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**Regulation No. (24) for the Year 2001**  
**Regulation for the Development of Wadi Rum Area**

Issued in Accordance with Articles (11) and (56) of the Aqaba Special Economic Zone  
Law No. (32) for the Year 2000

**Article (1)**

This Regulation shall be known as the (Regulation for the Development of Wadi Rum Area for the Year 2001), and shall come into effect as of the date of its publication in the Official Gazette.

**Article (2)**

The following words and phrases wherever mentioned in this Regulation shall have the meanings ascribed thereto hereunder unless the context indicates otherwise:

|                           |                                                                                                                                                                                                                                                                                                  |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Law</b>                | : The Aqaba Special Economic Zone Law.                                                                                                                                                                                                                                                           |
| <b>Authority</b>          | : The Authority of the Zone.                                                                                                                                                                                                                                                                     |
| <b>Board</b>              | : The Board of Commissioners.                                                                                                                                                                                                                                                                    |
| <b>Chief Commissioner</b> | : The Chairman of the Board.                                                                                                                                                                                                                                                                     |
| <b>Commissioner</b>       | : The Commissioner of Environmental Affairs.                                                                                                                                                                                                                                                     |
| <b>Wadi Rum Area</b>      | : The Area announced pursuant to the decision No (18) by the Board of the Aqaba Regional Authority in its session No 1/96, dated 1/7/1996, and any amendments thereon approved by the Board after the enforcement of the provisions of this Regulation and endorsed by the Council of Ministers. |
| <b>Infrastructure</b>     | : All movable and immovable facilities, amenities and installations falling within Wadi Rum Area's perimeters including roadways, pedestrians and riding animals' passage ways, camp sites, collecting garbage and waste installations, billboards and land border marks.                        |

**Article (3)**

The Authority shall, in coordination with the relevant bodies, assume the following powers in the Wadi Rum Area:

- A- Developing Wadi Rum Area and premises thereof, improving its efficiency to achieve growth in all aspects therein, promoting tourism, developing basic services therein and creating work opportunities in fields of tourists, handicrafts, mountain climbing and desert guiding to improve life conditions of the Area's inhabitants.
- B- Preserving the historical heritage, geological compositions and unique natural landscapes of Wadi Rum Area.
- C- Preserving wild creatures whether plants, animals and birds in the Area.
- D- Relocating endangered wild creatures such as (Badan) and Arabian gazelle by means of creating appropriate environment for such in the area, and maintaining the original environment conditions which is appropriate thereto and any other means.

- E- Preserving historical places, facilitating access thereto and providing necessary information thereabout through different means to introduce such.
- F- Preserving Wadi Rum Area's environment, preventing pollution sources and preserving public safety.
- G- Increasing level of environmental education and awareness to identify importance and vulnerability of environment and methods of preserving and sustaining such.
- H- Exchanging expertise and information with relevant local and international bodies.

#### **Article (4)**

A- A special committee named the "Wadi Rum Area Committee" shall be formed in the Authority to administer the Area, under the Chairmanship of the Commissioner, and the membership of the following:

- Wadi Rum Area's Director Vice-Chairman
- One representative of the Ministry of Tourism and Antiquities nominated by the Minister of Tourism and Antiquities.
- Three Members appointed by the Chief Commissioner upon the Commissioner's recommendation provided they include representative(s) of local community.

B- The Committee shall undertake the following tasks:

- 1- Establishing the policy necessary for Wadi Rum Area's administration, development and improvement in accordance with the accredited Environmental Management Plan, and submitting such to the Chief Commissioner to be presented to the Board to issue a decision thereon.
- 2- Preparing an annual administration plan for Wadi Rum Area subject to the Board's approval, and overseeing its implementation.
- 3- Defining necessary allocations for the Wadi Rum Area's expenditures to be approved by the Board and listed within the Area's annual budget.
- 4- Drafting administrative, financial and technical instructions and submitting them to the Chief Commissioner to be presented to the Board to issue a decision thereon.
- 5- Seeking the advice of people of expertise and competence in preparing necessary studies to develop and promote Wadi Rum Area.
- 6- Any other tasks required for Wadi Rum Area's good performance and assigned thereto by the Chief Commissioner.

#### **Article (5)**

A- The Committee shall convene its meetings upon an invitation by the Chairman or the Vice-Chairman in his absence at least once every month. The quorum shall be met upon the attendance of the majority of the members, provided that the Chairman or the Vice-Chairman shall be one of them. The Committee shall issue its decisions by majority vote of its members. If the votes are tied, then the vote of the meeting's Chairman shall be determinative.

B- The Committee shall document all its activities and shall submit its decisions and recommendations to the Chief Commissioner to adopt necessary actions thereon.

#### **Article (6)**

A- The Director of Wadi Rum Area shall oversee the implementation the Environmental Management Plan for the Area, which includes the following:

- 1- The roadmap for vehicles allowed to enter the Area, and lanes for pedestrians and riding animals.
- 2- The appropriate locations to establish and develop tourist camp sites within Wadi Rum Area to harbor tourists and provide them with any necessary services.
- 3- The hiking places and routs and training the Area's habitants on hiking and rescue operations.
- 4- The pastures within Wadi Rum Area in accordance with pasturing seasons, and monitoring livestock movement.
- 5- The specific entrance and exit points to visit Wadi Rum Area, and monitoring such through approved scouts by the Authority.

B- In order to achieve the purposes and goals of Wadi Rum Area, the Director shall assume the following authorities:

- 1- Issuing daily permits necessary to allow owners of private cars entering Wadi Rum Area.
- 2- Regulating the use of private vehicles which belong to the inhabitants of the Area for transporting tourists to their destinations.
- 3- Establishing specifications of vehicles for tourist transport whether as to the outer appearance or the type of upholstery or the technical and mechanical readiness of the vehicle and the requirements to be met in the driver.
- 4- Establishing bases to facilitate the use of all facilities within Wadi Rum Area so as to insure the safety and comfort of tourists.

#### **Article (7)**

Subject to the provisions of any enacted legislation in the Kingdom, the Board may, upon the Chief Commissioner's recommendation, contract with competent parties to develop or manage any part of the Wadi Rum Area in accordance with a contract concluded for this purpose.

#### **Article (8)**

A- The amounts incurred to Wadi Rum Area from implementing the provisions of this Regulation and the compensations resulting from violating its provisions shall be allocated in a special account within the Authority's budget to expend therefrom on the purposes and activities of Wadi Rum Area and villages of Diese Basin.

B- The Committee of Wadi Rum Area may accept donations and grants given thereto subject to the Board's approval, provided that the Council of Minister's approval is secured where the source of such donations is non-Jordanian.

#### **Article (9)**

A- Subject to legal liability, it shall be prohibited to undertake any actions, activities or procedures that may result in the destruction, damage or deterioration of the natural environment, or damaging the wild and plant life, or affect the esthetic of Wadi Rum Area. In particular, it shall be prohibited to undertake the following:

- 1- Constructing within the Wadi Rum Area's perimeters, excluding the village site existing in Rum and the visitor's center, provided that provisions of zoning and the instructions issued in accordance with this Regulation are taken into account when constructing therein.

- 2- Entering and exiting Wadi Rum Area from other than the specified areas.
  - 3- Entering to no-entry places without official authorization.
  - 4- Mining, stone-crashing and engraving and quarries.
  - 5- Hunting, transferring or harming wild animals, birds and reptiles, or undertaking any action that may lead to harming such.
  - 6- Destroying or damaging geological compositions or places that are considered habitation, reproduction or migration places of species of animals, birds and plants.
  - 7- Writing, painting or engraving any compositions of Wadi Rum Area.
  - 8- Timbering or destroying plant cover (Flura).
  - 9- Polluting soil, water or air resources.
  - 10- Entering exotic (alien) animal or plant species to Wadi Rum Area.
  - 11- Undertaking any procedures which affect Wadi Rum Area's environment such as lighting fire or littering within the Area.
  - 12- Driving vehicles outside the designated roads.
  - 13- Pasturing in other than the allowed areas and seasons.
- B- Subject to legal liability, it shall also be prohibited to engage in any tourist, agricultural, industrial, commercial, service, collective or individual sporting activities or conducting military exercises unless pursuant to a permit obtained by the Chief Commissioner or Commissioner as the case may be, and according to the conditions and basis established in accordance with the instructions issued by the Board for this purpose.

#### **Article (10)**

The Wadi Rum Area's employees, public security forces shall be entitled to seize any offence, organize a violation ticket and undertake any appropriate procedures according to the provisions of Environmental Protection Law, any enacted legislation and this Regulation. The forms for the violations minutes and any procedures related thereto shall be specified pursuant to instructions issued by the Board for this purpose.

#### **Article (11)**

The committed violations shall be referred to the Governor of Aqaba to undertake necessary legal actions against violators.

#### **Article (12)**

- A- The Board shall issue the necessary instructions for implementing the provisions of this Regulation, including the following:
- 1- Determining charges collected by the Wadi Rum Area's Committee in exchange of using its facilities and the services rendered therein.
  - 2- Specifying the forms of adopted documents necessary for expenditure and receipt and persons authorized to sign such.
- B- The instructions issued in accordance with the provisions of this Regulation shall be published in the Official Gazette.

## **Rum Protected Area**

### **Natural and Cultural Conservation**

### **Future Ecological Research and Monitoring Programs**



**Prepared by  
The Royal Society for the Conservation of Nature**

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# **Rum Protected Area**

## **Natural and Cultural Conservation**

### **Future Ecological Research and Monitoring Programs**

#### **Introduction**

In the light of the preparation stage of the Rum Protected Area management plan, the cultural and natural information were analysed and the following results were obtained:

- A list of the different priority targeted species and habitats; see Rum Protected Area ecological baseline reports.
- Clear idea about the distribution of species; see Rum Protected Area ecological baseline reports.
- The general ecological relationships and habitats requirement for the different targeted species see Rum Protected Area ecological profile.
- Clear idea about the different archaeological sites and their distribution; see Rum Protected Area archaeological baseline report.

One major objective was included in the management plan dealing specifically with the conservation of Rum Protected Area's habitats. This objective is:

***Conserve and where necessary restore the representative habitats of the protected area.***

According to this objective and for the purpose of determining the appropriate actions for the protection and management of the targeted species and habitats in the protected area, it is necessary to identify and monitor the their trend. According to this fact, the following outputs were prepared to achieve the above mentioned objective and were also highlighted as the major outputs in the management plan for the habitat conservation:

- **Output 1: Completed baseline survey especially for the Protected Area extension.**
- **Output 2: Well-implemented monitoring programme.**
- **Output 3: Detailed research programme applied to key management issues.**
- **Output 4: Established metrological station in the Protected Area.**

## **Output 1: Completed baseline survey especially for the Protected Area extension**

Whilst the different natural and cultural baseline surveys have provided baseline information on the majority of Wadi Rum's fauna, flora and archaeological sites, still more comprehensive research is needed for habitats, species and archaeological sites. Below is the detailed future research program for flora, fauna and archaeological sites.

### **A. Flora**

#### **1- Carry out the biomass productivity study once every five years.**

**Purpose:** to estimate the carrying capacity of the protected area's vegetation for grazing. This study is very vital in order to have a better understanding of the effect of grazing on the protected area's natural vegetation. For more information see Rangeland report.

#### **2- Carry out a flora baseline survey in the proposed extension area for Rum Protected Area.**

**Purpose:** to establish the presence and distribution of flora species in the proposed extension area. During the ecological baseline surveys, the survey team suggested to extend the southern boundaries of the protected area. This suggestion was raised as a result of the valuable observations that were taken during that period. So a detailed flora assessment is needed. For more information on the methodology, see the flora baseline survey.

### **B. Fauna**

#### **Invertebrates**

#### **1- Carry out a comprehensive sampling for the macro-invertebrates with particular emphasis on the extension area.**

**Purpose:** to enrich the macro-invertebrate species checklist of the protected area with special emphasis on the proposed extension area. The macro-invertebrates baseline study should be considered as a preliminary study and the resulting species list is far from complete. A comprehensive species list of the macro-invertebrates of the protected area and the extension area would require much more extensive sampling for several years. That is because of weather conditions, species development, population densities of many species and species migration varies from year to year.

#### **2- Assess the presence and distribution of the butterfly fauna of the protected area.**

**Purpose:** to create a clear idea about the presence and distribution of butterflies at the protected area. Only one butterfly species was recorded at the macro-

invertebrates study. However, several others are expected to occur in the protected area or in the neighbouring areas in the Hisma basin.

## Reptiles

### 1- Carry out a reptiles phase II survey to include the extension area.

**Purpose:** to study the status and distribution of species that were not covered in the first survey at the protected area and the extension area such as:

- ♦ *Ablepharus ruepelli*: restricted to humid areas.
- ♦ *Chamaeleo chamaeleon*: a Mediterranean species inhabiting humid areas with good vegetation cover.
- ♦ *Uromastyx egyptius* rare species.
- ♦ *Varanus griseus*: rare species, globally endangered.

The mountainous habitat must be also included in the phase II study . These habitats form a favorable type of habitat for some species, which may not prefer the lower altitudes.

### 2- Carry out a nocturnal reptile species survey.

**Purpose:** to investigate nocturnal reptile species, presence and distribution comprehensively in different times of night, immediately after sunset, midnight, and before sunrise, one-hour duration is recommended.

## Birds

### 1- Determine the breeding bird densities.

**Purpose:** bird density information would allow more accurate estimation of breeding bird populations within the more accessible habitats occurring within the Protected Area, though only for the more numerous species. This could be determined by using line transects of the bird baseline survey – see *section 3 – Methods* for details of carrying out transects. Transects should be carried out in each of the main wadis during March to May.

### 2- Assess the breeding bird success.

**Purpose:** although an estimate of the population size and distribution of all breeding bird species has been determined from the previous study, there is no data available on breeding bird success. This is important to determine as grazing and tourism through nest destruction and/or disturbance may adversely affect species.

**Method:** it is suggested that a series of 1 km x 1 km sample plots be established in a range of habitats throughout the Protected Area to give coverage of differing habitat types and in areas of high and low human use. Within each study plot, breeding bird numbers should be determined by territory mapping (as detailed in *section 3 – Methods*) combined with nest finding in order to monitor chick survival rates. Fieldwork should be carried out during April and May and would require one or two experienced ornithologists.

### 3- Carry an owls and nightjars survey.

**Purpose:** to establish the presence and distribution for owls and nightjars. Neither of these groups was effectively surveyed in 1999. Survey work for both groups needs to be carried out after dark. As Wadi Rum may support nationally important populations of the former groups, especially Hume's Tawny Owl, *Strix butleri*, a dedicated survey is suggested to address this situation.

**Method:** the main calling period of the three owl species breeding in Wadi Rum is likely to be January to March and the number of territory holding males could be assessed during this period by using the tape playback technique outlined under *Methods* and used successfully for sampling Hume's Tawny Owl during the baseline survey. Breeding territories of the three species range from 0.5 square km for Little Owl, *Athene noctua*, to more than 80 square km for Eagle Owl, *Bubo bubo*, but with nests sites for all of the species potentially being as close as 1 to 2 km. Sampling using the 2 x 2 km survey grid used for the current survey could be used for this work. The following measures should be taken into consideration

- All of the major wadi systems should be visited during a two to three hour period from dusk onwards and tapes of calling males of each of the species played and responses listened for.
- When sampling for the presence of Hume's Tawny Owl during the previous baseline survey, territory holding males tended to respond almost immediately after the first sequence of calls ended and this is likely to be the case in the other two species as well.
- If no response is obtained after five minutes, the tape should be played again.
- If no response is obtained after playing the call twice, it is likely that the species is not present.
- Each species should be sampled in turn, for example two sequences of Little Owl, followed by two sequences of Eagle Owl, followed by two sequences of Hume's Tawny Owl. Sampling should only be carried out on calm, dry evenings.
- Given a period of good weather, sampling of the whole Protected Area would probably take approximately three weeks. Existing RSCN staff would be able to undertake this work.

Both species of nightjar, Nubian, *Caprimulgus nubicus* and Egyptian, *C. aegyptius* could potentially breed at Rum. The same tape playback technique as outlined for owls could be used with surveys being carried out from mid-March to late April. Existing RSCN staff should be able to undertake this work.

### 4- Carry out a detailed study on the nationally important Sooty Falcon.

**Purpose:** to assess the presence, distribution and the size of the breeding population of Sooty Falcon, *Falco concolor*. Due to their late breeding strategy, Sooty Falcons were only just arriving in Wadi Rum at the end of the bird baseline survey period and therefore the size of the breeding population remains unknown but could be of national importance. As with other breeding raptors, the most effective census technique is to visit all suitable areas and record the presence of birds and look for evidence of nesting. Therefore it is suggested that a two to three week visit be made

to the site during July/August to look for nest sites, which would be located on ledges on the mountains. Existing RSCN staff should be able to undertake this work.

## **Bats**

### **1- Assess the presence and distribution of bat species at Wadi Rum Protected Area including the extension area.**

**Purpose:** to assess bat species presence/absence and distribution inside Rum Protected Area. In addition to mist nets, other techniques such as harp traps and bat detectors can do this. Studying habitats requirement and roosting sites for bats are also recommended.

## **Ungulates**

### **1- Carry out an aerial survey to assess the presence and distribution of Nubian Ibex.**

**Purpose:** To establish the relative abundance of the Nubian Ibex at Wadi Rum Protected Area including the extension area. The aerial survey is highly recommended because it is the most suitable method to be used in the protected area and can cover all the sites in a short period of time. This method can also give a full view of the Ibex habitat and population in the protected area. For more details, see the ungulates baseline survey.

## **Carnivores**

### **1- Carry out a carnivore survey in the area south of the protected area reaching the Saudi borders.**

**Purpose:** to establish the presence and distribution for carnivores. This survey should be carried out for the importance of this area to big carnivores like the striped hyena, wolf, leopard and caracal. The potential presence of the cheetah at the joint borders of Jordan, Iraq, and Saudi Arabia (Attalah 1969) should be examined carefully for the possibility of movements of such a remnant population to the buffer zone of the reserve if full protection was provided. Also, special emphasis should be addressed toward those species that are known as shy carnivores like the sand cat, fennec fox and the sand fox. See the carnivores' baseline report for the appropriate methodology.

## C. Archaeological sites

The different epigraphy and rock art of the Protected Area have been well studied and they continue to form the focus of current projects. It would therefore be unnecessary to undertake any separate study in this field. Other, more general surveys have not covered the ground systematically and there are therefore gaps in the archaeological record.

For instance, dams are to be found in many places in the clefts of the hillsides and although a few have been recorded there are many more. In recent years, Bedouins have been building new dams and reservoirs, some of which are in fact refurbishments of ancient ones. This is certainly a topic that deserves further study. Another type of site that is also under-represented in the previous archaeological work is graves and cemeteries, which are usually very difficult to date. There are many unrecorded ones within the Protected Area.

In light of the previous archaeological study, further field survey should initially cover a number of larger gaps left by previous projects. The suggested work can be divided into four project categories:

### **1- *Systematic walking survey to look for new sites.***

This should concentrate on Wadi Marsad in the west and south-western part of the Protected Area, past Hadbat Qara as far east as Jabal Qattar. The survey should cover the foothills on the eastern side of Wadi Marsad as well as sample areas of the south-western part, concentrating on the edges of the inselbergs and lower rock ledges that is where sites are most likely to be. Selective survey on the mountains where tracks may lead up to sites should also be carried out. All sites located should be recorded, pinpointed on the 1:50,000 topographic sheets and GPS co-ordinates taken.

### **2- *Revisiting some of the previously recorded sites.***

Recorded sites that should be revisited should particularly include those that have structures, in order to confirm their locations and current state of preservation. There are a number of sites the locations of which are given only to the nearest kilometre, and some of these should be verified if possible. This, it should be noted, can be a time-consuming exercise.

### **3- *In Wadi Rum itself, along both sides, paved enclosures were noted by Harding in 1947.***

Those paved enclosures should be all documented. A sounding was put into one, on the east side, by D. Kirkbride in 1959 (who concluded that it was a sanctuary, as opposed to a domestic structure). Apart from this, they have never been properly recorded and, given the heavy use of the area today, what is left of them should be surveyed.

#### **4- To establish a recording log for the observed archaeological sites.**

This can be achieved through using the local knowledge. Therefore interviews should be conducted with some of the local residents to find out about previously unknown sites and also to help in relocating sites.

#### **Noteworthy comment**

- ◆ The inventory of known sites could be increased gradually with the help of researchers carrying out different types of field projects. If they were to find an archaeological site they could note down the location (preferably with GPS co-ordinates) and a brief description of what is there (e.g. a grave, enclosure, dam, epigraphy, flints etc).

All archaeological projects that work within the Protected Area should be properly recorded and the results copied to both the Department of Antiquities and the RSCN.

## Output 2: Well-implemented monitoring programme.

The purpose of preparation of an ecological monitoring program is to assess the change in species and accordingly for its habitats status during the implementation of the suggested management schemes. The result of this ecological monitoring program is very vital to evaluate these schemes and actions and try to suggest, modify and use the appropriate ones.

The following ecological monitoring program addresses the needed actions and monitoring activities for these species. The suggested activities were compiled from the recommendations chapters of the different ecological baseline reports.

The program is broken down into sections by target two groups, the flora and fauna of Rum Protected Area. The sub-headlines under each section are as follows:

- Monitoring aim
- Methodology
- Timing
- Equipment
- Manpower

### A. Flora monitoring programme

#### 1- Update the List of Plants and Herbarium of Wadi Rum Protected Area.

**Monitoring aim and justification:** to finalize the species list and complete the herbarium collection. The winter season during the flora study and the year before were very dry and had less than 35% of the average rainfall. As a result, only 158 species of plants were recorded in the study, although it is estimated that about 350 species of plants can be found in the protected area.

**Methodology:** see the Rum Protected Area/flora ecological baseline survey

**Duration:** 4 months.

**Timing:** March – April and November – December.

**Manpower:** two researchers.

**Equipment:** three plant pressers, filter paper, GPS, nylon bags, camera, maps (1/50,000).

#### 2- Monitor Freshwater Spring Vegetation (Nab'a Al-Qattar, Shallalat Lawrence and, Nab'a Lawrence).

**Monitor aim and justification:** to monitor the change in the vegetation quality and structure in the main springs in the protected area. All the spring vegetation in the protected area versus the human activities such as grazing, water overuse and other activities that affect and destruct these springs should be monitored.

Water vegetation is one of the most scarce vegetation types in the desert ecosystem, it can be found in certain locations of the protected area, and is suffering from high grazing pressure and water use for livestock. All the springs in the area should be

monitored and protected from destruction. These springs are Nab'a Al Qattar, Shallalat Lawrence and, Nab'a Lawrence.

**Methodology:**

A fixed – photography. Field team should first do a systematic searching to exactly locate these springs. After that, the photographs must be taken in the same time every year for these springs. Then every time, these photographs will be scanned, girded using the Adobe Photoshop software and saved on the computer to compare them with future ones.

**Manpower:** two researchers.

**Duration:** two weeks.

**Timing:** mid March and mid August.

**Equipment:** camera, nylon bags, tripod, paint, maps (1/50,000).

### **3- Monitor the Acacia Trees**

**Monitoring aim and justification:** to assess the structure and function of the acacia tree's population, the problem that they are facing and the capacity of seedlings in the protected area. There are few *Acacia raddiana* trees in the protected area and protection measures should be taken especially since they are in the areas where high tourism and grazing pressure occur. It is recommended to monitor the level of use of the existing trees (woodcutting, grazing especially by camels, burning, etc).

**Methodology:**

1- Mapping the trees using a systematic transect, the GPS and the aerial photographs of the protected area. All information can then be inserted into the GIS system.

2- Tree regeneration can be assessed by recording the Acacia seedlings in a 10m radius from the old trees.

3- Carry out interviews to assess the function, use and the identification of the problem. Interviews with locals can assess the major uses and the relationship between their settlements and the tree locations.

**Manpower:** one researcher.

**Duration:** one week per month.

**Timing:** Feb. – May.

**Equipment:** GPS, camera, meter tapes, maps (1/50,000).

### **4- Monitor the Haloxylon Shrubs**

**Monitoring aim and justification:** monitor the regeneration capacity of the Haloxylon Shrubs.

The Haloxylon shrubs (*Haloxylon persicum*) are considered as one of the main components of the vegetation communities in the protected area. It is a very important species for sand fixation especially in the sand dune areas. This species is highly grazed in some areas especially by camels and is also cut for firewood by the

local people in the surrounding villages. The control of grazing, in the flowering and fruiting periods (autumn and early winter), will help in the regeneration process for this species. Tree regeneration is assessed by recording the Haloxylon seedlings around the old shrubs. Regeneration monitoring is also recommended in the different locations where this species is concentrated.

**Methodology:**

1- Mapping the Haloxylon community using a systematic plotting, the GPS and the aerial photographs of the protected area. All information can then be inserted into the GIS system.

2- Tree regeneration can be assessed by recording the Haloxylon seedlings in a 10m radius from the old trees.

3- Carry out interviews to assess the function, use and the identification of the problem. Interviews with locals can assess the major uses and the relationship between their settlements and the tree locations.

**Manpower:** one researcher.

**Duration:** one week per month.

**Timing:** Oct – May.

**Equipment:** GPS, meter tapes, camera, map (1/50,000)

## **5- Monitor the False Fig Trees**

**Monitoring aim and justification:** monitor the regeneration capacity of the False Fig Trees.

The rare False Fig Trees (*Ficus pseudo-sycomorus*) are found almost in all the side wadis of the protected area. They are very important since their fruits are the main diet for several animals (especially small birds). In addition to that, they are the most common trees in the low-elevation part of the protected area. Tree regeneration is assessed by recording its seedlings in the runoff wadis, where these trees occur due to the fact that seeds are usually transferred from mature trees by running water.

**Methodology:**

1- Mapping the Falsi Fig trees using a systematic transect, the GPS and the aerial photographs of the protected area. All information can then be inserted into the GIS system.

2- Tree regeneration can be assessed by recording the False Fug seedlings in a 10m radius from the old trees.

3- Carry out interviews to assess the function, use and the identification of the problem. Interviews with locals can assess the major uses and the relationship between their settlements and the tree locations.

**Manpower:** one researcher.

**Duration:** one week per month.

**Timing:** Mar. – Jul.

**Equipment:** GPS, meter tapes, camera, map (1/50,000)

## **6- Monitor the Tamarisk Trees**

**Monitoring aim and justification:** monitor the regeneration capacity of the Tamarisk Trees in order to understand their status in this arid environment.

Tamarisk trees (*Tamarix aphylla*) form unique stands of giant trees in inaccessible locations in the protected area. They can be considered as the largest trees of this species in Jordan. Although this species is not rare, threatened or endangered, its presence in such an arid environment is rare. Locating these few stands in the protected area is important since there are not more than ten trees in total.

### **Methodology:**

1- Mapping: Mapping the trees using a systematic transect and by referring to the flora ecological baseline report of the protected area. Distribution map for the Tamarisk tree can be prepared using the GIS.

2- Tree regeneration is assessed by recording its seedlings in around the old ones.

**Manpower:** one researcher.

**Duration:** one week per month.

**Timing:** Feb. – May every 2 years.

**Equipment:** GPS, meter tapes, camera, map (1/50,000).

## B. Fauna monitoring programme

### Invertebrates

#### 1- Monitor the population change of the darkling beetles like *Trachyderma hispida*, *Trachyderma philistina* and *Erodium rothi*.

**Monitoring aim and justification:** to establish the population density for darkling beetles at the protected area. Because species of the darkling beetles like *Trachyderma hispida*, *Trachyderma philistina* and *Erodium rothi* are abundant in the protected area and are easily collected by pitfall traps, such species may be used in future studies as indicators for the population change over a long period of time (at least several years).

**Methodology:**

1- Pitfall trap stations (See the Macroinvertebrates ecological baseline survey): In such studies, pitfall traps should be placed at specific sites and collected regularly (for example, every week) and then results may be compared over a long period. If populations are decreasing, further studies are needed to find out the causes.

**Manpower:** 2 researchers.

**Duration:** one week

**Timing:** every month

**Equipment:** GPS, camera, meter, plastic containers, vinegar, insect box, dissecting set, pins,

#### 2- Monitor the population change of the dragonflies.

**Monitoring aim and justification:** to establish the population density for dragonflies species at the protected area. The presence of dragonflies in the protected area is a sign of the presence of water ecosystems that can support them or the fauna that they depend on. If observation reveals that their population is decreasing, this could be a sign of deterioration in their aquatic ecosystem.

**Methodology:**

1- Transect Counts: Since many of the aquatic macro-invertebrates are present above the water surface or at the edge of the water, it is possible to walk along the shores and identify the individuals present. Such counts can be extended to the entire shoreline area, or use representative samples for a specific time during a monitoring period.

Transect locations will be chosen along shorelines, not necessarily at random. For monitoring programs it will be necessary to sample the same locations several times over the monitoring period to see any changes in species compositions. Several stretches should be chosen, preferably with different vegetation compositions adjacent to each in order to study the various species that may be present. Each location must be recorded exactly so that surveys can be conducted there in the future.

**Manpower:** 2 researchers.

**Duration:** 2 weeks

**Timing:** Mar., April, May, and June, every 3 years.

**Equipment:** GPS, camera, measuring tapes, insect box, dissecting set, pins, Insect net, invertebrate identification field guide, Entomological forceps (soft and hard)  
Tubes containing crock with ethyl acetate solution or 70% alcohol (to store collected specimens)

## Reptiles

### 1- Monitor and assess the relative abundance of Rum Protected Area reptile species.

**Monitoring aim and justification:** to assess the population change in the reptile species, in order to assess and evaluate the impact of different management actions and schemes on these species. Any negative or positive indication will affect respectively negatively or positively on the protected area's habitats.

**Methodology:**

1- Line transects (see chapter 2 for methods used in the baseline survey).

**Manpower:** 4 researchers.

**Duration:** one month

**Timing:** July – August, every 2 years.

**Equipment:** Compass, GPS, Maps, Stopwatch, Data sheets 200m, Tapes.

### 2- Establish and monitor *Phrynocephalus arabicus* distribution and relative abundance inside the protected area.

**Monitoring aim and justification:** To assess the presence, distribution and the relative abundance of *Phrynocephalus arabicus* inside Rum Protected Area. This species has a restricted range and distribution in Rum area. Most of the previous studies has not recorded it inside Rum Protected Area . The RSCN current baseline survey observed and recorded this species in the eastern part of the protected area, which indicated a good sign for an increase in its distribution.

**Methodology:**

1- Line transects (see chapter 2 for methods used in the baseline survey).

**Manpower:** 2 researchers.

**Duration:** one week

**Timing:** June, July, and August, every 2 years.

**Equipment:** Compass, GPS, Maps, Stopwatch, Data sheets 200m, Tapes.

### 3- Monitor and evaluate the risk of road killed incidences for the nocturnal reptile species.

**Monitoring aim and justification:** to count the road killed incidences for the nocturnal reptile species. During the night routes on Rum main road, it was found that road-killed incidences of reptiles are relatively high. Controls of vehicle's speed

on the road should be formulated and more awareness to the drivers should be supported. Continuous investigations of road-killed animals may help to find a permanent treatment.

**Methodology:**

1- Road count (see chapter 2 for methods used in the baseline survey).

**Manpower:** 2 researchers.

**Duration:** one week

**Timing:** June, July and August.

**Equipment:** Vehicle, GPS, Maps, Data sheets, Flashlights, Spotlight.

## **Birds**

### **1- Monitor the bird species status and distribution. (Repeat of current survey including the extension area)**

**Monitor aim and justification:** In order to assess the effects of any changes in habitats resulting from implementation of the Management Plan (or continued and accelerating uncontrolled use), it is suggested that the previous survey should be repeated, in order to compare results of both surveys.

**Methodology:** using the same techniques and survey squares, see methodology section in the bird ecological survey report.

**Manpower:** 4 researchers

**Duration:** Two months, every five years

**Timing:** mid February to early May

**Equipment:** Vehicle, GPS, Maps, Data sheets, Binoculars, telescopes

### **2- Monitor the autumn and spring raptor migration in the Rum Protected Area.**

**Monitoring aim and justification:** It is clear that the Wadi Rum Protected Area is important for migrating raptors, both in spring and autumn. The last survey was only able to cover a part of the autumn passage period and until now no systematic counts exist for spring passage. It is recommended that further surveys should be carried out to quantify spring movements.

**Methodology:** See the Raptor Baseline report.

**Manpower:** 2 researchers.

**Duration:** 8 weeks in spring, 8 weeks in autumn

**Timing:** August and late September and from early March to mid May

**Equipment:** Vehicle, GPS, Maps, Data sheets, Binoculars, telescopes

## **Rodent**

### **1- Assess and monitor the fluctuations in density of rodent species.**

**Monitoring aim and justification:** to assess the population density of rodent species. This will help to evaluate the impact of the implemented management schemes at the protected area. This can be done through comparing the result of this survey with the baseline survey.

**Methodology:**

1- Capture-Mark recapture technique (Trapping gird), see chapter 2 for methods used in the baseline survey.

**Manpower:** 4 researchers.

**Duration:** Two weeks

**Timing:** July, August.

**Equipment:** Sherman traps, GPS, Maps, Compass, Bait (Peanut butter + Oat), Markers, Plastic bags, Trapping kit.

## **Carnivores**

### **1- Monitor the carnivore species status and distribution. (Repeat of previous survey)**

**Monitoring aim and justification:** to assess the effects of any changes in habitat resulting from implementation of the Management Plan (or continued and accelerating uncontrolled use). It is suggested that the present survey should be repeated. Monitoring of carnivores should be repeatable from one year to the next and under the same conditions, thus giving unbiased, comparable results.

**Methodology:** Two methods are advised to be included in the monitoring plan of the protected, trapping and transects (both spotlight and spoor). These methods should be done by the protected area staff themselves and under the supervision of the Research and Survey Section in the RSCN. Applying such methods in the monitoring plan will be qualitative not quantitative, i.e. they will give an indication about what species found and crude abundance, but will not give information about the real abundance or density for each of these species inside the protected area.

**Manpower:** 4 researchers.

**Duration:** 4 months

**Timing:** every 5 years, December – March.

**Equipment:** carnivore's traps, trapping kits, GPS, compass, baits (Sardine), maps, data sheets, spotlight, binoculars, Car 4X4.

### Output 3: Detailed research programme applied to key management issues.

Various conservation and management issues were highlighted during the different ecological baseline surveys. These issues are related to habitats and the type of impact that they are facing. Human impact is one of the major influences for habitat disturbance and destruction. This impact is represented by tourism activities, grazing and other related activities. For the purpose of monitoring, examining and finding the management solutions for these impacts and issues the following research monitoring activities were suggested:

#### 1- Monitoring of sand dunes movements within the Protected Area.

**Monitoring aim and justification:** to assess the status and study the movement of sand dunes. There are no studies on sand dunes movement in the protected area although all the protected area is of sandy soils and sand dunes occur in the central and eastern parts of it, especially in Wadi Um 'Ishrin area. Sand dune formations are very fragile habitats and very sensitive to human activities especially 4-wheel driving, over grazing and plant cutting (especially plants that play a big role in sand dune fixation such as *Haloxylon persicum* and the *Calligonum sp.*).

**Methodology:** Several methods are recommended for this study. The simplest one is the fixed-point photography. Photographs can be taken yearly and compared to see the movement of the sand dunes.

Another method is the use of marked grids. The grids will be marked with metal poles that will have their bases painted at the sand surface. After that, these poles will be checked to see the sand movement.

The last method is to use aerial photographs or satellite images on yearly basis to monitor the movement of the sand dunes.

**Manpower:** two researchers.

**Duration:** 1 week.

**Timing:** Aug.

**Equipment:** GPS, camera, tripod, metal poles, paint, meter tapes, map (1/50,000), aerial photographs, satellite images and stereoscope.

#### 2- Monitor the change in the vegetation communities within the Protected Area.

**Monitoring aim and justification:** To assess the effect of management activities on the different vegetation communities. There are five different vegetation types that have been recorded in the protected area and they are all of ecological importance. Different impacts on the area will result in a change in the composition of these vegetation types, which will also affect the different related fauna.

**Methodology:**

1- Fixing quadrates (at least 10X10m) in the different vegetation communities that can be studied each year. The data that should be collected include the following: dominant species, number of individuals, species cover and total vegetation cover.

2- Aerial photographs and satellite images can also be used yearly to see the change occurring on the different communities. Another method is to use the frame quadrates (1X1m) and to estimate the vegetation cover, density and abundance in the different vegetation communities.

**Manpower:** two researchers

**Duration:** one week

**Timing:** mid March - every 2 years.

**Equipment:** GPS, meter tapes, camera, aerial photographs, satellite images, 1X1 quadrates, map (1/50,000)

### **3- Test seeds viability for main tree species.**

**Monitoring aim and justification:** to monitor the regeneration of different trees and shrubs in the protected area. The viability of the seeds should be tested in the laboratory. The main trees species in the protected area (*Juniperus phoenicea*, *Acacia raddiana*, *Pistacia atlantica*, *Ficus pseudo-sycomorus* and *Haloxylon persicum*) should all be tested. It should be determined when is the right time for collecting the seeds and the means of treatment. It is recommended that several visits should be made around the year to decide the exact time for the seed collecting. Coordination should be arranged with one of the university laboratories to do the testing.

**Methodology:** in consultation with a specialist.

**Manpower:** 2 researchers.

**Duration:** two months (one month for fieldwork and the other for laboratory analysis)

**Timing:** Mar., Jun., Oct. and Jan.

**Equipment:** GPS, camera, nylon bags.

### **4- Carry out the livestock counting, through the year in three counts, each two years.**

**Monitoring aim and justification:** Livestock count is highly needed in order to understand the fluctuation in livestock numbers and to evaluate the effect of that on the vegetation cover and structure.

**Methodology:** See Rum Protected Area rangeland report for details.

**Manpower:** 2 rangers, researcher

**Duration:** 2 weeks

**Timing:** April, August, December

**Equipment:** Car 4X4, Binoculars, maps, data sheets.

### **5- Assess and understand the Bedouin tribes' movements.**

**Monitoring aim and justification:** to understand the effects of these movements on the vegetation cover and structure. It was noticed that there were some difference in movements recorded by this study and the movements recorded during the socio-economic survey. It might be that the main tribe that its movement should be studied is the Zalabia tribe since the highest number of livestock was recorded in their zones.

**Methodology:** See Rum Protected Area rangeland and socio-economic reports for details

**Manpower:** 2 rangers, 2 researchers

**Duration:** 2 weeks

**Timing:** April, August, December.

**Equipment:** Car 4X4, Binoculars, maps, data sheets.

## **6- Monitor the effect of grazing on vegetation cover in the different grazing zones of the protected area.**

**Monitoring aim and justification:** to monitor the effect of grazing on vegetation cover in the different grazing zones of the protected area. Establish a grazing monitoring program in the protected area. According to the information collected, several exclosures can be built in different parts of the protected area.

**Methodology:** For applying this program, the same methods of the Dana Nature Reserve exclosure monitoring program can be used. The following approaches are needed to be taken into consideration:

Six (20mx20m) exclosures are planned to be established in the protected area. Two of these exclosures are going to be in the autumn seasonal grazing zone of the protected area. Another two will be in the no-grazing zone and the last two will be in the grazing area. Each one of the grazing exclosures will have a control plot adjacent to it. Unlike the exclosures, these control plots are not going to be fenced.

The location of the exclosures is as follows:

- a. Exclosures in the autumn seasonal grazing zone:
  - Um Mqour exclosure (coordinates: 735511E, 3259539N)
  - Hadbat Qara exclosure (coordinates: 721101E, 3273887N)
- b. Exclosures in the all-year grazing zone:
  - Wadi Rum exclosure (coordinates: 735415E, 3275423N)
  - Khor 'Ajram exclosure (coordinates: 734584E, 3269800N)
- c. Exclosures in the no-grazing zone:
  - Um Ishrin exclosure (coordinates: 739367E, 3292683N)
  - Rumman exclosure (coordinates: 728459E, 3284901N)

**Manpower:** 3 researchers

**Duration:** 1 week for each exclosure

**Timing:** March, April

**Equipment:** Car 4X4, Binoculars, maps, data sheets, rope, camera, meter.

#### **Output 4: Established metrological station in the Protected Area.**

##### **1- Set up two meteorological stations in the Protected Area.**

**Monitoring aim and justification:** to collect climatic information for the Protected Area. There are no meteorological stations at Rum Protected Area. The closest stations are in Aqaba and Ma'an. Both of these stations are not representative for Rum area. It is needed to establish two stations in the protected area in order to get the data needed for the different habitats. These two stations should be set up in two different locations and on different elevations. The first is recommended to be set in Rum village near the proposed rangers station and will be representing the lower parts of the protected area and will be working and checked daily. The other one is recommended to be set on the top of Al Khaz'ali Mountain. This station will be working on daily basis but checked once a week.

To accomplish this output, the following activities were suggested:

- 1- Identify the needed meteorological parameters and measurements.
- 2- Identify the needed equipment and materials.
- 3- Consult the meteorological department in Amman.
- 4- Identify the needed resources for the station establishment.
- 5- Purchase the needed equipments and materials in coordination with meteorological department.
- 6- Carry out a training course on the data gathering and analysis for Rum Protected Area responsible staff. This course will be carried out in coordination with meteorological department.

## Five years Workplan

**Output 1: Completed baseline survey especially for the Protected Area extension**

[illegible]

|                                                                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| area.                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2- Carry out a nocturnal reptile species survey.                        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Birds                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1- Determine the breeding bird densities.                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2- Assess the breeding bird success.                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3- Carry an owls and nightjars survey                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4- Carry out a detailed study on the nationally important Sooty falcon. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Res.: Responsibility.

| Activity                                                                                                        | Res. | Year1 |    |    |    | Year2 |    |    |    | Year3 |    |    |    | Year4 |    |    |    | Year5 |    |    |    |
|-----------------------------------------------------------------------------------------------------------------|------|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|
| Bats                                                                                                            |      | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| 1- Assess the presence and distribution of bat species at Wadi Rum Protected Area including the extension area. |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| Ungulates                                                                                                       |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 1- Carry out an aerial survey to assess the presence and distribution of Nubian Ibex.                           |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| Carnivores                                                                                                      |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 1- Carry out a separate carnivore survey in the area south of the protected area reaching the Saudi borders.    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |

Res.: Responsibility.

| Project                                                                                                                                                               | Res. | Year1 |    |    |    | Year2 |    |    |    | Year3 |    |    |    | Year4 |    |    |    | Year5 |    |    |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|
| C. Archaeological sites Research                                                                                                                                      |      | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| 1- Systematic walking survey to look for new sites                                                                                                                    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 2- Revisiting some of the previously recorded sites, particularly those which have structures, in order to confirm their locations and current state of preservation. |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 3- Recording properly the observed paved enclosures (a sanctuary, as opposed to a domestic structure).                                                                |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 4- Interviewing the local communities to find out about previously unknown sites and also to help in relocating sites.                                                |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |

Res.: Responsibility.

## Output 2: Well-implemented monitoring programme.

| Activity                                                                                          | Res. | Year1 |    |    |    | Year2 |    |    |    | Year3 |    |    |    | Year4 |    |    |    | Year5 |    |    |    |
|---------------------------------------------------------------------------------------------------|------|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|
| A. Flora monitoring program                                                                       |      | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| 1- Update the List of Plants and Herbarium of Wadi Rum Protected Area.                            |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 2- Monitor Freshwater Spring Vegetation (Nab'a Al Qattar, Shallalat Laurence and, Nab'a Lawrence) |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 3- Monitor the Acacia Trees                                                                       |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 4- Monitor the Haloxylon Shrubs                                                                   |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 5- Monitor the False Fig Trees                                                                    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 6- Monitor the Tamarisk Trees                                                                     |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |

Res.: Responsibility.

| B Fauna monitoring program                                                                                                                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Invertebrates                                                                                                                                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1- Monitor the population change of the darkling beetles like <i>Trachyderma hispida</i> , <i>Trachyderma philistina</i> and <i>Erodius rothi</i> . |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2- Monitors the population change of the dragonflies.                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Reptiles                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1- Monitor and assess the relative abundance of Rum Protected Area reptile species.                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2- establish and monitor <i>Phrynocephalus arabicus</i> distribution and relative abundance inside the protected area.                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Res.: Responsibility.

| Activity                                                                                                        | Res. | Year1 |    |    |    | Year2 |    |    |    | Year3 |    |    |    | Year4 |    |    |    | Year5 |    |    |    |
|-----------------------------------------------------------------------------------------------------------------|------|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|
| Reptiles                                                                                                        |      | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| 3- Monitor and evaluate the risk of road killed incidences for the nocturnal reptile species.                   |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| <b>Birds</b>                                                                                                    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 1- Monitor the bird species status and distribution.<br>(Repeat of current survey including the extension area) |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 2- Monitor the Autumn and Spring raptor migration in the Rum Protected Area.                                    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| <b>Rodent</b>                                                                                                   |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 1- Assess and monitor the fluctuations in density of rodent species.                                            |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| <b>Carnivores</b>                                                                                               |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 1- Monitor the carnivore's species status and distribution.<br>(Repeat of current survey)                       |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |

Res.: Responsibility.

### Output 3: Detailed research programme applied to key management issues.

| Activity                                                                                                   | Res. | Year1 |    |    |    | Year2 |    |    |    | Year3 |    |    |    | Year4 |    |    |    | Year5 |    |    |    |
|------------------------------------------------------------------------------------------------------------|------|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|
|                                                                                                            |      | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| 1- Monitor the Sand Dunes Movements within the Protected Area.                                             |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 2- Monitor the Change in the Vegetation Communities within the Protected Area.                             |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 3- Test the Seeds Viability for the Main Trees Species.                                                    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 4- Carry out the livestock counting, through the year in three counts, each two years.                     |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 5- Assess and understand the Bedouin tribes' movements.                                                    |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |
| 6- Monitor the effect of grazing on vegetation cover in the different grazing zones of the protected area. |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |

Res.: Responsibility.

**Output 4: Established metrological station in the Protected Area.**

| Activity                              | Res. | Year1 |    |    |    | Year2 |    |    |    | Year3 |    |    |    | Year4 |    |    |    | Year5 |    |    |    |
|---------------------------------------|------|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|
|                                       |      | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| 1- Set Up Two Meteorological Stations |      |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |       |    |    |    |

Res.: Responsibility.

## **Thing to be taken into consideration during research planning**

### **Before Going into the Field**

This is the time when you plan what you are going to do, what you will need to bring, and what you propose to find out. You will need to know why you are going into the field and you will need to know what you will do when you get back. Basically, before doing anything, you need a clear plan of the entire process from start to finish.

The planning phase is often taken care of by only one or two people, with the rest of the researchers only joining the project once they go into the field. In either case, however, it is important that everyone participating in an ecological field survey has an understanding of the overall project aims.

### **Survey Aims**

Before you can even try to justify going into the field and undertaking some sort of research, you will need to clearly understand the aims of your study. You will need to decide the depth of data you want, whether you want to get a general idea of what species are present or get better details of the population sizes. Will you conduct a baseline survey or a comprehensive one?

The following list describes some possible aims of a field study:

- To assess the presence and distribution of various species.
- To describe and define the importance of a site.
- To establish the population size and relative abundance of a species.
- To determine the habitat requirements of a species.
- To identify ecological relationships.
- To determine if a population is changing.
- To determine why a population is changing.

### **Baseline surveys**

For regions without very much information, such as a newly established reserve or a proposed one, baseline surveys are useful to get an idea of the ecology of the area. Baseline surveys may be done for different components of the ecosystem in order to get an idea of each one, such as one for birds, another for large mammals, a third for carnivores, and so on.

Once all or most of the ecosystem's components have been studied in a region to the level of a baseline survey, it is possible to consider all of them together to establish an ecological profile of the region. An ecological profile considers the relationships of various species in order to gain an understanding of which ones are most important for the ecosystem. These species are known as key species, and they are often the subject of further studies or conservation measures.

The following list provides some of the aims of baseline surveys:

- To provide initial information to guide the establishment and monitoring of protected areas and other forms of species protection.

- To provide a basis for monitoring and to establish monitoring programs.
- To increase understanding of ecological relationships, habitat associations, inter-specific relationships, and potential threats to the system.
- To identify needs for specific ongoing research.

### **Data needed**

Ecological field research is essentially the collection of data relating to the natural environment. Depending on the aims of the study, you will need to collect different types of data both from references and while you are in the field. You will need to have an idea of what data you need in order to choose methods you want to use to collect that data.

Once you have a basic idea of what data you need, you will want to narrow it down even more. The questions on the following list should be considered before you continue:

- What are the particular target species which you will be trying to survey?
- Will you need to collect specimens?
- Which data sheet(s) will you use to record data while in the field?
- What sort of database will you use to compile all the data once you return from the field?
- What type of data (nominal, ordinal, etc.) will you need in order for it to be compatible with other data on the subject?
- What statistics will you use to analyse your data once it is collected?

The following table may be consulted to determine what data is needed, based on the general aims of a study.

Table 1: Conservation functions, objectives, and data needed

| <b>Functions</b>                                                                   | <b>Objectives</b>                                                                                                                   | <b>Data needed</b>                                                                                                                                        |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b> To identify ecosystems, habitats, and species of high conservation value. | <b>A.1</b> To establish species distributions                                                                                       | <b>A.1.1</b> Presence/ absence of species in each region                                                                                                  |
|                                                                                    | <b>A.2</b> To determine relative species richness and heterogeneity of different sites and identify unique communities and habitats | <b>A.2.1</b> Species richness (number of species)<br><b>A.2.2</b> Community heterogeneity                                                                 |
|                                                                                    | <b>A.3</b> To identify target species                                                                                               | <b>A.3.1</b> The recognised status of endemic, rare, and flagship species<br><b>A.3.2</b> The identity of other species known to be in decline nationally |

| Functions                                                                                                    | Objectives                                                                                                                              | Data needed                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                              | <b>A.4</b> To determine the relative abundance of the target species                                                                    | <b>A.4.1</b> Relative abundance                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                              | <b>A.5</b> To record information on population structure relevant to the viability of the target species or of the community as a whole | <b>A.5.1</b> Age structure<br><b>A.5.2</b> The presence of breeding individuals<br><b>A.5.3</b> Sex ratio                                                                                                                                                                                                                                                                  |
|                                                                                                              | <b>A.6</b> To assess the suitability of a habitat for conservation                                                                      | <b>A.6.1</b> The size of the area<br><b>A.6.2</b> An estimate of the degree of habitat fragmentation<br><b>A.6.3</b> Human utilisation patterns<br><b>A.6.4</b> Relevant biotic and abiotic influences (e.g. water catchment size)<br><b>A.6.5</b> Specific threats (e.g. erosion, disease, and hybridisation threats)                                                     |
| <b>B</b> To determine appropriate action for the protection and management of important habitats and species | <b>B.1</b> To establish priorities based on the relative value of different habitats/ species.                                          | All the data found for Function A, above, is needed for a coherent determination of management priorities                                                                                                                                                                                                                                                                  |
|                                                                                                              | <b>B.2</b> To establish species distributions                                                                                           | <b>B.2.1</b> Presence/ absence of species                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                              | <b>B.3</b> To identify ecological associations                                                                                          | <b>B.3.1</b> Associations between species (found through assessing relative or absolute density in a range of habitats)<br><b>B.3.2</b> Associations between species and habitats<br><b>B.3.3</b> A synthesis of this data to identify taxa which are useful indicators for target species or the habitat as a whole<br><b>B.3.4</b> Physical determinants of habitat type |

| Functions                                                                               | Objectives                                                              | Data needed                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                         | <b>B.4</b> To establish the conservation requirements of target species | <b>B.4.1</b> Population trends<br><b>B.4.2</b> Habitat associations<br><b>B.4.3</b> If the species is found to be in decline a detailed study is needed, which will require the following additional data:<br>Population structure<br>Reproductive behaviour<br>Food/ prey availability<br>Impact of predation<br>Effect of intra- and inter-specific competition |
|                                                                                         | <b>B.5</b> To identify and monitor trends in population/ habitat change | <b>B.5.1</b> Relative abundance of indicator species and appropriate target species, measured at regular intervals<br><b>B.5.2</b> Changes in species composition<br><b>B.5.3</b> Changes in population structure<br><b>B.5.4</b> Measurements of key environmental parameters                                                                                    |
| <b>C</b> To establish and maintain a national database of Jordan's biological diversity | <b>C.1</b> To establish species distributions                           | <b>C.1.1</b> Presence/ absence of species                                                                                                                                                                                                                                                                                                                         |
|                                                                                         | <b>C.2</b> To establish the status of Jordan's species                  | <b>C.2.1</b> The national and international conservation status of each species                                                                                                                                                                                                                                                                                   |

### Survey method needed

Once you have an idea of your study's aims and the data you would like to collect, you need to decide which survey methods you will use to collect that data and achieve those aims. Most studies will include several survey methods which all complement each other in order to provide a more complete picture of your target species.

All of the field research methods used by the RSCN are found in the Survey Methods section, organised by target species. Methods are described in a way that you will only need to read the first sentence or two of each to determine if it may be applicable to your study.

## **Report plan**

Although most of the work involved in writing the report to document your research findings will come once the field work is complete, you should at least have some idea about how you will present your research later on. An idea of the format your report will take should help to guide the types of data you will collect and how you organise it. You should also try to determine if you will need some supporting information that will not specifically be obtained through your field research methods. This may include photographs of certain things which you are focusing on. It may mean you will want to utilise the Research and Survey Sections GIS resources to produce maps of your study area, so you will need to find out what sort of data will be needed in order to produce them.

## Field Plan

Once you know exactly what you want to do when you are in the field, you need to establish a field plan so that your time is all used efficiently. Whatever you can easily plan before you arrive at the field location should be, because you may not be able to decide things as efficiently once you are out there. Often there are only one or two people who are responsible for planning the fieldwork, but it should nonetheless be understood by the rest of the team that this could be a big task.

The following list of questions should be considered in order to come up with a comprehensive plan to make the most of your time in the field:

- Where will your sampling sites be located?
- How much time will you need to spend at each sampling site?
- What will your route from one sampling site to the next be?
- How much time will it take to get from one site to the next?
- How many days or weeks will the fieldwork take?
- What data sheets will be used? Do you have enough copies?
- Who will be going?
- What will be the specific responsibilities for each of the people on the team?
- What equipment will be needed for the methods you plan to use?
- Do you have a sufficient supply of the consumables, such as preservation fluid for insects, test pellets for water analysis, or film for your camera?
- Will you want to take photographs at any of your sample locations?
- If you will need to recharge batteries, where will you do this?
- Where will you spend the night while you are in the field? Do you need to make reservations?
- If you will be camping, do you have the right equipment (tents, blankets, firewood, cooking equipment, etc.) for everyone to be safe and comfortable?
- What will everyone be eating? Will enough food be brought, or will it be bought along the way? If you will be preparing your own meals, are there enough plates, pots, cups, etc. for everyone?
- How much money will be needed? What is the budget allocated for the field portion of this project?

## Tips

The following three lists give quick tips to keep in mind when planning any ecological field research.

**Effective Survey Design.** The following list of questions is designed to help formulate a field research plan. Once each point has been sufficiently considered, you should be nearly ready to commence your research.

- Define your aims - why is the data needed?
- What type(s) of data are needed to achieve those aims?

- What statistics will you use for the analysis?
- How accurate will your estimate need to be, and what sample size is needed to obtain this accuracy? Use statistics.
- Which survey types will provide the necessary data?
- Which of these surveys would be most appropriate? Factors influencing your choice may include:
  - Physical characteristics and/or behaviour of the target species.
  - The size of the survey area.
  - The terrain and climate.
  - Personnel and time.
  - Budget and equipment.
- What additional information might help explain trends or patterns, and how can this additional data be collected?
- What other surveys could be done at the same time to maximise the efficiency of your survey schedule?
- What data sheet will be used to collect field data, and how will the data be stored once it is collected? Use the standard field data sheet for your survey method. The structure of this data sheet should be as similar as possible to that of the computer database or spreadsheet that will ultimately be used for storing the data.
- Are your methods clear? Can they be reproduced by others in the future?

***The Rules of Ecological Surveys.*** You should review the points on this list once you have your rough plan, and change it accordingly in order to comply with these rules. (From Krebs, 1999, chapter 1)

- Not everything that can be measured should be.
- Find a problem and state your objectives clearly.
- Collect data that will achieve your objectives and make a statistician happy.
- Some ecological questions are impossible to answer at the present time.
- With continuous data, save time and money by deciding on the number of significant figures needed in the data before starting an experiment.
- Never report an ecological estimate without some measure of its possible error.
- Be sceptical about statistical tests of significance.
- Never confuse statistical significance with biological significance.
- Code all your ecological data and enter it on a computer in some machine-readable format.
- Garbage in, garbage out (if your data is insufficient, your results will be, too).

***Common Survey Sins.*** The points on this list should be kept in mind as you start to formulate your research plan, and they should be reviewed in the final planning stages to make sure you are not committing any of these survey sins.

- Not understanding why you are surveying.
- Not considering how you will analyse the data before you collect it.

- Not thinking about your sample size.
- Not sampling randomly.
- Surveying one or a few large areas instead of many small ones.
- Not knowing the biology of your species well enough to survey it properly.
- Not giving precise geographical and habitat information about where the sampling occurred.
- Changing the survey method without telling anyone.
- Not being precise about the methods used.
- Assuming sampling efficiency is the same in different habitats.
- Counting the same individual twice in one transect.
- Deviating from transect routes.
- Believing that the density of trapped animals is the same as the absolute density.
- Not being critical about your own results.
- Not attaching confidence intervals to population estimates.
- Not storing information in a way that it can be easily accessed.

### While in the Field

The fieldwork part of your research project will likely be the most enjoyable part of the entire study if you like being outdoors, but you must always keep in mind that you are out there to accomplish something in a scientific manner. You will need to try to follow the methods you have chosen as closely as possible, and you will need to keep careful records of everything you do that is related to the study.

Your time in the field will also be limited, so you should use your time efficiently. Even if it is possible for you to return to the field location later if you realise that you forgot to collect some data, it is much easier to get everything done at once rather than to have to go back again.

### Field notes

When you are in the field collecting data, it is vital that it is collected in a clear format so that it can be understood later when the time comes to write up the findings. The following list gives useful points for note-taking in the field:

- *Use standardised data sheets.* Data sheets outlining the important notes to take while in the field are helpful for remembering to take down all the details.
- *Always enter complete information.* Never leave any sections to be filled in later. Even if you are not able to take notes as you make the observations, you should write them down as soon as you have the chance. Field notes should always be written the same day as they were observed.
- *Record everything, even if it is nothing.* It is as important to record not seeing or catching species as it is to record when they are seen.
- *Record peripheral details.* Although it may not be included on the data sheet for your particular method, you should still note other details such

as all of your activities, observations, locations visited, routes, and times. Write a description of the habitat at each survey site.

- *Write your name.* Be sure to include the date and the names of the field researchers on each page. Differences in data between studies can sometimes be attributed to the varying data collection skills of different researchers, even if they are using the same methods.
- *Use waterproof ink (or a pencil).* This is a precautionary measure in case the field notes get wet, so you will not lose your data.

## **Specimen Collection**

In the early days of environmental research, a scientist's prestige seemed to be directly related to the number of preserved specimens in his collection. While the environmental consciousness that environmental researchers have since gained now prefers to see wild animals alive and in the wild, there are still some cases where specimens must be taken.

First of all, specimens of many groups of species should never be taken from Jordan, as there is no scientific need to do so. This is the case for all of the birds and larger mammals. It should be kept in mind that one mandate of the RSCN is law enforcement in order to protect these species from illegal hunting, so we would be setting a particularly bad example if we started killing those same species.

The main reason to take a specimen of a species is to document its existence at a specific location. If, for example, you observe what you think is a foreign species in Jordan, you will need at least one specimen of this species to back up your claim that this species has indeed been seen in the country. This is called a voucher specimen.

The RSCN has adopted guidelines pertaining to the collection of specimens in order to avoid the excessive removal of species that we are supposed to be protecting. First of all, the RSCN already has samples of most of Jordan's bat, rodent, reptile, and amphibian species, so the necessity of collecting more should be very clear, and it should be approved by the RSCN before you actually start your field work. In other words, you probably will not be collecting any animal specimens.

This is very different for macroinvertebrates however. Since the killing and preservation of specimens is often part of the survey methodology, you will be collecting numerous samples during your survey. Macroinvertebrate specimens also require detailed identification procedures to determine the genus or species, which usually involves killing and transporting the samples from the field. The mounting of insects is an important and time-consuming part of any macroinvertebrate survey.

The procedure for collecting flora samples is also a lot more relaxed than for animals. The RSCN has a large collection of preserved flowering plants found throughout Jordan, organised taxonomically.

Ideally, collections should be stored at the protected area they were collected in. A catalogue of all specimens should be kept and made available for visiting researchers. Each specimen should have a distinct number in that catalogue that is also on the specimen label. The collection should be available to anyone wishing to see it, though permission should be taken, especially if specimens leave the collection.

Visiting researchers often wish to take samples of their study species back to their home country. For this, the standard is generally that they can collect two specimens for themselves - one male and one female. If the RSCN does not yet have samples of that species, the researcher is entitled to capture an additional pair for the RSCN collection. The visiting researcher needs to get permission before doing this, and it is only granted for small mammals, reptiles, and amphibians.

### **After the Field Work**

Once you return from the field, you will have a lot of data you collected through various methods, but it is not yet useful until it is in a clear format. You must first collect all of your data and organise it into lists, tables, or graphs. Then you will need to analyse the data and perhaps compare it with results of other studies. Once you have a clear idea of the ecological processes you observed, you will need to write up your findings into a report. Finally, if all of your effort is to be of any use, it will need to be distributed to other researchers and to decision makers.

### **Compiling the Data**

The first step you will need to take once you have collected a lot of data during your field work is to organise it. Depending on the type of data, this may take several forms. Often, the best way to compile data is with a database program. If your data is continuous, your database program will be able to perform mathematical functions on it. It will also be able to produce graphs and lists in order to display the data in a format that is easier to read. If you are interested in extrapolating your to cover a greater area than that which you surveyed, you will need to be able to demonstrate your reasoning in your write up. Any graphs or equations used to estimate population density based on sample counts, for example, must be clearly explained as part of the report.

For any equations you use, you should provide a measure of accuracy along with the results. This manual provides some statistical tests for the equations used in a few sections, so they should be used and included with the data in your report. For further statistical methods, the following references are recommended:

*Ecological Methodology*, by Krebs (1999) is a full text dedicated to the proper statistical methods used to analyse ecological field data.

*Biostatistical Analysis*, by J Zar (199) includes most of the same statistical methods, but has a lot more explanations.

*Ecological Census Techniques: A handbook*, edited by Sutherland *et. al.* (1996) includes many of the methods described here, along with the statistics needed to properly analyse the data.

## Writing the Report

The report is the product of all of your labour that other people will actually see, so it should be given a fair amount of effort. You should try to complete the report as soon as possible once you return from your field excursions. It requires detailed explanations of what exactly you did while in the field, so if you wait too long to write it your descriptions may not be as complete. The most important part of your report is the results section. This is where you clearly explain exactly what you determined as you collected and analysed your data. Once you have compiled and examined all of your data as explained in the previous section, you should explain exactly what it all means. You should write a list of all the comparisons you wish to perform, and then go through them one at a time. This list can change as you go through it, but it is good to at least have an outline of what you plan to cover. Once you have completed your first draft of the results section, you should move on to the discussion section. In this section you should talk about what your findings may mean. You may want to include speculation on the implications of events which occurred in the study area, such as the building of a fence, a particularly heavy storm, or the local disappearance of a key species. Here you can also refer to other documents which cover similar topics in order to offer comparisons with your findings. Finally, you should offer recommendations for the management of the study area, which can range from leaving it alone to applying new laws to introducing new species. Together, the results and discussion sections should form the backbone of your report, while the other sections act to fully explain the details which enabled you to obtain your data. These other sections include the methods, the introduction, the abstract, the references, and the appendices. There is also often a conclusion, although this can sometimes be incorporated as part of the discussion section.

The methods section should explain in detail each of the ecological field methods used during the study. If you used the methods exactly as they are described in this manual, you can refer directly to it. If you made any changes to the standard methods described here, however, you should explain what they were and the reasons for the difference. Although some of the details of the methods may seem clear enough to you already, you should still include everything in case the reader is not yet familiar with the method you used.

The introduction to the entire report can be brief, but should include the main points. First of all, the aims of the entire study should be clearly stated. Then you should, in effect, say that it would be very interesting to find out what you just wrote (in the results and discussion sections) that you found.

Once you have written a good introduction, you should write the abstract.

This has some similarities to the introduction, but you should definitely not just cut and paste anything within the same document. The abstract should first clearly state the aims of the study. Then the methods used to achieve those aims should be mentioned briefly, followed by the results of the study. The abstract should ideally be about half a page, and should not usually be much

more than one full page. You should revise it a couple of times to make sure that it is excellent, because it is often the only part of a report that people read. The abstract is also usually translated into at least one other language, so in Jordan it is advisable to include an Arabic abstract.

The references section should include a comprehensive list of each and every written document used in the course of the study. This should include field guides, reference books, web sites, magazine articles, journal articles, reserve management plans, RSCN reports, and so on. If you use any information in your report which was derived from one of these outside sources, it must also be referenced directly in the text.

You should never cut and paste information to compile your report, because it will never be exactly applicable and the product will therefore be of poor quality. If you do choose to copy something from another source, write it again in your own words so that it fits with the rest of your report, and then acknowledge the source with the proper referencing format.

The rest of the report consists of supporting pages, such as the title page, the table of contents, lists of figures, acknowledgements, a list of participants, and appendices. The RSCN has a standard title page format which should be followed for all RSCN documents. Tables of contents or other tables such as lists of figures or appendices can be inserted easily into documents using Microsoft Word, as long as you used the same styles for all of your section headings. Acknowledgements should be on a separate page and list each of the individuals who contributed in any way to the successful completion of the study. A list of participants should include those people who were directly involved in the study, including the author or authors of the report.

Appendices should include all of the raw data exactly as it was collected.

Another appendix should include the data sheets used in the field.

For all of these sections, you can refer to previous reports for guidance on the proper format. Keep in mind, however, that some parts such as the title page may not have become standardised yet at the time they were written, so you should not necessarily use them as a guide. Basically, the following lists first show the order in which you should write each section, with the order in which you should present each section in your report listed on the right.

|                                   |                              |
|-----------------------------------|------------------------------|
| Write the sections in this order: | Present the sections in this |
| Results                           | Cover page                   |
| Discussion                        | Table of contents            |
| Methods                           | Acknowledgements             |
| Introduction                      | Abstract                     |
| Abstract                          | Introduction                 |
| References                        | Methods                      |
| Appendices                        | Results                      |
| Acknowledgements                  | Discussion (with Conclusion) |
| Table of contents                 | References                   |
| Title page                        | Appendices                   |

Once you have your report written, print it out and read through the whole thing again. Try to make improvements, and ask a friend or colleague to read

through it and offer suggestions on how to improve it. Once you have completed all of your sections, compiled them in the proper order, and edited the entire document a couple of times, then you are ready to print out your final document.

### **Distributing Your Findings**

The final stage of your study once everything else is complete is to actually have it get some use. There is not much sense in putting in so much effort simply to write a report and put it on a shelf - it needs to be disseminated to potential users.

The policy of the RSCN, at the bare minimum, is to produce three copies of each document. One is kept at the main office in Amman, one is kept at the reserve where the research took place, and a third is given to the National Library of Jordan where it gets copyrighted.

## Wadi Rum Protected Area Summary Zoning Scheme

January 2010

### **Introduction**

Management of protected areas PAs has recently transformed to a wider and more inclusive approach. From isolated islands set aside for research and conservation, PAs are now run with ecological, social, cultural and economic objectives (IUCN 2003). To achieve these objectives, PAs should be managed according to scientifically based management plans MPs that are regularly reviewed and updated (MoEnv 2003). MPs contain supporting documents, among which are zoning plans ZPs. These are created when different management actions and procedures need to be applied in different parts of a PA in order for its objectives to be met.

*"Zoning defines what can and cannot occur in different areas of the PA in terms of natural and cultural resources managements; human use and benefit; visitor use and experience; access; facilities and development; maintenance and operations. Through management zoning the limits of acceptable use and development in the PA are established". (Young and Young 1993).*

Development of ZPs generally involves combining all spatial and non-spatial datasets available in order to establish a comprehensive understanding of a PA and then delimit the zones' boundaries accordingly. Geographic information systems GIS offers a suitable platform to analyze the different data layers involved in the zoning plan preparation.

This analysis aims at updating Wadi Rum PA zoning plan using a GIS-based evaluation model to reflect the vision for the PA as world renowned site of ecological, geological and cultural significance.

### **Methods**

#### *The general outline*

In order to develop a GIS- based evaluation model according to which a ZP will be developed, it was necessary to identify a frame and concept for the analysis.

The purpose of the zoning plan, as perceived in this analysis, is to provide maximum protection to the parts that are most important and representative

to the PA and least disturbed by human activities while permitting a spectrum of reasonable human use in limited areas when possible. Accordingly, two sets of evaluation criteria were developed with the assistance of relevant experts to evaluate the PA. The analyses were carried out in two main streams:

## **1- Site representation / significance analysis**

A set of criteria to identify the most significant and representative parts of the PA that deserve maximum protective measures were selected. In this case, Wadi Rum was perceived as a site of outstanding ecological, geological and cultural significance. It was necessary then to understand how and in what intensity ecologically, geologically and culturally significant features were distributed through the PA, noting that some datasets were considered relatively more important than others. Here, the analysis was concerned by both the intensity of distribution as well as the relative importance (weight) of each dataset compared to others.

In order to combine datasets (distribution of fauna and flora, geologic formation, and distribution of archeological sites) with different formats according to their relative weights, it was necessary first to convert all datasets to suitable raster formats like (density rasters or multi-ring buffers), then re-classify the resulting rasters using a common comparison scale. Thus, the categories of each dataset (i.e. species density values or classes of geologic formations, etc) were given evaluation scores on a (1 – 10) scale, while the scale was directly proportional to significance. (For example: the higher the species densities the higher the score, or the higher the importance of a certain geologic formation the higher the score).

The reclassified (standardized) datasets were finally combined according to their relative weights. Geology and culture were given higher relative weights than the ecology for the purpose of this analysis.

Table 1 includes all the datasets of this part of the analysis and their relative weights.

## **2- Human impact analysis**

A set of criteria to identify the most intensively used parts of the PA compared to the parts that still retain their naturalness were selected. Datasets representing all types of human use from tourism activities, to local settlements and grazing as well as the available infrastructure and facilities were all considered. Parallel to part 1, it was necessary to understand how

and in what intensity the types of human use were distributed throughout the PA.

The targeted landuse activities were represented by fixed features in most cases (locations of camps, pre-identified tourism trails, settlement, etc), thus their impact was investigated in relevance to proximity and not density. The impact was considered inversely proportional to distance, where the closer to the features representing a certain threat/landuse the higher the human impact. For this to be accomplished, distributions of landuse activities/threats represented as points, line and polygons were converted to multi-ring buffer rasters representing the straight line distance functions at each spot of the PA to the nearest feature in the dataset being investigated.

As not all of these datasets were considered of equal impact on the naturalness of the PA, thus different datasets were assigned relative weights and summed accordingly. Table 2 includes all the datasets of this part of the analysis and their relative weights

It is important to note, that the relative weights in both Part 1 and 2 of the analysis were assigned by a team of technical specialists from the PA staff and mission consultants.

### **3-Significance/ Representation minus Human Impact**

The result of part 2 was subtracted from part 1 in order to understand how both parts of the analysis were related. The purpose of the minus raster was to identify parts of high representation/ significance and low human impact compared to the parts that have low representation/ significance and high human impact.

#### ***Software and tools***

ArcGIS/ArcView 9.3 and ArcGIS 9.3 Spatial Analyst Extension from the Environmental Systems Research Institute ESRI were used to prepare the GIS model that combined all the analysis steps since they offer a platform for performing advanced spatial analysis and weighted overlay / weighted summation techniques. The following geo-processing tools were used: Density, Straight line distance, Reclassify, Weighted summation, Raster calculator while the model was structured and processed using "ArcGIS Model Builder".

## Results and Discussion

As a result of running part1 1 and part 2 of the analysis, two raster datasets resulted:

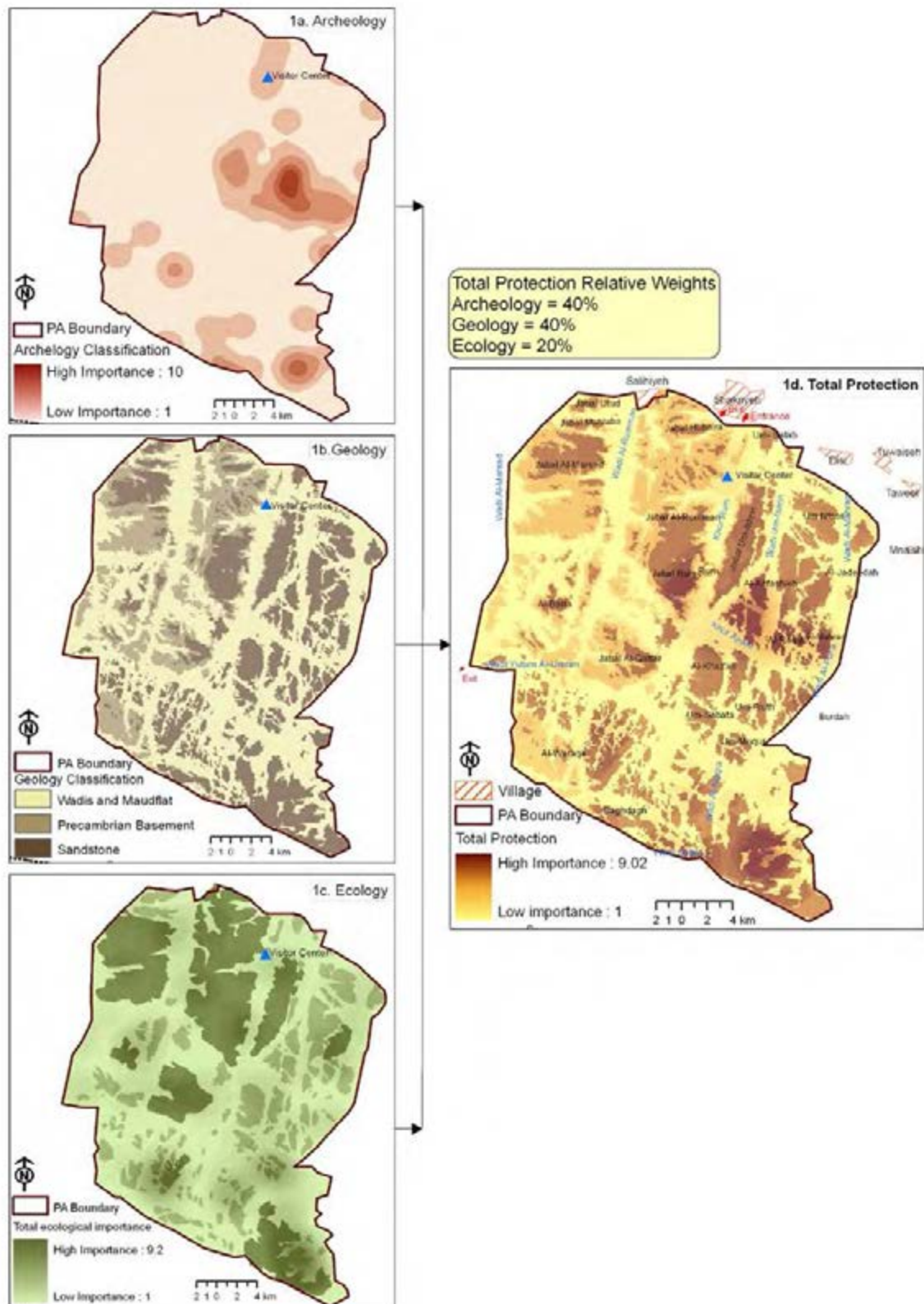
- 1- **Total significance/ representation raster:** The PA was divided according to this raster into parts of high, medium and low significance on a 1 – 10 scale based on the cumulative weighted summation of significance/ representation datasets.
- 2- **Total human Impact raster:** The PA was divided according to this raster into parts of high, medium and low impact on a 1 – 10 scale based on the cumulative weighted summation of all human impact standardized datasets.
- 3- **Significance/ Representation minus Human Impact:** This raster provided understanding on how both parts of the analysis were related. Higher values of the resulting raster indicated parts with very high significance / representation scores and low human impact. This indicates that these spots deserve that highest conservation measures, and may be therefore considered the parts that form the "Conservation Zone".

The lower values represented low significance/ representation scores and high human impact implying that these spots might be the most suitable parts of the PA for general use and access, and were identified therefore as the "General use Zone"

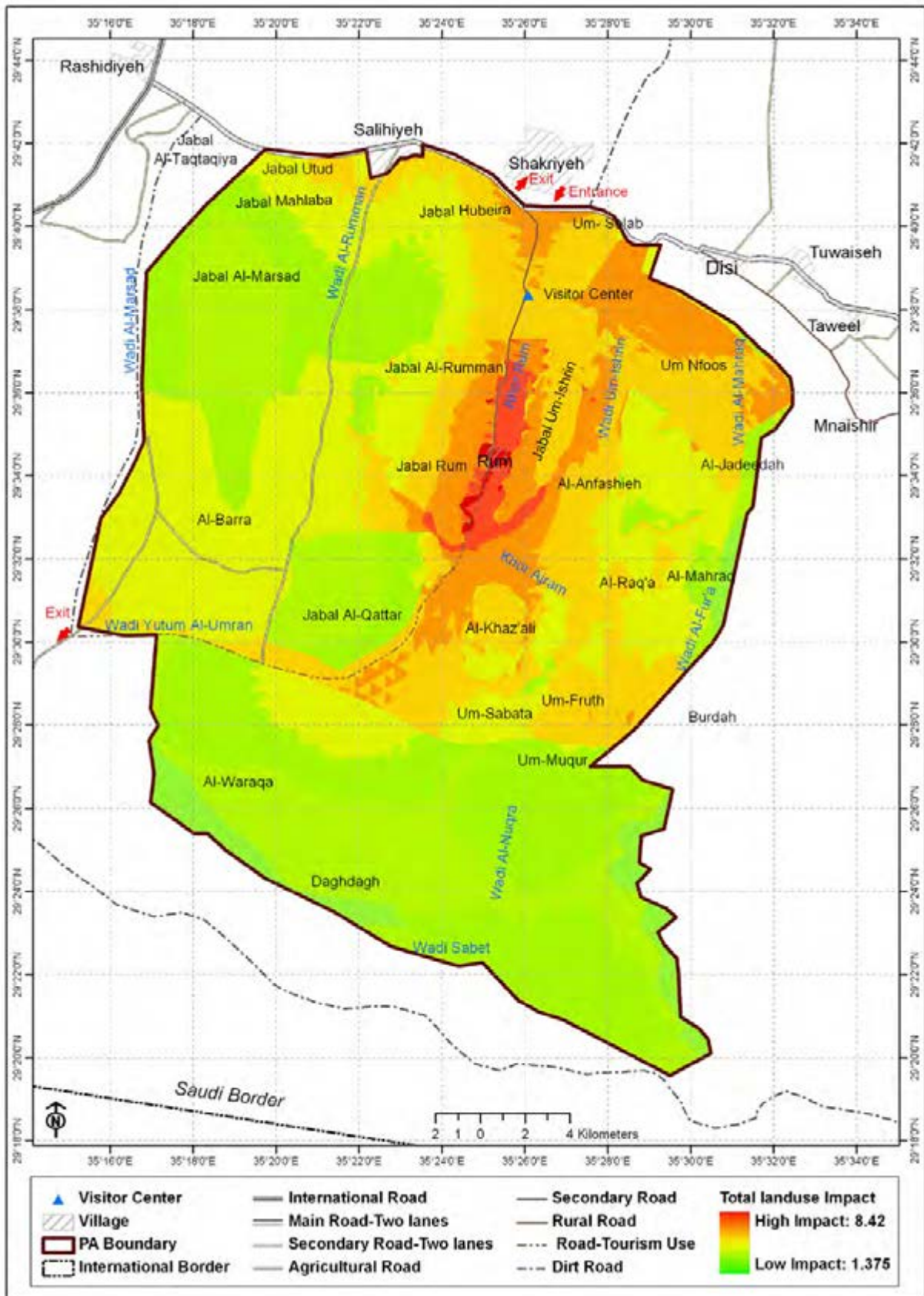
Scores that fall within the medium range of the scale indicate that these parts of the PA had medium significance/ representation scores and medium human impact; these parts were therefore considered as the "The Resources Use Zone". It should be noted here that physical features such as mountain boundaries were also considered during the final delimitation of the zone boundaries in combination with the GIS analysis results.

The Maps below represent the analysis flow, the datasets included in the analysis and their relative weights.

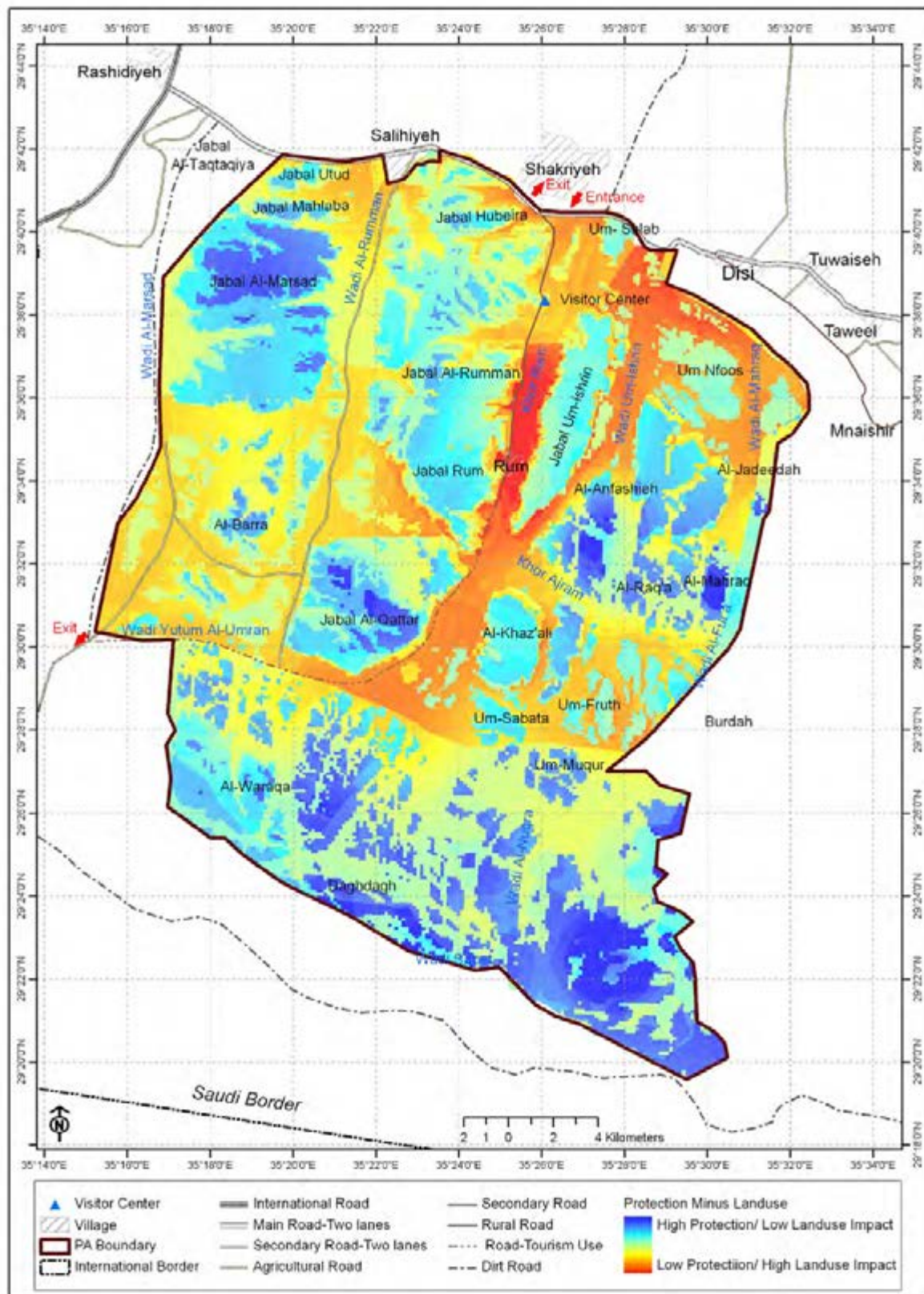
## Step 1: Protection Overlay Development



## Step 2: Land Use Overlay Development



### Step 3 - Protection Minus Land Use Overlay Development



## Step 4 Final Step – Zoning Map

