stipagrostis sp.</i> |
| <i>Heliotropium digynum</i> | <i>Teucrium polium</i> |
| <i>Iphiona scabra</i> | <i>Zilla spinosa</i> |
| <i>Launea spinosa</i> | |

Wadi Moaged

Date: 1/7/05 **Location:** 28.27165N, 33.90434 E, 663 meters
Coverages: Large Rock: 17% Small Rock: 11% Bare/Fine: 62% Vegetation: 10%

Description:

Wadi bed moderately wide, approximately 75 meters. Evidence of previous flash flooding events. Wadi bed somewhat vegetated but suffering from heavy grazing activity. Low plant cover and low plant richness. Dominating plant species include: *Raetama raetam*, *Artemisia herba-alba*, and *Deverra tortuosa*.

Plant List:

| | |
|---------------------------------|------------------------------|
| <i>Artemisia herba-alba</i> | <i>Lindenbergia indica</i> |
| <i>Astragalus sp.</i> | <i>Mentha longifolia</i> |
| <i>Ballota undulata</i> | <i>Moricandia sinaica</i> |
| <i>Capparis sinaica</i> | <i>Phoenix dactylifera</i> |
| <i>Chrozophora oblongifolia</i> | <i>Polypogon sp.</i> |
| <i>Citrullus colocynthis</i> | <i>Reseda sp.</i> |
| <i>Cleome droserifolia</i> | <i>Retama raetam</i> |
| <i>Deverra tortuosa</i> | <i>Schismus barbatus</i> |
| <i>Fagonia arabica</i> | <i>Teucrium polium</i> |
| <i>Fagonia mollis</i> | <i>Trifolium sp.</i> |
| <i>Gypsophila sp.</i> | <i>Typha latifolia</i> |
| <i>Hyoscyamus muticus</i> | <i>Zygophyllum coccineum</i> |
| <i>Lavendula coronopifolia</i> | |

Wadi Nabq Hawa

Date: 26/7/05 **Location:** 28.59880N, 33.92178E, 1521 meters
Coverages: Large Rock: 56% Small Rock: 25% Bare/Fine: 15% Vegetation: 4%

Description:

Wadi located near small village of Abu Sayla. Wadi bed narrow consisting of rocky substrate near the edges and gravel in main water channel. Wadi bed snakes (curves) resulting from past water action. Area dry with no evidence of recent water action. Low plant cover and diversity. Dominant plant species include: *Fagonia mollis* and *Artemisia judaica*. Heavy grazing activity in area mostly from goats and camels. Well developed foot trail through wadi. Sandstone and pink granite geology.

Plant List:

| | |
|------------------------------|---------------------------|
| <i>Alkanna orientalis</i> | <i>Lotus sp.</i> |
| <i>Andrachne aspera</i> | <i>Matthiola arabica</i> |
| <i>Artemisia judaica</i> | <i>Peganum harmala</i> |
| <i>Asclepias sinaica</i> | <i>Polygala sp.</i> |
| <i>Fagonia arabica</i> | <i>Schismus barbatus</i> |
| <i>Fagonia mollis</i> | <i>Stachys aegyptiaca</i> |
| <i>Galium sinaica</i> | <i>Teucrium polium</i> |
| <i>Gymnocarpos decandrus</i> | <i>Zilla spinosa</i> |
| <i>Kickxia aegyptiaca</i> | |

Wadi Rem

Date: 11/8/05 **Location:** 28.68040N, 33.70219E, 784 meters
Coverages: Large Rock: 45% Small Rock: 27% Bare/Fine: 10% Vegetation: 18%

Description:

Wadi intersects Wadi Feiran. Transects completed in a farsh habitat close to the main road. There is a moderate to high level of vehicle tracks in this wadi. There is also a moderate amount of grazing from camels and goat. Wadi consists of mainly rock, having a high amount in the large rock class. Plant species richness is moderate to high with low plant coverage. Many plants are dead/dormant due to phenology. Wadi narrows further up and the bare/fine component increases. There is a higher amount of plant cover in this sandy area. The edges of the wadi remain rocky with low plant cover. Sandstone and granitic geology. Dominating plant species include: *Retama raetam*, *Artemisia judaica*, and *Hamada elegans*.

Plant List:

| | |
|------------------------------|-----------------------------|
| <i>Acacia tortilis</i> | <i>Hamada elegans</i> |
| <i>Aerva japonica</i> | <i>Heliotropium digynum</i> |
| <i>Anabasis sp.</i> | <i>Hyoscyamus muticus</i> |
| <i>Artemisia judaica</i> | <i>Ochradenus baccatus</i> |
| <i>Caylusea hexagyna</i> | <i>Pulicaria crispa</i> |
| <i>Capparis sinaica</i> | <i>Pycnocycla tomentosa</i> |
| <i>Citrullus colocynthis</i> | <i>Reseda pruinosa</i> |
| <i>Cleome brachycarpa</i> | <i>Retama raetam</i> |
| <i>Erodium sp.</i> | <i>Schismus barbatus</i> |
| <i>Fagonia arabica</i> | <i>Zilla spinosa</i> |
| <i>Fagonia mollis</i> | |

Wadi Shaq Musa

Date: 2/8/05 **Location:** 28.52830N, 33.96183E, 1892 meters
Coverages: Large Rock: 66% Small Rock: 13% Bare/Fine: <1% Vegetation: 20%

Description:

Steep, deeply cut gorge habitat. Transect located near grazing enclosure #7. Extremely high plant diversity with a high percentage of cover. Plants in very good condition. Low impacts through trails or grazing. Most grazing is found on Labiatae species, mostly by goats. Dominating plant species include: *Mentha longifolia*, *Origanum syriacum-sinaicum*, *Alkanna orientalis*, and *Phlomis aurea*. Black granite geological features. Some evidence of flash flooding.

Plant List:

| | |
|-----------------------------|-----------------------------------|
| <i>Alkanna orientalis</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Artemisia herba-alba</i> | <i>Panicum turgidum</i> |
| <i>Ballota kaiseri</i> | <i>Phlomis aurea</i> |
| <i>Chiliadenus montanus</i> | <i>Polypogon sp.</i> |
| <i>Cynodon dactylon</i> | <i>Stachys aegyptiaca</i> |
| <i>Echinops glaberrimus</i> | <i>Tanacetum sinaicum</i> |
| <i>Juncus sp.</i> | <i>Teucrium polium</i> |
| <i>Mentha longifolia</i> | <i>Verbascum sinaiticum</i> |
| <i>Nepeta septemcrenata</i> | |

Wadi Sheikh

Date: 29/7/05 **Location:** 28.61297N, 33.98836E, 1421 meters
Coverages: Large Rock: 3% Small Rock: 70% Bare/Fine: 3% Vegetation: 24%

Description:

The main road entering St. Katherine is through this wadi. Human impacts (road, litter, domestic animals) is extremely high. Wadi is approximately 300 meters wide. Wadi bed flat to slightly undulating, with a high small rock component and high vegetation cover. Plant richness greatly increases on wadi slope. There are also vehicle tracks going through survey area in addition to the main road. Dominating species in wadi bed include: *Artemisia judaica*. Dominating species on slope include: *Fagonia mollis* and *Chiliadenus montanus*. Grazing is heavy, especially on *Ochradenus baccatus*. Granitic geological features.

Plant List:

| | |
|------------------------------|-----------------------------------|
| <i>Alkanna orientalis</i> | <i>Launea spinosa</i> |
| <i>Artemisia herba-alba</i> | <i>Mentha longifolia</i> |
| <i>Artemisia judaica</i> | <i>Ochradenus baccatus</i> |
| <i>Chiliadenus montanus</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Citrullus colocynthis</i> | <i>Peganum harmala</i> |
| <i>Deverra sp.</i> | <i>Plantago sinaica</i> |
| <i>Echinops glaberrimus</i> | <i>Schismus barbatus</i> |
| <i>Fagonia arabica</i> | <i>Stachys aegyptiaca</i> |
| <i>Fagonia mollis</i> | <i>Stipagrostis ciliata</i> |
| <i>Gymnocarpus decandrus</i> | <i>Stipagrostis obtusa</i> |
| <i>Iphiona scabra</i> | Unknown (sent to Cairo by T. Ali) |

Wadi Sherij

Date: 27/7/05 **Location:** 28.55147N, 33.95625E, 1731 meters
Coverages: Large Rock: 35% Small Rock: 53% Bare/Fine: 3% Vegetation: 9%

Description:

Wadi located behind Fox Camp, with a steep climb up rocky terrain to access wadi. However, the wadi is relatively flat at the top. A small foot trail runs through wadi, with low impacts to the surrounding vegetation. Low to moderate grazing in this wadi, mostly by goats. Wadi width is approximately 50 meters. However, the water channel is only about 10 meters in width. Slopes of wadi consist of large boulders. Pink granite geology. High plant diversity due to increased water regime. Dominating plant species include: *Artemisia herba-alba*, *Phlomis aurea* and *Alkanna orientalis*.

Plant List:

| | |
|-----------------------------|-----------------------------------|
| <i>Alkanna orientalis</i> | <i>Lotus sp.</i> |
| <i>Andrachne aspera</i> | <i>Matthiola arabica</i> |
| <i>Artemisia herba-alba</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Ballota undulata</i> | <i>Phlomis aurea</i> |
| <i>Chiliadenus montanus</i> | <i>Scrophularia libanotica</i> |
| <i>Echinops glaberrimus</i> | <i>Stachys aegyptiaca</i> |
| <i>Fagonia mollis</i> | <i>Tanacetum sinaica</i> |
| <i>Fagonia arabica</i> | <i>Teucrium polium</i> |
| <i>Galium sinaica</i> | <i>Zilla spinosa</i> |

Wadi Souria

Date: 18/8/05 **Location:** 28.66003N, 33.89318E, 1185 m; 28.65533N, 33.89376E, 1149 m

Coverages:

| | |
|-----------------|-----------------|
| Large Rock: 1% | Large Rock: 1% |
| Small Rock: 73% | Small Rock: 90% |
| Bare/Fine: 5% | Bare/Fine: 2% |
| Vegetation: 22% | Vegetation: 7% |

Description:

Wadi runs parallel to Wadi Couria Shamun, separated by an area of sandstone outcropping. However, there is a higher percentage of plant cover in this wadi. Dominating plants include: *Fagonia mollis* and *Artemisia judaica*. Grazing heavy on: *Ochradenus baccatus*

Plant List:

| | |
|-----------------------------|----------------------------|
| <i>Acacia tortilis</i> | <i>Iphiaona scabra</i> |
| <i>Anabasis sp.</i> | <i>Launea spinosa</i> |
| <i>Artemisia judaica</i> | <i>Ochradenus baccatus</i> |
| <i>Atragalus spinosus</i> | <i>Retama raetam</i> |
| <i>Fagonia arabica</i> | <i>Schismus barbatus</i> |
| <i>Fagonia mollis</i> | <i>Stipagrostis sp.</i> |
| <i>Fagonia thebaica</i> | <i>Zilla spinosa</i> |
| <i>Heliotropium digynum</i> | |

Wadi Talah

Date: 6/7/05 **Location:** 28.34'02.39N, 33.55'55.81E, 1581 meters

Coverages: Large Rock: 37% Small Rock: 48% Bare/Fine: 4% Vegetation: 14%

Description:

Transect completed at the mouth of Wadi Talah. Width is approximately 50 meters. Granitic geology. Wadi has high species richness and high plant coverage. Area used heavily for Bedouin gardens. High grazing activity and trail use. Dominating plant species include: *Alkanna orientalis*, *Pulicaria undulata*, *Achillea fragrantissima*, *Origanum syriacum-sinaicum*, and *Fagonia mollis*. Heavily grazed species include: *Scrophularia libanotica* and *Juncus sp.*

Plant List:

| | |
|--------------------------------|-----------------------------------|
| <i>Achillea fragrantissima</i> | <i>Lavendula coronopifolia</i> |
| <i>Alkanna orientalis</i> | <i>Matthiola arabica</i> |
| <i>Artemisia herba-alba</i> | <i>Mentha longifolia</i> |
| <i>Ballota undulata</i> | <i>Nepeta septemcrenata</i> |
| <i>Capparis spinosa</i> | <i>Origanum syriacum-sinaicum</i> |
| <i>Chiliadenus montanus</i> | <i>Phlomis aurea</i> |
| <i>Deverra triradiata</i> | <i>Pulicaria undulata</i> |
| <i>Echinops glaberrimus</i> | <i>Scrophularia libanotica</i> |
| <i>Euphorbia peplis</i> | <i>Stachys aegyptiaca</i> |
| <i>Fagonia arabica</i> | <i>Teucrium polium</i> |
| <i>Fagonia mollis</i> | <i>Verbascum sinaiticum</i> |
| <i>Ficus carica</i> | <i>Zilla spinosa</i> |
| <i>Juncus sp.</i> | |

Wadi Tenya

Date: 21/7/05 **Location:** 28.57080N, 33.90359E, 1768 meters

Coverages: Large Rock: 8% Small Rock: 41% Bare/Fine: 36% Vegetation: 13%

Description:

Wadi composed of mainly small rock with some large rocks. Vegetation healthy overall with larger growth forms (especially *Zilla spinosa*) and proficient flowering/fruiting than seen in other sites.

Wadi approximately 75 meters wide. Foot trail through wadi that seems to be used moderately.

Low grazing impacts in the area. Dominant plant species include: *Zilla spinosa* and *Achillea fragrantissima*.

Plant List:

Achillea fragrantissima

Alkanna orientalis

Asclepias sinaica

Ballota undulata

Chiliadenus montanus

Origanum syriacum-sinaicum

Phlomis aurea

Pulicaria undulata

Scrophularia libanotica

Stachys aegyptiaca

Tanacetum sinaicum

Teucrium polium

Cruciferae sp

Zilla spinosa