A BASELINE SURVEY OF THE MAMMALS IN JABAL MOUSSA NATURE RESERVE (JMNR)

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1. Introduction

The magnitude and complexity of threats to biodiversity are well-documented (Soulé 1986, Primack 2002, Wilson 2002). Human numbers have increased from 2.5 billions to 6 billions over the last two generations, and might reach 12 billions in the coming two generations (Wilson 2002). Based on current patterns of use, people currently sequester 40% of the world's net primary productivity (Vitousek et al. 1986) and more than 50% of the world's renewable fresh water (Raven 2002). If these trends continue, people will increasingly destroy many of the natural resources that remain. Thus, half to two-thirds of all animal species on the earth may be lost during the next four generations (Wilson 2002, Raven 2002).

Increasing human populations usually cause loss of habitat, both in terms of its area and its quality (Gittleman and Harvey 1982). Habitat loss and fragmentation can occur through urbanization, and through agricultural and industrial expansion, and this poses the greatest threat to biodiversity (Vitousek et al. 1997, Brooks et al. 2002, McKinney 2002, Ricketts and Imhoff 2003).

The fast rate of biodiversity loss, and its effect on the wellbeing of human communities, has been documented by a growing number of scientists (Wilson and Peter 1988, Brockelman 1989, Bunting 1990, Solbrig 1991). Many people no longer question the importance of conservation objectives, but achieving success in conservation depends on adopting good management practices.

Protected areas (PAs) can play an important role in conserving flora and fauna, including of large carnivores, and constitute live laboratories that permit the understanding of native species within functioning ecosystems (Sinclair et al. 2001). PAs, including natural

reserves and national parks, can inspire the protection of biodiversity as it existed before people wrought the drastic environmental changes that are now seen outside many of these PAs. Small PAs (or habitat patches) tend to lose species more rapidly than large ones (Rosenzweig 1995, Laurance and Bierregaard 1997). Indeed, the relationship between the size of a reserve, and the number of species in that area is considered a strong and consistent predictor to estimate time to extinction (Belvosky 1987, Brooks and Balmford 1996, Brooks et al. 1997),

Conflicts between local people and PA managers represent a common problem in developed and developing countries. Local people living around PAs hold negative attitudes towards them for several reasons besides conflicts with wildlife (Leader-Williams and Hutton 2005). Integrated conservation and development concepts that address poverty and conservation could provide a sustainable economic incentive for communities surrounding PAs to tolerate coexistence with wildlife (Wells and Brandon 1992).

1.1 Lebanese Biodiversity

In Lebanon the situation is not different and might be worse. Increasing in human population, unorganized urbanization, absence of government over seeing or monitoring program, economic situation and others all of these will have a certain impact on the environment in general and biodiversity in particular. The increase in the prices of real state and the shaky world wide economic situation will encourage people to invest more in their land either through urbanizing or agriculture so to get the maximum profit. Besides, the economic situation will divert people from buying fuel to cutting of trees for heating in winter.

Moreover, the fast rate of biodiversity loss, through forest fires that is happening every year in Lebanon, hunting and persecution, quarries, and real estate businesses that are destroying many natural areas and their biodiversity urges to take an action to conserve

what is left. The only resort will be by protecting as much of the Lebanese wilderness as possible to help in securing a small resort for biodiversity (flora and fauna)

Even though mammals play a major part of the Lebanese biodiversity and their presence is essential for the wellbeing of the ecosystem, they were less surveyed and studied. In addition, mammals are being persecuted a lot in Lebanon, hence to protect themselves they have switched to nocturnal behavior. This behavior in turn resulted in difficulty in monitoring them, requiring increasing effort and time, and using of hi-tech equipment for surveying.

1.2 Jabal Moussa Nature Reserve

Jabal Moussa is a typical Lebanese Mountainous Mediterranean Scrubland Biome with different topography and elevations ranging from 700m-1500m asl. This significant landscape will probably lead to rich biodiversity, but threats facing biodiversity in Lebanon did not spare Jabal Moussa. These threats include: hunting, deforestation, urbanization, over-grazing, quarries, logging, etc…. However, the extent of biodiversity disturbance is less if compared to other sites in Lebanon and this probably due to the difficult landscape, inaccessibility of the area, and the surrounding un-urbanized mountainous area.

Mammals in Jabal Moussa face the same threats as in any other area in Lebanon. They are hunted, poisoned, and habitat destruction through quarries, deforestation and urbanization all these make their assessment difficult. In addition, the inaccessibility of the area makes besides the limited work that was done on Lebanese mammals and none on Jabal Moussa made assessing mammals in the area very difficult as it has to start from scratch.

2. Aim of the Study

1- To gather information regarding the species of mammals present
2- To collect species inventory data for mammals
3- To assess the conservation importance of Jabal Moussa Nature Reserve
4- To identify necessary conservation interventions in Jabal Moussa Nature Reserve

3. Methods

Because little was known of the mammals in Jabal Moussa, it was necessary to glean very basic preliminary data at the beginning of the study. These preliminary data were gathered in through a very rapid survey in 2007 and local people interviews.

3.1 RRA/PRA Methods

Information on local knowledge about mammal species was collected from focal group discussions, and from individual interviews undertaken in each village surrounding Jabal Moussa namely Yahchouch, Nahr AlDehab, AlMshaty, AlEbry, and Qamhez.

The RRA/PRA method used in this study was based on (Chambers 1992) and (Bernard 1995).

- A pre-appraisal dialogue was conducted among site officials (mayors) to introduce them to the project and to introduce me to the area and to the local residents.
- Focal group discussions were conducted from March 2008 to April 2008 with recommended key elderly residents in each village surrounding the reserve to establish facts on:
    - Mammal species that were and are present
    - Biodiversity of the reserve and the green cover
    - Population trends of mammals

- Conservation needs of mammals
- Attitudes of local people towards mammals and their support for mammals' conservation.

3.2 Field Surveys

3.2.1 Transect Surveys Across Study Sites

Studying mammals in a hard terrain like that in Jabal Moussa is not an easy task. The adaptive behavior of mammals, distance to be covered before reaching the reserve, the topography and the landscape of Jabal Moussa made the work hard and time consuming.

Transect surveys were conducted to determine the presence of mammals in Jabal Moussa. Transects were not of equal length, nor along straight lines, nor equally spaced, since the forest is very bushy, and closed. Instead, transects either followed very old human trails or corridors maintained by animals. Hence, I followed lines of least resistance through the bushy landscape, and maintained an approximate visibility of two metre in front of me. The start and end of all transects were marked with points in a Global Positioning System (GPS). The same transect routes were walked a minimum of one time each on weekly bases over the four seasons with or without the rangers from March 2008 to July 2009.

GPS points were also taken at each location where indirect signs of mammals were recorded along each transect, including footprints, hairs, and scats besides caves or dens and habitat type (Bang and Dahlstrom 2001, Bullion 2001, Davis 2002, Strachan 1995, Sargent and Morris 2003, Toms et al. 1999, Wilson et al. 1996). It was not possible to reliably determine whether these signs were from different animals. However, I was only seeking the presence of these mammals in Jabal Moussa

3.2.2 Night Drives

Night surveys commenced using a 4x4 vehicle and lasted between one and three hours. A powerful spot light was used to scan for eye-shine. The pace was slow to increase the chances of sighting the animals. During surveys a 1-1.5 million candle power spotlight was available to illuminate animals once their eye-shine had been detected to help with the identification.

However, due to the absence of roads in the reserve and the roads driven were far away from the core area, these resulted in poor results. Hence it was decided to stop this method and increase the numbers of camera traps.

3.2.3 Photo Trapping

Due to the difficulty of the landscape, absence of roads, besides the shy behavior of mammals, photo trapping would be the final resort (Carbone et al. 2002, Scheibe et al. 2008.

Twelve pre-baited active and passive remote camera traps, triggered by both heat and motion, were tied to a tree 40-60cm above ground (Plate 1). The cameras were programmed to take photographs 24hours/day with a 2-minute interval between photos, and to record date and time on each photograph. The bait was delivered for the first couple of month by the team and later a mule and a donkey were used for transporting the bait for all the cameras. The bait consisted of butchery leftovers, apples, carrots and corn seeds.

A chosen area selected randomly to cover the whole area of the reserve (Plate 2). Four cameras were broken after the second month, 2 were broken after the sixth month, and one was stolen plus two memory cards. Broken and stolen cameras were replaced by new ones.

Plate 1. Camera traps installed on a tree trunk and data were down loaded on the laptop in the field.

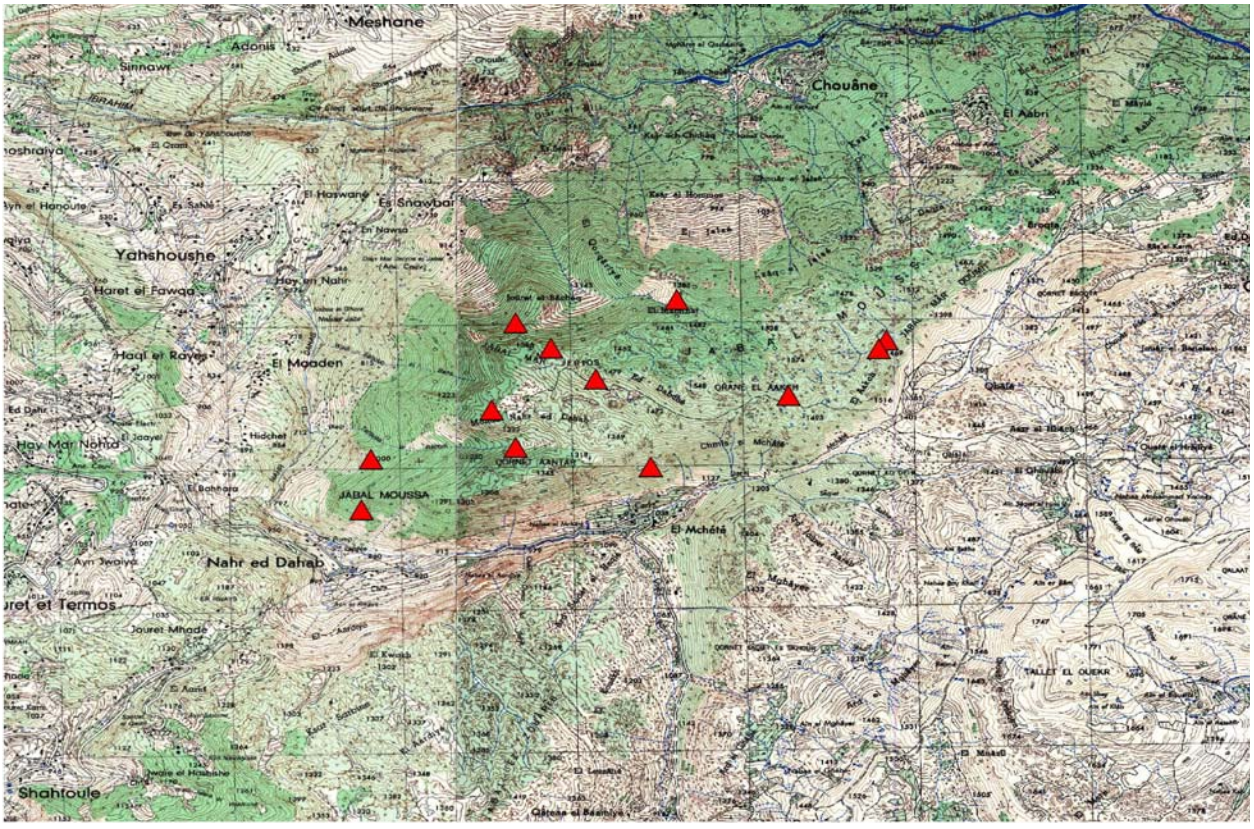

Plate 2. Location of the 12 camera traps in JMNR.

The cameras were visited twice weekly at the first two months, to check on the suitability of the site selected and to verify that the cameras are working normally, to check on the bait and add on the bait when needed besides down loading the photos, and later once a week.

Photos from the camera traps were dated, digitized and down loaded on a laptop on weekly bases (Plate 3).

Plate 3. Downloading the photos from the camera trap

3.2.4 Rodent Survey:

Two methods were followed (Barnett and Dutton 1995, Toms et al. 1999, Yalden 2003):

a. **Indirect Methods include:**
    i. Searching for small path used by these rodents
    ii. Signs of discarded food remains
    iii. Searching for scat pellets

iv. Searching for nests
v. Examination of owl pellets for rodents' remain
vi. Looking in the scats of other carnivores for any indication of rodents

b. **Direct method include**

i. Using camera traps
ii. Using Sherman live rodent traps (Plate 4):
    1. Thirteen sites were selected randomly on the different trails (Plate 5)
    2. Five traps (5meters apart) were triggered at each site (Photos below)
    3. Traps were baited with peanut butter or broiler feed mix.

Plate 4. Sherman live rodent traps set and baited in Qamhez

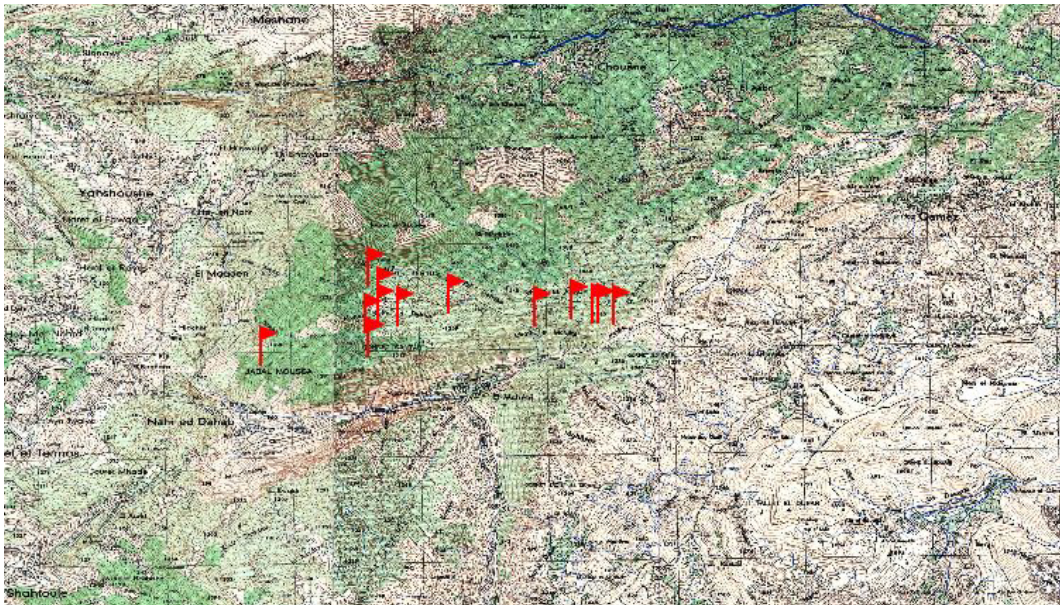

Plate 5. Location of the 13 rodents' traps in JMNR.

4. Results and Discussion:

4.1 Locals Knowledge:

During focal group discussions, elderly residents across the different villages surrounding Jabal Moussa reported that mammals were more abundant than these days. A lot of mammal species in the past were encountered. These include wolves, bears, antelope, wild cats, rabbits, hyrax and others. On the contrary, striped hyaenas appeared newly in the area after the civil war. However, most of the mammal species decreased in number and also those that are still present their population decreased, the informants added. They referred this decrease to logging, quarries, urbanization and hunting.

Some of the quotations that were given by the informants:

Naeem Sayf Abou Yaaqoup a 79 year-old farmer from Nahr AlDehab who works his own land. He described the old Jabal Moussa:

"*The forest was so diverse. It contained big trees (called Defran in Arabic) that were used in building the houses; they were so big that one tree could cover the roof of a house. Charcoal business helps in regulating the forest growth and helped in the economy of the local people".*

Mr. Naeem also described the fauna status of Jabal Moussa he said

"*Wolves were very abundant in the past. Three to four people have to protect a flock of sheep or goats due to the large number of wolves that were present. But now due to orchards and the excessive use of pesticide their number decreased drastically. Hyaenas were not seen before, they appeared after the war 25 years ago. Porcupine, badgers, jackals, hyrax, stone martin, hedgehogs, squirrel, rabbit, Arouuse alfar, besides a lot of rodents and bats still exist but not as they used to be.*

The numbers of animals in the past were more than now but due to pesticide, human disturbance and hunting their number decreased. However, some had benefited like foxes increased in number. Moreover, hunters decreased in number because there aren't many birds and bullets are expensive."

Another 82 year-old informant who was appointed as a ranger for Jabal Moussa in 1962 till he retired. He said,

"*The sustainable charcoal business was very common in the past. It benefited both the locals by generating income for them and the forest through regenerating of the forest and decreases the risk of forest fires. However now the forest is bushier and when it is used it is not used sustainably*."

He added "*The conflict with shepherds is as old as the forest. In the past there were 5 shepherds (with more goats than sheep) with 300hds each but now there is only one shepherd. They used to use Jabal Moussa in Fall and Spring. Visiting shepherds used to rent the site for grazing"*

Concerning wildlife in Jabal Moussa he said,

"*In the past there were a lot of wolves, foxes, stone martins, porcupine, badgers, and rabbits but no deer. However, these animals are on the decrease due to excessive use of pesticide, more orchards, less livestock, and more hunting. In the past his late uncle used to trap martins for their fur*."

Mr. Edwar Zwein a 55 year-old shepherd from Yahchouch. The only shepherd in the area who still uses Jabal Moussa in Fall and Spring said,

"*We've been using Jabal Moussa for grazing our flocks since my grand grand father with no effect on the flora since we use it only in the Fall and Winter. There were several shepherds in the past but now there is only another shepherd from a neighboring village.*

As for wild mammals wolves were encountered a lot. Three years ago wolves attacked my flock so; I poisoned a dead goat and killed five of them. However, their numbers nowadays are decreasing due to the extensive use of pesticide.

There are a lot of hyaenas. They started to appear 15years ago. Foxes, jackals, and porcupine are the most besides hyrax, little rabbits, hedgehogs, and stone martins. Badgers used to live in Jabal Moussa but were not seen for the past few years. Wild Boars appeared newly 4-5yrs ago.

Stray dogs are becoming a problem as they attack the goats and are not afraid of people. The main problem besides that of the stray dogs is with the wolves and hyaenas. From 10 – 12 years their number increased. Their population increase in Winter to decrease later in Spring and Summer".

4.2 Completeness of Coverage

Obtaining accurate data on the mammals present in JMNR is difficult and time consuming. It is expected that numerous surveys will be required before an accurate base line survey can be obtained. Following the information presented by the locals, the survey was able to focus efforts on the areas where information regarding the species reported. Still, the completeness of coverage for mammals' surveys remains poor and requires sustained effort for the foreseeable future.

Time was devoted to purely obtaining data on mammal species present in JMNR and the survey effort was high. It is suspected that the lack of data obtained is a result of severe population depletion of many species and not a lack of coverage.

4.3 Mammal Species

The richness of flora species and the ecosystem type will affect the fauna richness positively. The field survey revealed the richness of Jabal Moussa in mammal diversity.

Nineteen species of mammals belonging to six orders and 15 families were discovered, identified and documented. In addition to wild mammals domestic mammals like goats, dogs and cats were also encountered.

4.3.1 Order INSECTIVORA

4.3.1.1 Family Erinaceidae

4.3.1.1.1 **Hedgehogs (E); herisson (F); *Erinaceus concolor* (S) LC** (Plate 6)

The only extant species of this order belongs to the family Erinaceidae that was encountered in Jabal Moussa. The hedgehog is found mainly in agricultural areas, and woodlands both deciduous and conifers. It is essentially nocturnal spending the day in vegetation lined nest build under the ground. They feed on worms, ants, lizards, snakes, small birds, vegetable matters and even carrion and human garbage. Their quills provide an exceptional protection against enemies. This species was reported by Tohme and Tohme (1985) in Nahr Ibrahim and Faraya-village which are not far from Jabal Moussa.

Plate 6. The hedgehog

In Jabal Moussa the hedgehogs were trapped by the camera trap (Plate 7) in the deciduous forest of Qamhez, as well a live specimen was trapped by a rodent live trap above the Cross in a mixed conifer-deciduous forest.

Plate 7. A hedgehog trapped by the camera trap in July in Qamhez

Economic and Conservation

Hedgehogs are highly important economically. They play a major role in controlling agricultural pests. This species is characterized by Least Concern by the IUCN Red List but, it is highly endangered in Lebanon due to excessive use of pesticide and road kills. Monitoring of their population is important for the well being of the reserve. Awareness for local people around the reserve to protect this species and prevent being killed by cars at night is important for its existence.

4.3.2 Order CHIROPTERA

In this order three species belonging to three families were documented as of May till October-Mid November belonging to three families. All the bats that were documented were either identified by flight patterns or through analyzing their sound frequency through a bat detector.

4.3.2.1 Family Rhinolophidae

4.3.2.1.1 Mediterranean horse shoe bat (E); Le fer a cheval mediterraneen (F); *Rihnolophus euryale judaicus* (S) nT

The horseshoe bat is a medium-sized insectivorous bat. They hibernate solely from December to January in rock cervices and caves. Their feeding habit gives them an economic importance as well a major role in the ecosystem. This species was reported by Tohme and Tohme (1985) in AlKfour-Keserwan which is not far from Jabal Moussa.

4.5.2.2 Family Molossidae

4.5.2.2.1 European Free-Tailed bat (E); Le molosse (F); *Tadarida teniotis* (S) LC

The European Free-Tailed bat inhabits narrow and inaccessible rock cervices. It roosts in large colonies in narrow cervices in the chalk cliffs (Atallah 1977). Their feeding habit (feeding on insects) as well gives them an economic importance as well a major role in the ecosystem. This species was reported near Faraya by Lewis and Harrison (1962) which is not far from Jabal Moussa.

4.5.2.3 Family Vespertilionidae

4.5.2.3.1 **Kuhl's Pipistrelle (E); La pipistrelle de Kuhl (F); *Pipistrelle kuhli ikhawanius* (S) LC** (Plate 8).

The Kuhl's pipistrelle bat is a small-sized insectivorous bat. This bat is a colonial species; the colonies are usually found in cervices in the walls and roofs of buildings. Being insectivorous, they play an important role in the ecosystem and in controlling agricultural pests. This species was reported by Atallah (1970) in Aajaltoun.

The Khul's pipistrelle is common in Lebanon.

Plate 8. The Khul's pipistrelle

Economic and Conservation of bats

Even though adapted to various environments but are often negatively affected by environmental perturbations, both natural and human induced. According to IUCN Red List only the Mediterranean Horseshoe bat is Near Threatened; however, in Lebanon bats are highly facing the risk of extinction due to several threats. These threats include: loss of foraging habitats, loss of caves and riparian habitats, cave disturbance, habitat loss due to agriculture, exposure to pesticides, and human exploitation.

4.3.3 Order CARNIVORA

In this order eight species were documented belonging to three families

4.3.3.1 Family Canidae

4.3.3.1.1 Jackal (E); Le chacal (F); *Canis aureus syriacus* (S) LC (Plate 9)

Plate 9. The jackal

The jackal has a short tail with a medium sized body. They closely resemble the wolf but smaller. They are totally nocturnal. They go out at night in groups or pairs. They are famous for their howling behavior that is never mistaken at night. They usually live at low altitudes in dense thick forest or in caves. They are omnivores they feed either on fruits, insects, hunt birds and small rodents or scavenge on poultry farms and domestic wastes.

Jackals are common in Lebanon. They were reported in the coastal region, Mount Lebanon and some areas in the Beqa'a valley (Harrison and Bates 1991, Tohme et al., 1975). However this is the first time to be reported in Jabal Moussa region.

The only time that they were seen in the Jabal Moussa was in response to a call from a local farmer from AlEbree to check on a dead wolf but it was a dead jackal (Plate 10).

Plate 10. The dead jackal that was encountered in AlEbry

Economic and Conservation

Jackals play a role in cleaning the environment by feeding on domestic wastes. However, they do affect poultry farms since they feed on chicken. Jackals are categorized by the IUCN Red List as Least Concern and this applies to Lebanon as well but not in Jabal Moussa and this could be referred to food availability and competition with other species. Hence this could be an indicative of the natural balance that still exists in the reserve

4.3.3.1.2 The Wolf (E); Le loup (F); *Canis lupus pallipes* (S) LC (Plate 11)

Plate 11. The female wolf photo trapped in Qamhez

Wolves look like jackal but they are much heavier and bigger. They usually hunt or scavenge by night and rest at different dens during the day.

Wolves inhabit different habitat ranging from forests to shrub lands to bare lands where there is abundance of hiding places like caves or rock cervices where they rest during the day. Wolves are present where ever their preys (livestock in Lebanon) exist.

Even though wolves are categorized by Least concern (LC) by IUCN Red List, they are endangered (EN) in Lebanon. They were reported in Ammique, Harbata (Tohme 1975), Hermel and Anti-Lebanon (Tohme and Tohme 1985). The only time the wolf were seen and caught by the camera traps were in Niha Cedars beside Tannourine Cedar Nature Reserve (Abi-Said 2005). In 2006 a couple was killed in Maasser AlShouf.

In Jabal Moussa region the first breeding individual was documented in country as well in Mount Lebanon. In addition, Jabal Moussa being part of their territory as the same female was photo trapped (Plate 12) for two consecutive years 2008-2009 when she was pregnant and when it had the puppies. Besides this female, a couple was photo trapped twice (Plate 13). The wolves use or inhabit Jabal Moussa in winter and early spring following the shepherds and their livestock to their wintering sites and to escape the harsh winter in the higher mountains

Plate 12. Pregnant female wolf in Qamhez

Plate 13. A couple of wolves photographed by the camera trap in Qamhez.

Economic and Conservation

Wolves are facing the risk of extinction in Lebanon due to persecution, poisoning, pest control, habitat loss and habitat degradation. The presence of wolves is very important for keeping the natural balance in Jabal Moussa. This importance appeared by the low population of wild boar in the reserve. Wolves might affect livestock but this remain marginal if compared to diseases that affect livestock and the role that the wolves play in restoring natural balance.

4.3.2.1.3 Red Fox (E); Le renard (F); *Vulpus vulpus palaestina* (S) LC (Plate 14)

This is the largest species of foxes in Arabia. The red fox is famous for its long fluffy tail that ends with white spot. They are nocturnal however they may go out during the day.

They are very common in Lebanon (Harrison and Bates 1991, Lewis et al, 1968, Tohme and Tohme, 1985). They inhabit different ecosystems and at different elevations from coastal areas to high mountains. They can adapt to habitat change and urbanization very easily. Moreover, red foxes are opportunistic feeders. They feed on whatever is available from hunting birds, reptiles, insets to scavenging and feeding on fruits and vegetables.

Plate 14. The red fox

In JMNR the foxes were photo trapped all year round by the camera traps (Plate 15) day and night. Moreover, their footprints and scats were encountered regularly during each visit.

Economic and Conservation

Red foxes are probably very common in JMNR. They don't face any threat. Foxes play a role in the reserve by feeding on harmful insects and rodents as well by distributing fruits' seeds that they feed on. However, they might affect bird population negatively and

compete with other carnivores on food resources. Accordingly their population should be monitored.

Red foxes are categorized as Least Concern by the IUCN Red List and this applies to Lebanon as well as JMNR. Their common status could be referred to food availability and the absence of competition with other species.

Plate 15. A red fox trapped by the camera traps at sunset beside AlBerki

4.3.3.2 Family Mustelidae

4.3.3.2.1 Stone martin (E); La fouine (F); *Martes foina syriaca* (S) LC (Plate 16)

This is a medium sized mustelid of slender graceful build. The tail is long, full and bushy. The stone martin is a flexible and adaptable predator that is equally at home in trees or on

the ground. It makes its den in cervices amongst rocks or on hollow trees. They are nocturnal omnivores. They feed on small mammals, birds, eggs, reptiles, amphibians, and large insects as well as fruits and berries. Like foxes, stone martins are very common in Lebanon (Harrison and Bates 1991, Lewis et al, 1968, Tohme and Tohme, 1985).

Plate 16. The stone martin

As foxes, stone martins are common in JMNR. They were photo trapped (Plate 17) more often in the reserve over the whole year and in the four different seasons day and night

Economic and Conservation

Stone martins play a role in cleaning the environment by feeding on domestic wastes and dead animals. Stone martins also feed on fruits and help in seed dispersal. When stone

martins are very common they affect other animal species like birds, reptiles… and they do affect poultry farms by feeding on them. Stone martins are categorized by the IUCN Red List as Least Concern and this applies to Lebanon as well as JMNR.

Plate 17. A stone martin photo trapped above Yahshoush and under the Cross

4.3.3.2.2 Weasel (E); La belette (F); *Mustela nivalis* (S) LC

The smallest mustelids that occur in Arabia with slender body, short tail and legs. They are the only mustelids that are diurnal. They hunt by day, feeding mainly on small rodents, birds, lizards, and amphibians. It lives in holes and hollow trees. It is an adaptable predator, found in a variety of habitats including farmlands, cultivated fields, forests, scrub, steppe and semi-deserts. This species occur from sea level and ascending high into the subalpine zones of mountains. Habitat selection is usually determined by

local distribution of rodents. One specimen was collected from Kammouha at an altitude of 1385m (Harrison and Lewis, 1961). Another specimen from Sanine was photographed by Dr. R. Sadek from the American University of Beirut in the 90s.

The weasel that was photographed in JMNR (Plate 18) is a new record for this species in Lebanon. This species was photographed twice above Nahr AlDehab.

Plate 18. The weasel that was photo trapped above Nahr Aldehab

Economic and Conservation

Weasels play a very important role in controlling rodents' population as well as other forests pests like insects and worms. Even though this species is characterized by IUCN Red List as Least Concern; this species is highly endangered in Lebanon. It is threatened

by poisoning with rodenticides and persecution. Monitoring is required to quantify the population trend in JMNR in particular and in Lebanon in general.

4.3.3.2.3 Badger (E); Le blaireau (F); *Meles meles canescens* (S) LC (Plate 19)

Plate 19. The badger

The badger is readily distinguished by its large size, heavy build and distinctive coloration (black and white stripes on the head). It is a nocturnal mammal dwelling in under ground earth. The opening of the earths is often situated on steep banks and amongst the roots of trees. Badgers prefer deciduous woods with clearing or open pastures with small patches of woodlands. It is also found in mixed and coniferous woodlands, scrub, and suburban areas. They are opportunistic foragers with an omnivorous diet including insects, worms, snakes, fruits, vegetables, small mammals like rodents and moles and scavenge as well. This species was reported by Tohme and Tohme (1985) in Nahr Ibrahim which is not far from Jabal Moussa.

The badgers were photographed (Plate 20) twice in JMNR mainly on Qamhez side.

Plate 20. A badger photo trapped in Qamhez

Economic and Conservation

Badgers play a role in keeping a healthy forest by feeding on the forest pests. Even though this species is characterized by IUCN Red List as Least Concern; this species is highly endangered in Lebanon. It is threatened by persecution and hunting for food. Monitoring is required and awareness for the locals on the importance of badger in controlling agricultural pest is a must for its existence. In addition informing the hunters of the type of food (Scavenging and omnivorous diet) that the badgers consume will help in decreasing its persecution.

4.3.3.3 Family HYAENIDAE

4.3.3.3.1 Striped hyaena (E); L'hyene (F); *Hyaena hyaena syriaca* (S) nt (Plate 21)

Plate 21. The striped hyaena

The striped hyaena is a medium sized carnivore and the second largest member of the *Hyaenidae* family. The striped hyaena's rear legs are less developed than the front legs, giving it the appearance of backward inclination. The ears are tall and narrow with bluntly pointed tips. They have exceptionally very strong jaws that characterize their feeding habits. Striped hyaenas are generally solitary scavengers. They feed on dead animals, domestic waste, fruits and insects. Striped hyaenas are exclusively nocturnal throughout their range (Kruuk 1972, Mills 1989). Striped hyaenas only start to become active after dark, and begin to lie up before day breaks. The striped hyaena inhabits ravines and rocky deserts, where the vegetation comprises a sparse cover of bushes across

plains or gentle slopes with few low herbs and grasses and also close to dense human settlement. During the day they hide or rest in caves or under a bushy tree.

This species is fairly abundant in Lebanon (Abi-Said and Marrouche-Abi-Said 2007, Tohme and Tohme 1985). However, it is the first time to be reported in Jabal Moussa region. Striped hyaenas are very abundant in JMNR and they were photographed (Plate 22) on monthly bases by all the camera traps.

Plate 22. A striped hyaena photo trapped above AlMshaty.

Economic and Conservation

The striped hyaena is very important in keeping the forest clean, as a disease control through feeding on carrions and in forest regeneration by distributing the seeds of the fruits that they feed on. The striped hyaena is categorized as Near Threatened by IUCN

Red List. The major reason for their decline is persecution by human and changes in livestock practices. The new appearance of striped hyaena in JMNR probably due to the safety that they found at the reserve

4.3.3.4 Family FELIDAE

4.3.3.4.1 **Wild cat (E); Le chat sauvage (F); *Felis silvestris tristrami* (S) nt** (Plate 23)

Plate 23. The wild cat

The wild cat is a relatively small species of light and slender built. The ears are high and triangular never with white patch on the back. The wild cat is probably the ancestor of the domestic cat. It appears to be strictly nocturnal carnivore and is most found hunting in scattered trees and bushes habitat. It may hide in fox's dens and will also hide in bushes and tall trees. It climbs with great agility and can run very fast up to 32km/hr for long periods.

This species was reported by Tohme and Tohme (1985) in Nahr ElKalab, Jiita, Adonis valley which are not far from Jabal Moussa. However, it is the first time to be reported in Jabal Moussa region.

In JMNR the wild cat was photo trapped (Plate 24) by the camera trap more than once in different places in the reserve

Plate 24. A wild cat photo trapped below the Cross

Economic and Conservation

The wild cat is very important in keeping the natural balance in the reserve by feeding on rodents and other species. The wild cats are categorized as Near Threatened by IUCN Red List but in Lebanon they are endangered. The major reason for their decline is the extensive hybridization with domestic cats. This was very evident in Jabal Moussa where

more than once a domestic cat was photo trapped (Refer to Plate 37) inside the core area of the reserve. This hybridization is occurring world wide (Nowell and Jackson 1996, Sunquist and Sunquist 2002, Macdonald *et al*. 2004, Phelan and Sliwa 2006, Driscoll *et al*. 2007). Besides hybridization, disease transmission from domestic cats could be another reason affecting their decline positively.

4.3.4 Order HYRACOIDEA

4.3.4.1 Family PROCAVIIDAE

4.3.4.1.1 The Rock Hyrax (E), Le daman (F), *Procavia capenis syriaca* (S) nt (Plate 25)

Plate 25. The rock hyrax

The rock hyraxes are small mammals with many unique structural peculiarities. The build is robust, with a head hardly defined from the short neck, tail is vestigial, and short limbs. The rock hyrax is a relatively small species of light and slender built. The ears are small,

simple in form and dusky colored. The rock hyraxes belong to the same order of elephants. They are inhabitant of rocky terrain especially favoring steep and even precipitous mountainsides. It is a colonial and mainly herbivorous mammal, dwelling deep rock cervices which are sometimes connected with caverns. In general they are diurnal. Several members of the colony are usually to be seen perched like sentinels on the top of prominent rocks. They use alarm calls to alert other family members of danger. It feeds on any kind of plants even poisonous ones besides acorn

This species was reported by Tohme and Tohme (1985) in Mohtokra and Deir El Moukhales and by Harrison and Bates (1981) in Mount Lebanon and near Tyre. This is the first time that this species is reported in Jaba, Moussa region.

In JMNR there is a good population of rock hyrax this was shown by photos (Plate 26) taken by the camera traps installed in the mountain above Nahr AlDehab and that above AlMshety. They were even photographed inside the reserve beside AlBerki. Their wide distribution and population number in the reserve is due to the suitable habitat that is found in JMNR.

Plate 26. A cluster of rock hyrax photo trapped above Nahr AlDehab

Economic and Conservation

The rock hyrax is categorized as Near Threatened by IUCN Red List. However, in Lebanon are endangered. The major reason for being endangered is the destruction of their habitat and persecution.

4.3.5 Order: ARTIODACTYLA

4.3.5.1 Family SUIDAE

4.3.5.1.1 The Wild Boar (E), Le sanglier (F), *Sus scrofa lybicus* (S) LC (Plate 27)

Plate 27. The wild boar

The wild boar is typically heavy with short and relatively slender limbs. The muzzle is greatly elongated with a flattened truncated end which is muscular and moist, supported

by a pair of special bones. The neck is short and thick, eyes are small; the ears are pointed; the feet have four well developed toes; canine tusks most developed in males.

The wild boar is mainly an inhabitant of dense thickest and reed jungles; wooded hills, forests, oak woods, and in marshes. They forage also on agricultural land and resort during the day to the thick forest. They are nocturnal omnivorous mammals specialized for feeding by rooting up subterranean parts of the plants, fruits, rhizomes, cereal, nuts, berries, vegetables as well as feeding on larval insects, smaller vertebrates, fungi, refuse and carrion.

This species is wide spread in Lebanon. They are becoming like a pest infesting almost every area in Lebanon. However, in JMNR their population is still under control this was shown by photos (Plate 28) taken by the camera traps where only one male appeared which was hunted as no photos were taken for several months then a new one did appear above the Cross.

Economic and Conservation

The wild boars when in small population are important in the forest to turn up the soil and help in reforestation. However, when increasing in number they become pests that destroy the forest and other agricultural areas. The wild boars are categorized as Least Concern by IUCN Red List. In Lebanon they are very common and becoming a pest in most areas where they are present. However, in JMNR, from what the camera traps revealed, their number is still under control with no major effect yet.

Plate 28. A wild boar photographed by the Camera trap in AlQournet AlBayda

4.3.6 Order: RODENTIA

4.3.6.1 Family SCIURIDAE

4.5.6.1.1 The Persian Squirrel (E), L'ecureuil (F), *Sciurus anomalus syriacus* (S) **LC** (Plate 29)

This is a robust squirrel with a bushy flattened tail; the ears are prominent with insignificant apical hair tufts; and the hind feet have five digits. The Persian squirrel is an arboreal squirrel which is active mainly by day. They are found in trees and rock outcrops. They construct their nests in trees. It feeds primarily on the seeds of conifers and on the acorns of indigenous oaks. It may consume buds and other vegetable matter.

Eggs and birds may be eaten occasionally. Moreover, the squirrel store or cache large stores of nuts in hollow trees and in the clefts of roots and branches for winter.

Plate 29. The red squirrel.

This species used to be wide spread in Lebanon (Lewis et al., 1967) but now it is restricted to few places like Maaser AlShouf, Horch Ehden and other protected areas. However, in JMNR their population is very healthy and large. This was shown by photos taken by the camera traps (Plate 30) besides their footprints in different location inside the reserve. They are spread all over the reserve. Their population is healthy and reproductive.

Economic and Conservation

Red squirrels play a very important role in keeping a healthy forest through forest regeneration. As summer ends squirrel will be busy in collecting and storing nuts for the winter, some of which will germinate and increase the green cover of the forest. Red squirrels are categorized by IUCN Red List as Least Concern; however, this species is

highly endangered in Lebanon. It is threatened by deforestation, habitat destruction, and persecution. Monitoring is required and awareness for the locals on the importance of squirrels in reforestation is a must for its existence.

Plate 30. A couple of red squirrels photo trapped beside AlBerki

4.3.6.2 Family HYSTRICIDAE

4.3.6.2.1 The Porcupine (E), Le porc-epic (F), *Hystrix indica indica* (S) LC (Plate 31)

The porcupines are large rodents the largest in Lebanon. They are adapted for strictly terrestrial and fossorial life. The body is covered with modified hair called quills, eyes and ears are small. This massive rodent lives in large holes within colonies that are located on an elevated spot and are concealed amongst vegetation. Their main habitat is rocky terrain within oak forests. It makes its lair in cave or cervices. The porcupine feeds at night on bulbs, acorns and vegetables. It is known to cause damage to vegetable crops.

Plate 31. The porcupine

This species is locally abundant in the mountains of Lebanon (Lewis et al, 1967, Tohme and Tohme 1985). However, this is the first time to be reported in Jabal Moussa region. Their population is in a very good condition this was shown by photos taken by the camera traps. They were photographed in the camera traps all year round and more than one individual in one photo (Plate 32) were significantly recorded. They are spread all over the reserve and in good numbers. Their population is healthy and reproductive.

Economic and Conservation

Porcupines are considered as agricultural pests by locals who trap and kill them for food or to protect their crops. This species is categorized by IUCN Red List as Least Concern, this categorization applies to Lebanon and to JMNR.

Plate 32. A couple of porcupine photo trapped in AlQateen

4.5.6.3 Family SPALACIDAE

4.5.6.3.1 The Mole Rat (E), Le rat-taupe ou le spalax (F), *Spalax leucodon ehrenbergi* (S)

The mole rats live entirely underground. The eyes are vestigial without any trace externally. The external ears are also vestigial and the tail is virtually absent. They live in all terrains and at different altitudes. Their presence is noted by the hilly like soil that they leave while tunneling under the soil. The mole rat feed mainly on roots bulbs and rhizomes.

This species is locally abundant all over Lebanon from sea level to the higher mountain valleys (Lewis et al, 1967, Tohme and Tohme 1985). In JMNR this species is also very

common. The hilly traces (Plate 33) that they leave behind, are found all over the reserve and at different altitudes.

Plate 33. Hills of earth made by the mole rat.

Economic and Conservation

The mole rat plays both positive and negative role. Positive role, through aerating the soil and feeding on insects and worms, and where they are very common they play a negative role by destroying agricultural crops. This species was not yet categorized by the IUCN Red List due to Data deficit. However, in Lebanon they are common in certain areas and threatened in others. The main threat that they face is change of land use and urbanization.

4.3.6.4 Family MURIDAE

4.3.6.4.1 The Broad Toothed Field Mouse (E), Le mulot des champs (F), *Apodemus mystacinus mystacinus* (S) LC (Plate 34)

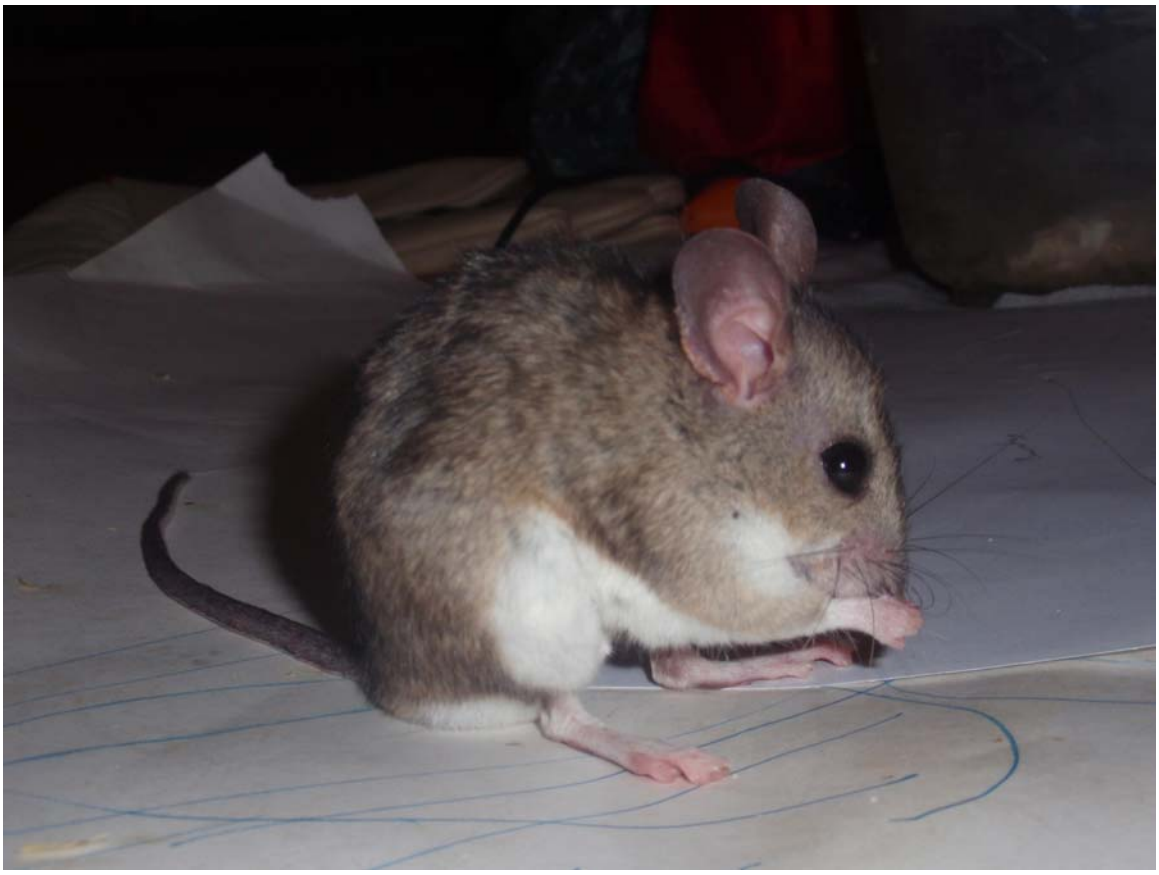

Plate 34. The broad toothed field mouse

The field mouse is small to medium sized mouse with soft fur that is grey dorsally and white ventrally. The tail is moderately tall; ears are large and broadly ovate above. The eyes are lustrous and well developed. The field mouse inhabits moisture hills, rocky scrub land and mountain ranges of the Mediterranean. It frequents the terraces walls of orchards and vine yards. They live in dense oak forests where the canopy of trees creates a continuous layer of foliage (Abramsky, 1981). It is totally nocturnal. They feed on acorns, grains and the seeds of the weeds, pines and carobs.

This species is locally abundant all over Lebanon. They occur from sea level up the alpine zone above the tree line. (Lewis et al, 1967). It was reported by Tohme and Tohme (1985) in Faqra and Farya that are not far from Jabal Moussa.

This mouse species is very abundant in JMNR. It was always photographed by the camera traps and most of the times more than one animal in the photograph. Moreover, during the rodent survey several specimens were trapped all over the reserve.

Economic and Conservation

The field mouse value could be by being food for predators like carnivores (foxes, weasels) and owls. They are categorized as Least Concern by IUCN Red List. In Lebanon they don't face any major threats.

4.3.6.4.2 The House mouse (E), La souris commune (F), *Mus musculus praetextus* (S) LC

The house mouse is a small rodent, found both as commensal, dwelling in and around human settlements and as a free-living feral species in a wide variety of habitats. Its diet varies from seeds, fruits, nuts, berries, to human refuse.

This species is locally abundant all over Lebanon from sea level to the higher mountain valleys. Many specimens were collected during the rodent survey in JMNR at the boarders of human settlements.

Economic and Conservation

The house mouse as the field mouse could be used by predators as food. They are categorized as Least Concern by IUCN Red List. In Lebanon they don't face any major threats on the contrary they are very common and their number is on the increase.

4.3.6.5 Subfamily GERBILLINAE

4.3.6.5.1 The Wagner's Gerbil (E), Le wagner's gerbil (F), *Gerbillus dasyurus gallagheri* (S) LC (Plate 35)

Plate 35. The Wagner's gerbil

The Wagner's gerbil is a medium size gerbil, of slender and graceful build. Its tail is long, ears are roundish and rare limps are much longer than the fore ones. The gerbil inhabits rocky steppe deserts or rocky scrub land with burrows constructed beneath shrubs. They are nocturnal, feeding on seeds of annual herbs.

This species was not reported before in Lebanon. Hence it is a new record for this species in Lebanon and eventually in JMNR (Plate 36).

Plate 36. The only gerbil that was trapped in JMNR to the Qamhez side

Economic and Conservation

Nothing much is known about the role of gerbils. They are categorized as Least Concern by IUCN Red List. Nothing is known yet about their status in Lebanon. This is the first specimen that was reported.

4.3.7 Domestic Animals:

Through the survey domestic animals were always present in the reserve. The domestic animals ranged from livestock mainly goats (Plate 37) that were roaming the reserve all year round except in snowy days. Cats (Plate 38) and dogs were also present

Plate 37. A goat flock beside the old houses

Plate 38. Domestic cat above the Cross

4.4 Conclusion:

4.4.1 Wild Mammals

The above results reflect the richness of the JMNR. Even though it is a very small area, but its ecosystem, location, and elevation differences distinguish it from all reserves in Lebanon. The harshness of the ecosystem makes the reserve unpopular for human activities, hence less disturbance to biodiversity. This was reflected by the activity of foxes (Plate 39), stone martins and striped hyaenas before darkness. The activity of these animals rarely starts before dark unless the area is peaceful and undisturbed. The closeness of the reserve to the urban area could be another reason behind the fauna richness in the reserve. Lots of mammals can find food beside urban areas either from domestic wastes, dead animals and birds as well as live animals and birds.

Plate 39. A red fox was photo trapped during day time feeding on the bait.

In addition to this richness, the population of the different species that were recorded in JMNR was very healthy and has a good population size. This was shown by the

documented photos taken by the camera traps for several species like porcupine (Plate 32), squirrels (Plate 30), hyraxes (Plate 26), hyaenas and wolves. Striped hyaenas were rarely seen in couples even in the densest places while in JMNR a couple was photographed by the camera traps (Plate 40). Furthermore, Wolves were rarely seen breeding in country due to persecution by people. However, wolves were breeding and using JMNR.

The presence of large number of squirrels that are distributed all over the reserve reflects the richness and the peacefulness of JMNR. Squirrels are very important to ensure the continuity of the forested areas through collecting and burying of nuts under the ground that some will germinate later into trees. Furthermore, the large population of porcupine is another indication of the reserve richness and the suitability of the reserve ecosystem to different species.

Plate 40. A couple of striped hyaenas caught by the camera traps beside AlBerki.

Moreover, these results showed that the JMNR is still less disturbed by human activities and the natural balance is conserved. Most of the mammals in Lebanon adapted to night activity due to persecution by people, however in JMNR lots of species, like hyaenas, foxes and wolves were active during day time (plate 41). Besides, the presence of a pregnant female wolf and her cubs later in JMNR reflects the undisturbed status, and the peaceful environment that mammals are finding in the reserve. In addition, natural balance in the JMNR is preserved. In most areas of Lebanon and in most villages they have a wild boar problem but in JMNR, the photos taken for wild boars can be counted and they were mainly for a male. Moreover, the presence of striped hyaenas in significant numbers will help in the sustainability of the reserve and its fauna. By feeding on dead animals, garbage and leftovers, striped hyaena will help in keeping the reserve clean, controlling the spread of diseases and enriching the soil by minerals and fertilizers.

Plate 41. A striped hyaena eating from the bait at noon time

Besides this richness of the fauna and the undisturbed environment, animal are living in peace with each other as plate 42 shows. Porcupine and wild boar feeding in harmony together

In short, JMNR represents a model of the Lebanese rich landscape. Compared to other reserves of Lebanon, JMNR is considered to be one of the richest reserves in mammal species. AlShouf Cedar Nature Reserve for example is the biggest reserve in Lebanon, but the mammal species in JMNR are more diverse. Moreover compared to its size, the population of mammal species that are present in JMNR is very healthy with large population sizes. This elevates the importance of Jabal Moussa protection and categorizes it as an important mammal area. Furthermore, the reserve could act as an in situ breeding place for mammals to augment other Lebanese reserves. In addition, the variety of species present and some of which are critically endangered like wolves, will highlight the importance of the reserve on the national and international level and put the reserve on the map of the reserves with rich biodiversity and endangered species.

Plate 42. Wild boar and porcupine feeding together on the bait

4.4.2 Domestic Animals:

The presence of domestic animals in the reserve has its positive and negative effect. The presence of goats in spring will be very destructive for the flora species. However, the presence of goats in late summer and fall is very essential for fighting forest fires and seed dispersal. Hence it is important to follow a grazing plan in the reserve for the reasons mentioned earlier besides helping the local shepherds and satisfy their needs.

The presence of other domestic animals like cats and dogs could have a negative effect on the fauna of the reserve as domestic cats might breed with wild cat and domestic dogs with wolves hence a hybrid species will appear. Moreover, the presence of these animals could affect other fauna species like birds and rodents.

4.5 Mammals' Diversity Evaluation

The results presented in this report covered only mammals. It would be useful if the results of this survey could be combined with other surveys that were done in JMNR like that of birds and plants.

The indications from the preliminary results obtained by the survey to date do show the area to be of large importance for biodiversity conservation in Lebanon. It is of the highest importance for species conservation due to the presence of globally threatened species that are critically endangered in Lebanon namely; wolves, hyraxes, hyaenas and weasels.

4.6 Threat evaluation

The forest of JMNR is under threat from clearance due to logging (Plate 43), quarries, and forest fires.

Plate 43. Logging of trees on the borders of the JMNR

Several threats do face mammals and biodiversity in JMNR. Hunting is a major threat that still occurs in the reserve and the area surrounding the reserve (Plate 44). However, hunting is reduced due to socio-economic factors. Poisoning is another threat facing mammals. Shepherds to protect their livestock they do practice poisoning to kill predators that kill their animals. An accident happened during the survey where poisonous baits (Plate 45) were spread in different parts of the reserve that might have affected some carnivores.

Plate 44. A dead tit shot by a hunter

Plate 45. A dead poisoned goat on the way to JMNR from Yahshoush baited by a shepherd against wolves and hyaenas.

Although not often considered as a threat, the lack of awareness regarding the status of mammals and their role in nature prevents effective conservation and law enforcement. Awareness activities should focus on young generation without neglecting adults. Awareness activities such as seminars at schools, field visits to educational centers and JMNR will widen the knowledge of the pupil and make them more appreciative of their environment and environmental resources. In addition Awareness program proved to be very effective in changing attitudes of people and the changing their faulty thinking about wildlife in general (Abi-Said, 2006).

Another hidden threat is disturbance by people. Visitors, camping, camp fires, music, singing, …etc all these activities will affect the presence of mammals in JMNR. This was evident during the Cross Holiday. Cameras were put around the camping areas beside the Cross two days before the holiday and left for three weeks after. No animals were photographed in these places even though a lot were photographed before the holiday. This could be an evidence of human disturbance. Visitors and hikers could have the same effect if the area is to be over visited by eco-tourists.

4.7 Protected Area Status Review

The area clearly deserves to be treated as a special protected area due to the presence of high diversity of mammals. This requests that the area be made a nature. Nature reserves are important for biodiversity conservation, which applies to JMNR. A Species/Habitat Conservation Area also allows more leeway for the involvement of local communities in the management of the forests. This has two benefits in JMNR;

1- It allows for limited and controlled extraction of forest resources by local people who depend on them, as long as this extraction does not harm the target species or habitat of the target species

2- It permit some level of community co-management of the forest hence, prevents potential conflict between the reserve and local communities.

From the results shown above JMNR should be protected. However, more information is required before a management plan and priorities for the protected area can be established.

4.8 Recommendations

1- Local decrees should be established that are species specific and monitored through existing village administration structures.
2- Increased law enforcement by the MoE and MoA.
3- An awareness campaign focusing on the importance of the protection of Jabal Moussa and its biodiversity should be conducted. This should target hunters, shepherds, locals and public at large.
4- Allow grazing within the reserve according to a grazing schedule after consulting a flora specialist for the time of grazing.
5- Monitoring of the effect of protection, ecotourism, and other activities on the biodiversity of the reserve.

4.8.1 Community-Based Conservation Activities

1- A forest stewardship committee in each village should be established. The committee should be responsible for developing local decrees, monitoring forest use and implementing projects. The committee should report to the JMNR committee and MoE.
2- In depth Participatory Rural Appraisal studies to identify community needs and the priorities for development and conservation of resources.
3- Forest protection contract systems should be given to the local people to protect their forest.
4- The current use of the buffer zone means a great opportunity to link conservation, economic incentives and forest protection is missed.

5- Identification of development priorities. Assistance should be given to such priorities and linked to the establishment of stewardship agreements and conservation initiatives.

4.8.2 Protected Area Establishment

1- Local community participation in the decision making process, identifying priorities and co-management of any protected or managed forest is vital for long-term success of such a project.

2- It is imperative for the long-term survival of the mammals that the forest as well as marginal land is protected, enriched and enlarged. This would best be done through community involvement in the reserve and must be included in the aims and management plan for the protected area.

3- Taking into consideration the global warming issue, planning to include marginal lands surrounding the reserve is crucial for the continuous existence of biodiversity and its restoration.

4.8.3 Increased Awareness

1- The initiation of an awareness programme throughout the villages surrounding JMNR on the importance of this reserve and its biodiversity on the local, national and global level.

2- Establishment of a long-term environmental education programme. In order for this to be sustainable a training of trainers approach should be taken.

3- Environmental awareness components should also be integrated in adult literacy programmes.

4.8.4 Research Activities

1- Further surveys and monitoring for mammals should be conducted to identify all species present, their population number, status, and their current range so that focus communes for targeted conservation can be identified.

2- A thorough analysis of the biodiversity of JMNR should be conducted.

3- Thorough ecological studies for endangered species will enrich the scientific knowledge of the species in question and could be a part of the eco-touristic activity in the reserve.

4- Additional research on habitat requirement for critical species should be carried out

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