

10. BIODIVERSITY AND NATURAL HERITAGE

Following the signature and ratification of the Global Convention on Biodiversity, -d), which is the most comprehensive assessment of biological diversity in Lebanon to date. With grant funding from 1994, 33 scientists reviewed and compiled existing data on species nationwide to produce this report. However, several aspects of the study are the source of continued debate among scientists (i.e., number and distribution of outstanding flora and fauna). Such discrepancies will persist as long as new field surveys do not effectively replace compilation of old data. Updating species inventories remains a dynamic process as new species are discovered, and endangered species become more widespread or tend towards extinction. The lack of qualified taxonomists (there are no university-level taxonomy programs in Lebanon) hinders effective field research.

This chapter highlights the biological heritage of Lebanon. Section 10.1 provides an overview of the geomorphology and biodiversity of Lebanon. Sections 10.2 and 10.4 examine the distribution of plant and animal species by habitat, in addition to plants and animals of special ecological and/or economical importance. Section 10.3 examines forest resources and pressures, while Section 10.5 provides an indicative assessment of the state of Karst heritage in the country.

10.1 Geomorphology, Habitats and Biodiversity

The biological wealth of Lebanon is intricately related to its geomorphology and microclimates. Moreover, successive civilizations have influenced the natural landscape of Lebanon. For example, ancient civilizations have felled historic cedar forests while others have contributed to the afforestation of vast areas such as the pine forests overlooking Beirut. In both cases, the landscape was radically modified and habitats changed accordingly.

10.1.1 Geomorphological regions and habitats

There are five geomorphological regions in Lebanon:

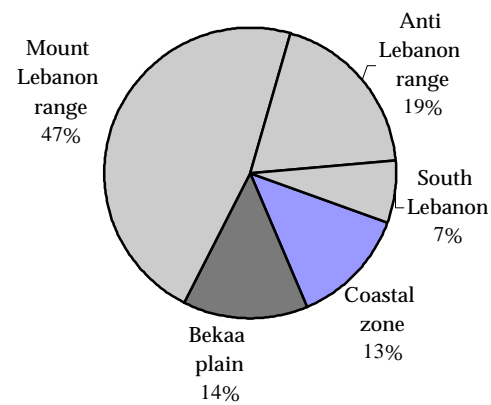
1. **Coastal zone**, including the shoreline and continental shelf, the coastal plains and the foothills of Mount Lebanon up to elevations of 250 meters. The Lebanese coast is about 250 km long (CDR/ECODIT-IAURIF, 1997);¹
2. **Mount Lebanon range**, about 160 km long and 25-40 km wide, includes middle and high elevation zones above 250 meters. It rises from Akkar in the North and extends south to the hills of Jabal Amel. Mount Lebanon peaks at 3,088 meters at Kornet es-Saouda in the north;
3. **Beqaa plain**, a land depression separating the Mount Lebanon and Anti-Lebanon ranges. It comprises an 8-12 km wide fertile corridor and is about 120 km from North to South. The Beqaa plain is drained by the Aassi river from the North and by the Litani River from the South;

¹ 1:50,000) from the northern border to just South of Ras El-Biyadah, which is about 8 km from the southern border.

4. **Anti-Lebanon range**, extends across the Lebanese-Syrian borders. It peaks at 2,600 meters (Tallat Moussa). Slopes are generally more gentle compared to Mount Lebanon. The southern sections of the Anti-Lebanon range include Jabal el Cheikh (Mount Hermon), which intercepts rainwater and redistributes water into at least three main watersheds across Lebanon, Syria and Israel; and
5. **South Lebanon**, an elevated plateau that extends a short distance inland from the western shores of South Lebanon to the Mount Hermon foothills in the East. Many seasonal streams flowing from west to east and discharging into the Mediterranean Sea intersect this region.

Roughly three quarters of the total surface area of Lebanon is mountainous (i.e., Mount Lebanon, Anti-Lebanon, and south Lebanon); see Figure 10.1. This diverse topography gives rise to many microclimates, favorable to the occurrence of many plant and animal species and communities. At the same time, steep terrains are prone to soil erosion and ultimately land degradation if poorly managed. The coastal zone is particularly vulnerable to urban encroachment and loss of habitat (see Section 11.4 for the state of the coastal zone).

Figure 10.1
Distribution of Geomorphological Regions of Lebanon



Source: MoA/UNEP, 1996a

The singularity of geomorphological regions give rise to at least 22 bio-climatic zones and several types of habitats, including several distinct semi-natural habitats that have evolved and adapted to anthropogenic activities and pressures (see Table 10.1). These semi-natural habitats potentially harbor a great number of plant and animal species, owing to microclimatic conditions and biological reshuffling. For example, it seems that floristic richness along the Lebanese coastal zone is highest in disturbed communities such as abandoned terraces (AUB/Dagher, 2001). While such terraces all over the country attest to great agricultural activities in the past, many today have been colonized by a wide variety of plant species, including some that may have been on the verge of extinction.

Table 10.1
Sample Locations of Semi-Natural Habitats

<i>Semi-Natural Habitat</i>	<i>Sample Locations</i>
Guarrigue and maquis	River valleys, Batroun
Pine forest (umbrella pine)	Bkassine, Dinniyeh
Juniper forest	Ainata
Coastal zone	Dammour plain, Qasmiyeh
Wetland	Aammiq marshes, Yammouneh
Abandoned fields & terraces	Kfar Houne, Bhamdoun
Olive groves	Nabatiyeh, Koura, Zgharta

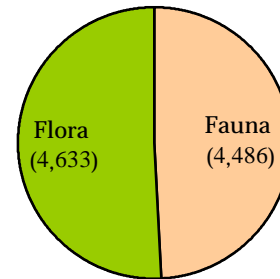
10.1.2 Biological diversity

The 9-

Convention. The report identified 9,119 species in Lebanon, roughly equally distributed between fauna and flora species (see Figure 10.2). This number, however, is believed to represent only 20 percent of the actual number of species in Lebanon and hence the need to pursue and intensify research further (MoE/UNDP, 1998).

In recognition of the importance of biodiversity (see Box 10. 1), at the June 1992 UN Conference on Environment and Development in Rio de Janeiro, 150 states including Lebanon signed the Global Convention on Biological Diversity. Lebanon later ratified the convention in December 1994 (see Appendix M). Under Article six of this convention, the GoL is required to develop and implement a national strategy and an action plan for the e, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross- Furthermore, under Article 26, Lebanon should present to the Conference of Parties regular reports on measures taken to implement the provisions of the convention (MoE/IUCN, 1999).

Figure 10. 2
Number of Known Flora and Fauna Species in Lebanon



Source: MoA/UNEP, 1996a

Box 10. 1 **Importance of Biological Diversity**

evolution and are the basis of the survival of our own species. Biological diversity - the measure of the variation in genes, species and ecosystems is valuable because future practical uses and values are unpredictable, because variety is inherently interesting and more attractive and because our understanding of ecosystems is insufficient to be certain

Source: MoE/IUCN, 1999

To that end and with the collaboration of the UNDP and GEF, the MoE developed in November 1998 a national strategy and action plan for biodiversity conservation. This strategy has defined the following nine goals:²

1. their availability for environmental and economic benefits;
2. To conserve freshwater biodiversity through the sustainable management and wise use of freshwater resources;
3. resources in a sustainable way;
4. To p availability while maximizing both environmental and economic benefits;

² Source: <http://MoE.gov.lb>

5. To conserve biodiversity under natural conditions and establish a balanced ecosystem where plants and animals evolve naturally;
6. To conserve Biodiversity *ex-situ* and utilizing existing capacities;
7. To protect natural ecosystems from invading species;
8. To share global responsibilities in the use, conservation and management of biodiversity; and
9. To share knowledge, costs and benefits with individuals and communities.

The Action Plan then included specific recommendations to achieve these goals on the short, medium and long term. With support from UNDP/GEF, the MoE prepared the first national report on biodiversity and submitted it to the Conference of Parties of the Convention on Biological Diversity in November 1998.

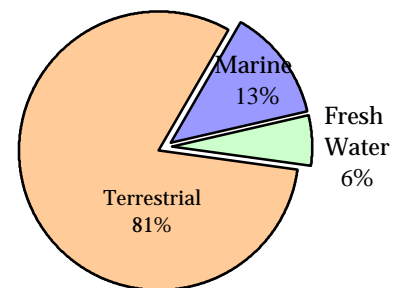
10.2 Flora

Relative to its size, Lebanon boasts one of the highest densities of floral diversity in the Mediterranean basin, which in turn is one of the most biologically diverse regions

More than 80 percent of plant species in Lebanon are terrestrial plants (see Figure 10.3).

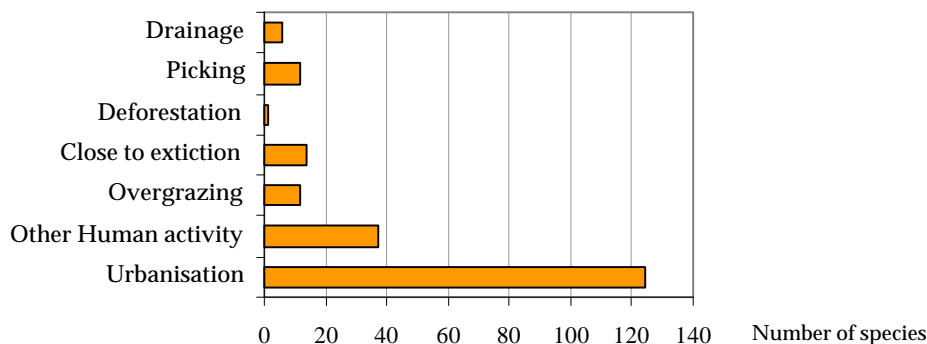
Ample evidence indicates that human activities are eroding biological resources. Habitat loss is the main source of pressure, both nationally and globally. Uncontrolled urban expansion (see Section 4.2.3), destruction and/or permanent alteration of the coastal zone (see Section 11.4), and man-made forest fires (see Section 10.3.4) all contribute to habitat loss. Additional sources of pressure on biological diversity include the widespread use of pesticides and other agrochemicals (see Section 2.2.2), overgrazing (see Section 2.2.3) and wild picking (see Section). Among 206 plant species listed as threatened in the biodiversity reports, urbanization accounts for over 60 percent, as illustrated in Figure 10.4.

Figure 10.3
Breakdown of Floral Species by Habitat



Source: MoA/UNEP, 1996c

Figure 10.4
Number of Threatened Plant Species by Type of Threat



Source: MoA/UNEP, 1996c

10.2.1 Endemic species

Endemism in Lebanon is significant, owing to its geomorphologic diversity and the isolation effect of its diverse topography. Lebanon has a high percentage of endemic plant species, surpassed only by Turkey in a list of six Mediterranean countries (see Table 10.2). From a genetic conservation point of view, endemic plants are very important globally because they are only found in restricted regions and therefore harbor unique genetic information that is potentially important to humankind. According to the Biodiversity Reports, approximately 400 plants are endemic to Lebanon, Syria and Palestine, of which 92 are presumed endemic to Lebanon only (MoA/UNEP, 1996c). The box explains the apparent discrepancies between the findings of

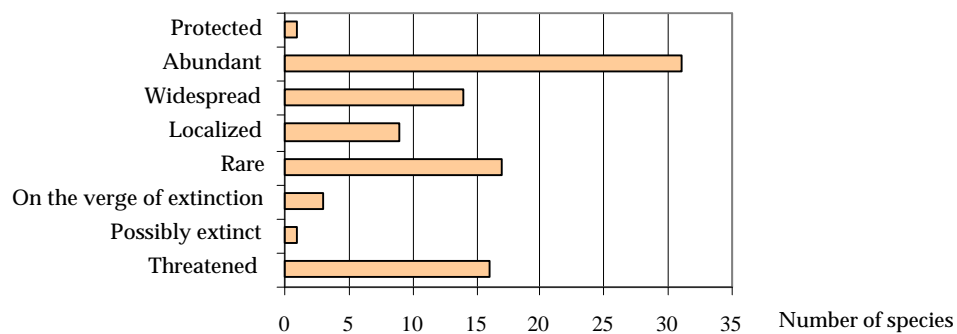
It is difficult to determine endemism with scientific certainty. Plants are usually endemic to a geographic region, rather than a specific country, and their assessment is an evolving science. Old assertions and data are subject to change as new research confirms, or sometimes disputes, old findings.

Species endemic to Lebanon are typically found on the high summits of Mount Makmel and Mount Sannine. Some endemic plants are abundant, while others are rare and/or endangered (see Figure 10.5).

**Table 10. 2
Floral Diversity and Endemism in Select Mediterranean Countries**

Country	Total surface (km ²)	Area in Mediterranean (km ²)	Number of species		Number of endemic species	
			Total	In Med.	Number	Percent
Egypt	1,000,000	15,000	2100	1100	70	3.3
Jordan	97,600	10,000	2200	1800	145	7
Lebanon	10,450	10,000	2600	2600	311	12
Spain	504,000	400,000	7500	5000	730	9.7
Syria	185,000	50,000	3100	2600	395	10.6
Turkey	779,000	48,000	8600	5000	2651	30.8

**Figure 10. 5
Status of 92 Potentially Endemic Floral Species in Lebanon**



Source: MoA/UNEP, 1996c

Recognizing the need to develop a functioning system for monitoring the status and trends of biodiversity, the World Conservation Union (IUCN), through its Species Survival Commission, is developing the IUCN *Red List of Threatened Species*. To unify the species assessment process, the IUCN developed in 1994 the *Red List Categories* and criteria. With over 40 years of experience in compiling data, the IUCN Red Lists are today widely recognized as the most comprehensive, apolitical and global approach for evaluating the conservation status of plant and animal species. According to the 2000 Red List, only the Cedar of Lebanon (*Cedrus libani*) is considered an endangered plant species

listed faunal species). The entire list is available at www.redlist.org

10.2.2 Plant species of economic importance

The impact of local plant varieties on Lebanese culture and economy is significant. Many aromatic plant species are extensively used in Lebanese cuisine and many people, mostly in rural areas, still widely use medicinal plants for the treatment of burns, gastrointestinal diseases, and other ailments. A Survey of Economic Plants for Arid and Semi-Arid Lands (SEPASAL) found 224 plants of economic importance distributed in Lebanon (SEPASAL, 1999). Other economic uses include local consumption (staple foods and wild edible plants), honey production (melliferous plants), landscaping (ornamental plants), and environmental uses (erosion control, agro-forestry, soil remediation, biotic indicators of pollution, etc.). While such plants are essential to many economic activities, over exploitation is potentially leading to a decline in the natural population of several plant species. For example, wild ornamental plants (and cut flowers such as the narcissus) are being harvested at liberty and perhaps at rates exceeding their rate of natural regeneration.

The MoA has issued specific regulations and decisions to control wild picking and the commercial use of wild plants. Decision 92/1 (27/2/1996) prohibits the export of all , myrtle

). In apparent contradiction with that Decision, Decision 340/1 -round and restricts their harvest season to the period from August 1 to December 31.³ Moreover, the Decision requires express permission from the MoA for the harvesting of sage. It also calls on forest guards to monitor harvesting periods and practices (e.g., thyme and sage should not be harvested with their roots).

Several laws and regulations restrict or prohibit wild picking in general, including the forest code and related ministerial decisions, and the laws establishing nature reserves and protected areas (see Section 13.2 for more information on protected areas and forests).

10.2.3 Wild relatives and agro-biodiversity

Biological diversity also occurs among agricultural crops. The trend nowadays is to adopt more commercial and productive crops, including genetically modified organisms (GMOs), at the expense of more traditional crop varieties. Whereas imported and genetically modified crops usually generate higher yields, traditional crops are incontestably hardier: they exhibit higher drought resistance, sometimes also higher resistance to salt and heat stress, and are less susceptible to pests and diseases.

³ Only *processed* wild thyme may be exported (i.e., ready for consumption)

Consequently, traditional crops and wild cultivars, while less productive, require less water and agro-chemicals. Hence the need to conserve agro-biodiversity, in Lebanon and elsewhere.

With grant funding from UNDP/GEF (US\$1.5 million), Lebanon is hosting a *Study on Sustainable Use of Dryland Agro-biodiversity (2002-2004)* which brings together several local (LARI) and international organizations (ICARDA, IPGRI, and ACSAD). Implementing partners include the AUB, NCSR and several local and national NGOs.

The project is promoting on-farm conservation management of wild relatives and land races in three areas in the district of Baalbeck (Ham, Maaraboun, and Nabha). To date, it has conducted eco-botanical surveys, vegetation surveys, indigenous knowledge surveys and implemented a number of small scale activities to improve soil, water and agro-biodiversity conservation of project target crops. To assess the impact of the project activities, 19 sites were selected and delimited using GIS to perform annual monitoring. The project is also helping establish a local NGO for development (Nabha) and/or empowering existing NGOs (Arsal). It has demonstrated to farmers the effect of cleaning and treating seeds of wild landraces on yields and is evaluating the resistance of several cereal and legume landraces and wild relatives.

The project is overseeing the establishment of a gene bank for local grape varieties at LARI, studying micro-propagation techniques for local almond cultivars, exploring the feasibility of expanding honey production, identifying and cataloguing medicinal and aromatic plant, and providing fellowships to university graduates as well as many other activities.

10.2.4 Ornamental and invasive species

Ornamental landscaping has become an important agri-business in Lebanon. While several retailers acquire their flowers and plants locally, many more rely on imports. Currently, there are no quarantine regulations on imported ornamentals. Likewise, thousands of trees are imported or donated annually to Lebanon for reforestation campaigns. These stocks are neither certified disease-free nor quarantined.

native cedar of Lebanon, thus producing new cedar varieties. Such varieties could compete with local species in the long run or attract potentially harmful insects. In order to mitigate potential threats to local cedar populations, the MoA has banned the import and introduction of all cedar seeds and plants (Decision 108/1, dated 12/9/1995), but implementation of the Decision remains sporadic at best.

10.2.5 Outlook

The GoL recently secured a top-up fund (US\$100,000) to assist the MoE to further assess national capacity building needs and priorities. During this 10-month project, the MoE will also analyze institutional and functional capabilities and determine the necessary mechanisms to protect national biodiversity.

10.3 Forests

Data on forest resources are old and outdated. The first set of national forest data was prepared in 1966 by FAO and the Lebanese Army. Since then, there has been only one attempt to update the data in 1991, based on 1987 Landsat images (FAO and Khatib & Alami). The resulting land use/land cover map of Lebanon was derived without adequate field validation. For example, the maps represent the majority of mountain villages as orchards (CDR/ECODIT-IAURIF, 1997)! In fact, only 66 percent of the pixels on the map matched their corresponding locations on the ground (Khatib & Alami, 1997).

There is an urgent need to produce a new and accurate land cover map of Lebanon, including a detailed assessment of forest resources, to inform policy makers and promote sustainable development of natural resources. New forest data are expected to become available in 2002, following the completion of a new land cover map for Lebanon under a joint project of the NCRS, LEDO and CERMO (see Section 11.2).

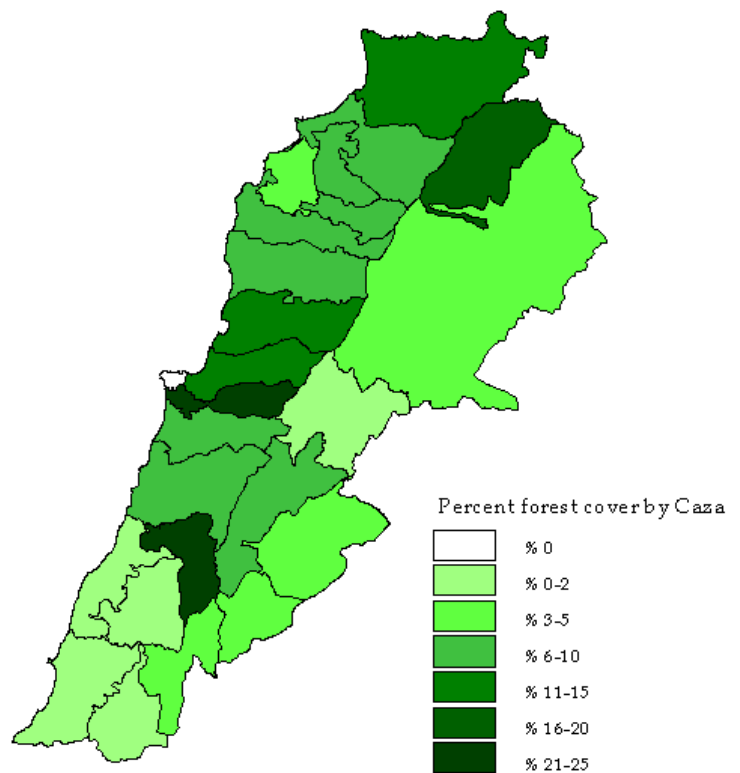
10.3.1 Forest cover

Several detailed studies have been performed to assess the state of localized forests and forest stands, such as the Rihane mountain region (see Box 11.3), fruit production in Aarsal (Box 2.1), select nature reserves (Section 13.2.1). In the context of a plant cover conservation and management project, the forests of Hadath el Jebbe (Qnat), Jabal Moussa (Nahr Ibrahim) and Kefraya (Bekaa) were also targeted. The basic difficulty in assessing forest resources is the lack of unified forest nomenclature (i.e., canopy closure, forest density and floral associations, state of degradation).

Current best estimates of forest cover vary grossly from as low as four percent to as high as 13 percent (FAO/Khatib, 1996). In 1996, the MoA reported that forests in 1966 covered 6.7 percent of the

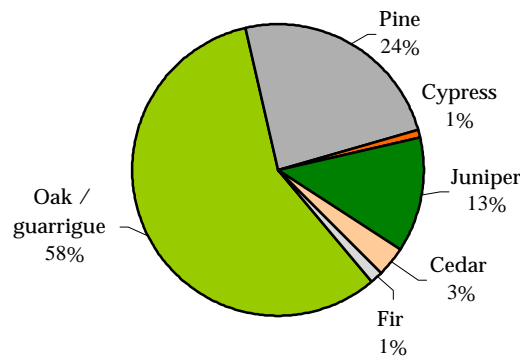
distributed across cazas as shown in Map 10. 1. While the forest cover today may not be exactly as depicted, the map provides a good visual appreciation of the relative geographic distribution of forests in Lebanon. For example, the Cazas of Jezzine and Baabda have the highest percent forest cover while Bint Jbeil, Tyre and Nabatiyeh have the lowest. Assuming that the percentage breakdown of forest species did not significantly change since 1966, Figure 10. 6 illustrates the plausible share of major forest species in Lebanon. Appendix I lists 39 forest species widely distributed in Lebanon for quick reference.

Map 10. 1
Approximate Forest Cover by Caza in Percent



Source: MoA/UNEP, 1996c

Figure 10. 6
Percentage Distribution of Forest Species



Source: MoA/UNEP, 1996c

10.3.2 Sources of pressure

Abusive felling, over-grazing, urban development, fires, and pests threaten Lebanese forests. The Juniper and several oak species are preferentially felled for the production of coal. Overgrazing is further threatening dwindling juniper forests and endangering its regeneration, which may be affected by the reduction in thrush populations. (This bird species eats the juniper fruit and releases the kernel together with its droppings, slightly braised and decomposed, ready for germination). The stone pine (umbrella pine) is chiefly threatened by urban development and forest fires, as best illustrated in the cazas of Metn, Baabda and Kesrouane (forest fires are further examined in Section). Table 10. 3 compares the threats faced by different arborous species on a qualitative scale of 1 to 5, with one representing the lowest degree of severity and five the highest.

Table 10. 3
Threats to Select Forest Species Based on Degree of Severity

Forest Species	Abusive Felling	Over-Grazing	Urban Development	Fires
Kermes Oak (<i>Q. calliprinos</i>)	3	4	3	3
Haired Oak (<i>Q. cerris</i>)	4	4	4	-
Aleppo Pine (<i>P. halepensis</i>)	3	3	4	5
Brutia Pine (<i>P. brutia</i>)	3	3	3	5
Stone Pine (<i>P. pinea</i>)	1	2	4	3
Cedar of Lebanon (<i>Cedrus libani</i>)	2	2	1	-
Fir (<i>Abies cilicica</i>)	3	4	3	-
Juniper (<i>Juniperus excelsa</i>)	4	5	2	-
Cypress (<i>Cupressus sempervirens</i>)	3	4	2	2

Source : MoA/UNEP, 1996a

10.3.3 Forest health

The proliferation of forest pests has over the past years caused extensive damage to several forests. For example, several species of pests, including the harmful pine processionary moth, have infested pine forests, and a previously unknown sawfly variety has infested and devastated cedar forests in Tannourine and Hadath El Jebbe. This sawfly was later named after the forest where it was first identified, *Cephalcia tannourinensis n.sp.*

Table 10. 4 presents a tentative list of harmful pests that have infested several forests in Lebanon. While most of these pests have perhaps always existed, an apparent rise in populations in recent years calls for an intensification of research and monitoring.

Table 10. 4
Most Destructive Pests in Lebanese Forests

<i>Forest Type</i>	<i>Pests</i>	<i>Management Status</i>
Stone (umbrella) pine	<i>Ernobius sp.</i> , <i>Chalcophora detrita</i> , <i>Phytoecia sp.</i> , <i>Pitophtorus pubescens</i> , <i>Tomicus piniperda</i>	These insects attack weak trees. Best technique is to remove all dead trees and twigs, which are the primary niches for infestation outbreaks
Aleppo pine	Moth (pine processionary), <i>Thaumetopoea wilkinsoni</i>	Using helicopters, the Lebanese Army and MoA have sprayed the biological insecticide <i>Bacillus thuringiensis</i> between September and November, depending on altitude since 1999
Cedar of Lebanon	Sawfly, <i>Cephalcia tannourinensis</i>	Three aerial spraying cycles have been conducted between 1999 and 2001, using Difluobenzuron (an insect growth regulator)
Oak	Moth (gypsy moth), <i>Lymantria dispar</i> and the processionary moth	No control, attacks are tolerable

Source: *Pers comm* Nemer N, AUB Entomology Lab, September 2001

10.3.4 Forest fires

Forest fires rage in many parts of the country between August and early October. Data on the number and extent of forest fires were sketchy until recently. Today, more data are available from several sources (MoA, Civil Defense, Lebanese Army, local NGOs) but these data are not always mutually consistent. Current statistics refer to all forested areas affected by fires, whether charred or just superficially burnt. Between 1998 and 2000, approximately 35 km² of forests were recorded as affected by fires (see distribution per *mohafaza* in Table 10.5).

Table 10. 5
Total Burned Forest Areas as Recorded by Mohafaza (in hectares)

<i>Year</i>	<i>North Lebanon</i>	<i>South Lebanon</i>	<i>Bekaa</i>	<i>Beirut</i>	<i>Nabatiyeh</i>	<i>Mount Lebanon</i>	<i>Total</i>
1998	179	900	-	-	253	271	1,601
1999	165	134	5.0	-	51	1,133	1,486
2000	107	79	127	-	22	74.0	408
Total	451	1,113	132	-	326	1,478	3,495

Source: MoA, MoE, Civil Defense and Internal Security Forces (LEDO Indicator # 77)

At the MoA, the Directorate of Rural Development and Natural Resources has responsibility for staffing and operating a fire control unit. This unit has already recruited 221 forest guards who man 31 monitoring stations (25 are located in forests, see Table 10. 6). Forest guards are responsible for enforcing forest protection laws and regulations (such as Forest Law 558/1996 - see Section 13.2.2) and apprehending offenders. Sixty forest guards received basic training (1997-2000) in forest management and fire control

measures under a cooperati (ONF). Furthermore, the unit currently owns four 7,500-liter water trucks and 26 utility cars that can be equipped with 600-liter tanks, used for early intervention.

Table 10. 6
Number and Distribution of Forest Monitoring Stations (May 2001)

<i>Mohafaza</i>	<i>No. of stations</i>	<i>Location</i>
South Lebanon	3	Saida, Tyre, Jezzine
Mount Lebanon	6	El Tayouneh, Beit Eddine, Hammana, Jbail, el Metn, Kesrouan
North Lebanon	11	Batroun, Zgharta, Aaindakt, Nahr Moussa, Syr, Ain Yaacoub, Tannourine, Bnechaa, El Aabde, Ehden, Harrar
Bekaa	7	Soughbine, Chtoura, Deir el Ahmar, Rachaya el wadi, Hermel, Harbata
Nabatiyeh	4	Marjaayoun, Nabatiyeh, Bint Jbeil/Yater, Hasbaya

Source: Data supplied to ECODIT by MoA / Directorate of Forest Resources, 2001

The fire control unit lacks basic equipment, such as uniforms, handset communication devices, and binoculars. Furthermore, due to low salary levels, forest guards may be forced to find second jobs, which may compromise their performance on the job. Finally, lack of funds and red tape have caused frequent delays in replenishing gasoline reserves at the Directorate. As a result, water trucks and utility cars often stand idle for days or weeks, sometimes even when fires are raging.⁴

The MoA is also planning the construction of 14 monitoring towers across the country to provide early warning and quick intervention to control forest fires. These towers will be strategically located in Akkar, el Danieh, Batroun, Zgharta, Jbeil, Kesrouan, Bologna, Beit Meiry, Sofar, Aghmid, Obay, Daraya and Lala. Due to lack of funds, no monitoring tower has yet been built.

Meanwhile, the Lebanese Air Force has been assuming a growing role in combating forest fires. Beginning in 1999, the Lebanese Army acquired 10 fire fighting ,100 liters of water each. In 2002, the Lebanese Army acquired five more (they currently can equip up to seven helicopters only). The buckets are filled in the sea or inland water bodies (Qaroun lake) and can be released anywhere in the country within 30 minutes of notification. Airborne fire fighting has proved instrumental in containing forest fires when they are reported early, but less effective when the blaze has propagated. The fire fighting unit of the Lebanese Air Force maintains direct contact with regional army stations and the civil defense. The construction and manning of forest fire monitoring towers (see box) would provide early warning of forest fire incidents. The MoE has provided financial support to build a monitoring tower in Kobeyyat (see Section 12.5 on MoE small grants to environmental NGOs).

⁴ *Pers comm* Bassil M, MoA, Department of Forests and Natural Resources

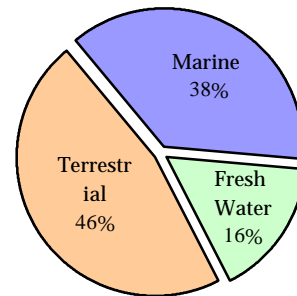
10.4 Fauna

Of the 4,486 known fauna species in Lebanon nearly half are terrestrial (see Figure 10.7). Insects and butterflies total 1,216 known species, or 27 percent of the total number of fauna species.

10.4.1 Mammals

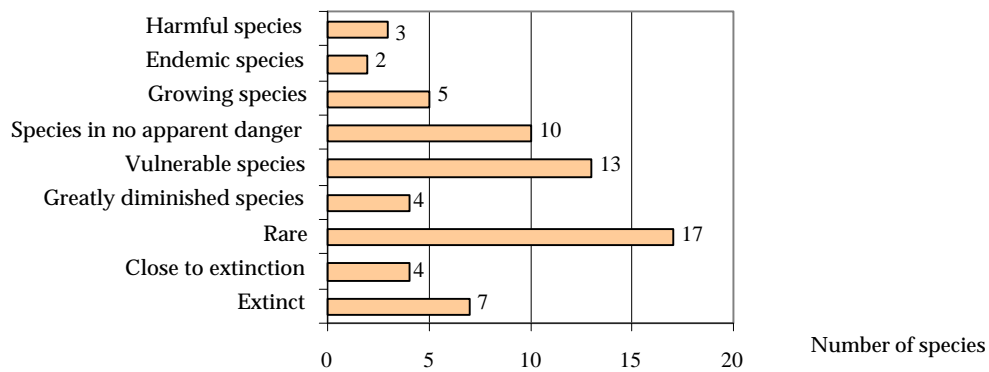
There are 52 reported mammal species in Lebanon today; in addition, seven mammal species are already extinct, including the Syrian brown bear, the Persian lynx and the Arabian gazelle (see Figure 10.8). Bats make up the largest single group of mammals in Lebanon (16 species). About one third of existing mammals are rare, including several species of shrews, bats, the weasel, the otter and the Spiny Mouse, and another 39 percent are vulnerable species or species in apparent danger. The wolf, wild cat, mongoose and squirrel are close to extinction.

Figure 10.7
Breakdown of Faunal Species by Habitat



Source: MoA/UNEP, 1996a

Figure 10.8
Conservation Status of Wild Mammals in Lebanon ^a



^a Some species are reported in more than one category

Source: MoA/UNEP, 1996d

Deforestation, urban encroachment, new roads, drainage of wetlands (e.g., Aamiq marshes), the bio-accumulation of agro-chemical residues, and hunting are the major sources of pressure on the mammalian fauna of Lebanon. The squirrel, once very common in Lebanese mountains, is close to extinction due to the excessive use of pesticides (MoA/UNEP, 1996c). The Horsh Ehdén Nature Reserve provides one of the last remaining sanctuaries for squirrels in Lebanon. Most commonly hunted mammals include the wild boar (*Sus scrofa lybicus*), the hare (common in the Bekaa and Mount Lebanon), and the hyena, (*Hyaena hyaena syriaca*). Wild boars have reportedly proliferated in recent years in the western Bekaa, in the upper mountains of the Al-Chouf Reserve, and in Horsh Ehdén.

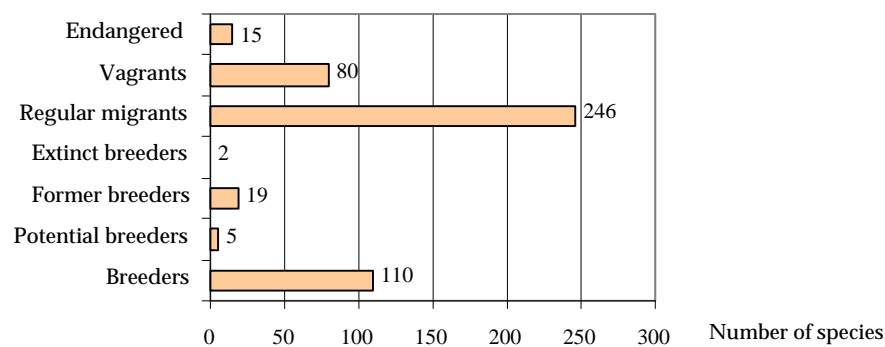
Many farmers and inexperienced hunters track down several important animal species that play a vital role in the ecological system. For example, the hyena is wrongly believed to attack people and newspapers frequently report of country. In reality, hyenas feed on dead animals and decaying carcasses, thereby cleaning the environment and recycling nutrients.

10.4.2 Birds

At least 372 species of birds have been recorded in Lebanon (see breakdown status in Figure 10.9). Of the 80 vagrant species of birds, 36 have not been recorded since 1972. The two extinct breeders are the Lesser Crested Tern (*Sterna bengalensis*) and the Blue-cheeked Bee-eater (*Merops persicus*). The 15 endangered species include the Eurasian Black Vulture, the Spotted Eagle, and the Dalmatian Pelican. The discontinuity of observations in space and time could be leading to inaccurate estimates of the true avian diversity and distribution.

The humid inland environment constitutes the most welcoming habitats for water birds in Lebanon, as well as for a wide range of aquatic flora. This includes the Ammiq Swamp, the Yammouneh basin, the Taanayel and Sheikh Zennad ponds, and the Qaraoun lake, all of which are threatened by urban development, drainage schemes for agricultural purposes, and illegal hunting (see Appendix I).

Figure 10.9
Status Breakdown of Avian Species in Lebanon⁵



Source: Jaradi, 1999

Birds are important bio-indicators: they can instantly colonize new, propitious grounds and are easily displaced if their habitats are disturbed or destroyed. Many bird species help maintain agricultural pest populations in check; their protection is therefore important for maintaining a healthy ecological balance. For example, the decline in the population of predator birds such, as owls or cuckoos, leads to an increase in rodents (in agricultural fields) and pine processionary moth (in pine forests), respectively.⁶ Several raptor populations that used to nest in Lebanon, including the Griffon Vulture, the Golden Eagle and the Peregrine Falcon, today merely pass through the Lebanese territory (Jaradi, 1999).

Excessive and inappropriate use of pesticides, the disappearance of natural biotopes, urban expansion, and hunting are at the root of declining bird populations in Lebanon. Hunting can significantly reduce bird populations, especially when practiced during the breeding season. An estimated 600,000 hunters (two-thirds have no proper hunting license) have taken a heavy toll on resident as well as migratory bird populations in Lebanon. This number is excessively high for a country the size of Lebanon and threatens the existence of many bird species (see Table 10.7).

⁵ Numbers do not add up to 372 because many bird species appear in several categories

⁶ Ramadan Jaradi, G., *pers. comm.*

Table 10. 7
Statistics on Hunting Sector in Several Countries

Country	Number of Hunters		Ratio of hunters to population (%)
	Total	Per km ²	
France	1,550,000	2.6	1.0
Italy	945,000	3.2	1.7
Lebanon	600,000	57	17
Portugal	305,000	3.3	3.0
Sweden	323,000	0.7	3.6

Source: Ramadan Jaradi, G., 2001 (Press release).

A moratorium on hunting was promulgated by Ministerial Decision 11 (30/8/1995) and still holds in theory - syndicates and owners of hunting apparel. The hunting ban has become all but a joke, and enforcement is sporadic at best (see Box 10.2). The sound of echoing shotguns can be heard throughout the year and almost everywhere in the country. Only select nature reserves have recently offered a sanctuary to birds, including Horsh Ehden, Palm Islands and Al Shouf Cedars Nature Reserves. Table 10. 8 presents a targeted list of hunting legislation between 1993 and 2001, clearly reflecting the lack of consensus on how to manage the hunting sector in Lebanon. After years of animosity, environmental NGOs, concerned individuals, hunters and hunting associations and syndicates seem to be converging on the need to reorganize the hunting sector by introducing stiffer legislation and proper hunting practices, rather than banning hunting altogether. Decision 38 (2/8/2001) established a ministerial committee to revise an MoE draft law that would replace the hunting law of 1952.

Table 10. 8
Legislative Developments in Hunting Sector (1993-2000)

Legal Instrument	Description
Decision 2/B, MoE (21/5/1993)	Bans the use and import of bird sound devices. Calls on customs officials to monitor and confiscate such incoming devices
Decision 102/1, MoE and MoA (28/4/1993)	Divided game birds and animals into 3 categories: harmful birds (can be hunted all year), birds and animals hunted during specific periods, and birds and animals for which hunting is banned
Decision 8/B (10/1/1994)	Declares a ban on hunting over the entire Republic of Lebanon effective from 1/1/1995 till 31/12/1997
Decision 110/1, MoE and MoA (18/5/1995)	Restricts hunting to certain animals and birds only. Considers all wild birds and animals (resident and migratory) protected, except designated game bird species, as well as the wild boar. Defines hunting season (September 15 to December 31) and schedules (everyday of the week except Mondays and Tuesdays). Empowers MoE and MoA to set bag limits for every game animal during hunting season if need be
Decision 11, CoM (30/8/1995)	Declares a ban on hunting (for three years) over the entire Republic of Lebanon.
Decision 15, CoM (12/9/95)	Reopens the season of hunting for four months starting from 15/9/95 and re-declares a ban on hunting from 15/1/96 till the end of 1997
Decision 35, CoM (27/5/97)	Renews the ban on hunting over the entire Republic of Lebanon till further notice
Decision 37, CoM (23/12/97)	Reasserts the application of the national ban on hunting until the hunting law of 18/6/1952 is revised and promulgated
Decision 55, CoM (8/11/2001)	Approves the MoE draft law to modify and update the hunting law of 1952

To protect migratory species, the GoL could begin by adhering to the Bonn Convention (also called the *Convention on the conservation of Migratory Species of Wild Animals*, CMS). This convention was concluded in 1979 and aims to improve the conservation status of migratory species through national action and international agreements. The Convention applies to terrestrial, marine and avian species over the whole of their normal migratory ranges. As a party to the CMS, Lebanon would have to commit itself to placing certain species under strict protection. It would also benefit from the regular exchange of information and co-operation with other countries sharing the same migratory animals or experiencing similar conservation challenges. Furthermore, it would have to conclude multi-lateral agreements such as the *African-Eurasian Migratory Waterbird Agreement* (UNEP/AEWA), concluded in June 1995 in The Hague, Netherlands. This agreement covers 117 countries, stretching from Europe, parts of Asia and North America, to the Middle East and Africa. Lebanon is a critical link in this geographic continuity. The agreement covers 172 species of birds ecologically dependent on wetlands for at least part of their annual cycle. At present, the MoE is seeking to ratify the AEWA and has submitted relevant documentation to the Council of Ministers.

Box 10. 2

Most hunters have no training in, or familiarity with, basic gun safety, game recognition, sportsmanship, or environmental stewardship. Their practices have penalized the minority of hunters who are ecologically minded and given them a bad image. Many hunters trespass on protected areas and on private properties against owners setback distances (safety, nuisance). They shoot at the smallest, non-game birds, and often begin shooting before sunrise and continue after sunset. Shooting from the car is not uncommon.

Lebanon consider them fair game, shooting at migrating Vultures, Eagles, Buzzards, Harriers, of some shooting, although the pressure on them seems to have subsided in recent years. An increasing number of hunters use illegal tricks and devices to catch birds or lure them within shooting range, such as:

- Sticky rods (limes) to catch small birds;
- Blinds and live decoys to attract and shoot/catch partridges (Chukar) and the Golden
- Recorded tapes played on loudspeakers to attract and shoot songbirds such as Thrushes and Quails
- High-powered light projectors to attract birds migrating at night such as thrush or to shoot roosting birds; and
- Mist nets, tranquilizers, and poison.

Hundreds of thousands (about 10 millions) of migratory birds are hunted each year over Lebanon, including small birds such as ortolans, chaffinches, and larks. Many hunters bag up to three or four hundred such birds on a heavy migration day (the concept of bag limits is totally foreign!). For example, on September 16, 2001, tens of thousands of quails were hunted throughout Lebanon, after being lured to the fields by song recordings during their night migration. Many hunters shot 100-200 birds on that day.

Protected by the Bonn convention, the Ortolan Bunting is the subject of a tug of war between Lebanese conservationists, who want to protect it, and hunters, who want it to be included on the official list of bird games in Lebanon.

Source: ECODIT & *Pers comm* Ramadan-Jaradi G.

10.4.3 Marine and aquatic life

The National Center for Marine Sciences (NCMS) has inventoried 218 marine fish species from 140 genera. An additional 25 species are confirmed to exist in Lebanese freshwater systems (MoA/UNEP, 1996e). Zooplankton account for the largest share of marine faunal diversity with more than 747 species recorded. Micro-zooplanktons are at the base of the marine food pyramid and are hence essential for maintaining the ecological equilibrium. Other families of marine organisms include the cephalopods (octopuses, cuttlefish and squids), reptiles (loggerhead turtle and green sea turtle) and mammals (dolphins and porpoises and, less common in local waters, whales and seals).

Over recent years, the presence of new species and the decline of other species in Lebanese fish markets have been noted (MoA/UNEP, 1996a). While it is still difficult to explain such evolution with scientific certainty, changes in hydrological conditions (increase of temperature and salinity) could be facilitating the settling of Indo-Pacific species in Lebanese and neighboring waters. Furthermore, a growing number of man-made embankments and the deterioration of the coastline have destroyed several important biocenoses.⁷ These biocenoses are vital environments for the spawning and feeding of several species of coastal and deep sea fish. Dynamite fishing (less common nowadays) has reportedly decimated fish stocks and degraded certain biocenoses further (MoA/UNEP, 1996a).

Box 10.3 Types of Pressures on Aquatic Habitats

Water sources: In an effort to secure water during the dry season, water authorities around the country are increasingly tapping water sources directly from springs. This frequently disrupts the aquatic habitat around the springs (lining material and cement). Spring water is often completely diverted, thereby drying up the surrounding aquatic habitat for several months. The incessant flow of villagers to some springs potentially leads to soil compaction and may also result in the transport of organic substrates to and from the site.

Rivers: Evidence of fertilizer and pesticide residues in rivers is increasing. Such agro-chemicals easily find their way to water courses and alter their chemical composition. This, in turn, affects the micro flora and fauna potentially leading to drastic changes in the number and composition of living organisms. For example, the tannery sector is releasing an estimated eight tonnes of chromium per year into the Litani River, polluting the water and threatening several aquatic organisms (MoE-CDR/MVM, 2000). Contamination by domestic wastewater is no less problematic, as evidenced by eutrophication in certain river sections during certain times of the year. Eutrophication leads to a floral imbalance, such as the proliferation of saprophytes and the degradation of the aquatic landscape (e.g., murky water, algae accumulation, foul odors). Hydroelectric power plants also impact aquatic flora and fauna by causing the intermittent drying of the watercourse downstream. Reckless disposal of inert material and aggregates from active quarries and construction sites also cause permanent modifications to the river bed and disturb several aquatic populations (Nahr Ibrahim). Open dumping (Zahle, Awali and Abou Ali rivers) cause the release of several toxic chemicals and organic pollutants (see section 8.2). Small hotels and open-air restaurants also release untreated liquid and solid waste.

⁷ Biocenoses are biological or biotic communities

More generally, the deterioration of the coast constitutes significant threat to marine ecosystems and organisms. Threats include the direct discharge of industrial effluents into the sea, waterfront waste dumps and floating garbage, cooling water and lubricating waste oil from thermal power plants, the construction of quays, sea walls and beach resorts, and the discharge of domestic wastewater (see Section 11.4 for more information on the state of the coastal zone). Box 10.3 provides a qualitative assessment of the pressures facing freshwater habitats including springs, stream and rivers. Appendix J provides an overview of three key freshwater hotspots, and current actions undertaken to improve the situation.

10.5 Karst heritage

Lebanon hosts many spectacular Karst formations, both on the surface and underground. Numerous extensive Karst formations are found in Mount Lebanon, such as in Feytroun and Kfarzebian in the caza of Kesrouane. Ice, wind and rain carved these rock formations to form majestic striated sculptures that decorate the landscape. Chaotic construction along the Rayfoun-Faraya highway has caused the destruction of several rock formations and greatly impacted this unique landscape.

For more than 50 years, speleologists have discovered, explored and documented Karst systems throughout Lebanon. Their accounts confirm the presence in Lebanon of an impressive underground Karst heritage, with hundreds of caves and abysses decorated with magnificent stalactites and stalagmites. Four licensed organizations practice speleology, a rising popular adventure sport in Lebanon today⁸. Speleologists have pioneered the discovery of important caves and abysses, often laced with subterranean rivers. Some of their discoveries have contributed to improving our understanding of groundwater flow and, hence, exploiting readily available fresh water resources. The best example to date is the discovery in 1996 of the Qattine Azar cave system in Antelias, which prompted the CDR in 1999 to contract a US\$ 300,000 study for the exploitation of that sink hole (CDR, 2001).

After having concentrated their efforts on Mount Lebanon in the past, Lebanese speleologists have gradually extended their exploration to North Lebanon and the Anti-Lebanon mountain range. To date, more than 450 Karst formations have been reported. Of those, 217 cave (over 20-m long) and abyss systems (over 20-m deep) were classified in terms of total extension (length) and altitude differential (from highest to lowest point). Table 10. 9 presents the top 10 cave/abyss systems based on total extension and the top 10 cave/abyss systems based on total drop (or altitude difference). While the *Jeita grotto* is by far the longest explored cave in Lebanon, *Fouar Dara* is the deepest abyss.

⁸ -Club of Lebanon (SCL), Groupe all (1984).

GERSL is the oldest of them

Table 10.9
Preliminary Classification of Largest Cave Systems in Lebanon

<i>Extension</i>		<i>Meters</i>	<i>Altitude difference</i>		<i>meters</i>
1.	M ^{a/} Jeita	9050	1.	H Fouar Dara	-602
2.	M El Roueiss	5066	2.	H Qattine Azar	-515
3.	M Afqa	3600	3.	H Ballouh/Baatara	-255
4.	M Nabaa el Chataouni	2550	4.	H Jouret el Aabed	-244
5.	M El Kassarate	2500	5.	H	-240
6.	H ^{b/} Fouar Dara	2500	6.	H	-205
7.	M	4000	7.	H El Qeddeha	-158
8.	M Dahr el Ain	1500	8.	H	-152
9.	M	1100	9.	H Tarchich	-147
10.	M Salem	1020	10.	M Jeita	+140

^{a/} Mghara - cave, cavern ^{b/} Houet - abyss, chasm

Source: Nour, 1994 (based on records from ALES and GERSL)

ge is seriously threatened by quarrying and the direct discharge of raw sewage (see Box 10.4). Quarrying activities (dynamite use, blasting) have caused the collapse of several cave systems and destroyed several stalactite/stalagmite formations. Speleologists also routinely report foul stench and murky waters in many cave systems due to the direct discharge of raw sewage above ground and in some cases directly underground through dry wells. They have discovered innumerable explosives and grenades at the bottom of some of the deepest systems (ALES, 1998). Other artifacts (e.g., plastic articles, and tires) also find their way to those systems through faults, and underground rivers. The remains of a Syrian bear (last seen in 1856) were also discovered during one of the explorations.

Box 10.4
Are we Protecting the Important Jeita Water Sources?

The important Jeita water sources are potentially exposed to contaminant due to rampant urbanization. For example, a major housing and recreational center is being completed on a mountain crest overlooking the Nahr el Kalb. The development covers 140,000 m² of pine forest situated directly atop the famous Jeita grotto (thousands of visitors a year). The facility will house more than a hundred chalets and three swimming pools. No EIA was conducted for the project although it could potentially pollute a major source of drinking water for Beirut.