the rehabilitation and preservation of the 30 remarkable sites defined by the NPMLT (CDR, 2005). This measure will strengthen the ability of coastal habitats and species to adapt on their own.

- **Accommodation adaptation measures:** they consist of reactive measures to minimize human impacts through reducing or moving sources of urban, industrial and agriculture pollution and introducing effective early warning systems along the coast for coastal hazards.

- **Protection adaptation measures:** consist of proactive measures that consist of developing a defense strategy to control sea level rise through soft or hard engineering. Hard engineering techniques are coastal structures such as sea walls, dykes, and embankments against high water and sea storms. However, they do not stop beach erosion and can contribute negatively to coastal water quality. They are usually adopted on active economic environments that cannot be moved as well as on highly urbanized areas to protect expensive properties or infrastructures. Soft engineering techniques include beach nourishment by feeding a beach periodically with material brought from elsewhere to remedy erosion, and sand dune stabilization by planting vegetation such as beach grass that retains sand and creates natural habitats for animals and plants (Parry et al., 2009; Ozhan, 2002).

An overarching adaptation and management option to relieve pressures on the coastal zones can be the adoption of integrated coastal zone management that includes preservation of coastal ecosystems and preventing and reducing the effects of natural hazards. Additional adaptation measures are presented in Table 4-10.

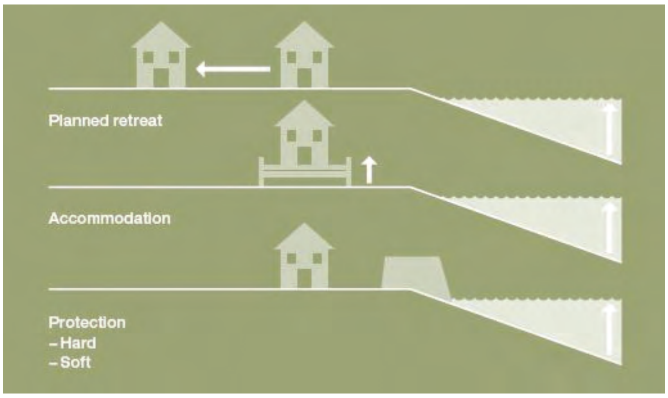

Figure 4-38 Illustration of the possible adaptation responses to sea-level rise. Source: Parry et al., 2009

4.7 Vulnerability and Adaptation of the Forestry Sector

Lebanon is a highly mountainous country with extreme variability in climatic conditions, soils and socio-economic status. Forests in Lebanon are very particular in their variation and characteristics as they represent a unique feature in the arid environment of the Eastern Mediterranean. Natural ecosystems in Lebanon and particularly forests are under various pressures most of which are landscape and habitat fragmentation, changes in land use, unorganized urban sprawl, forest fires and pest outbreaks. Many species have either disappeared or are endangered because of the different threats on their habitats (Asmar, 2005; AFDC, 2007). In view of this existing pressure on natural ecosystems, future expected climate change will mainly exacerbate their consequences.

4.7.1 Methodology

Scope of Assessment

The assessment focuses only on the forestry sector, particularly forest types that are most sensitive to climate change as identified by stakeholders during the scoping phase. The temporal scope of the assessment extends over the entire year, since forest vulnerability depends on both temperature increase (summer) and precipitation (winter). The year 2004 is taken as a baseline year, and projections are made until 2030, i.e., over a time frame of around 25 years.

Climatic factors

Temperature increase is an important factor affecting forest growth and survival. In addition, water availability which results from rainfall, snowfall in mountains and the soil's capacity to store water are considered as the most relevant parameters to the forestry sector, especially during critical phases such as spring and early autumn.

Mediterranean vegetation and specifically Mediterranean forests have adapted to prevailing climatic constraints and are typically represented by clear altitudinal leveling: the vegetation levels. In Lebanon, vegetation levels have been described and illustrated in the phyto-association map published by Abi Saleh & Safi (1988), in which 10 vegetation levels can be clearly distinguished with respect to altitude (Figure 4-39). These vegetation levels derive from the "Quotient pluviothermique" of Emberger (Quezel,1976), which reflect the tolerance of species within a range of precipitation, mean maximum

Table 4-10 Adaptation Action Plan for the costal Zones Sector

Impact	Proposed Adaptation Strategy	Activities
Increase in the salinity of coastal groundwater wells	Increase the resilience of groundwater to climate change in coastal areas	- Assess feasibility of artificial groundwater recharge in major coastal areas - Strengthen the capacity of water and wastewater establishments to monitor groundwater abstraction - Develop awareness programs to reduce water consumption in vulnerable areas
Decrease in the income from coastal economic activities, mainly fishing, agriculture and small tourism enterprises (coastal resorts) due to flooding and inundation	Increase the protective capacity of vulnerable coastal areas	- Identify/confirm vulnerable economic activities along the coast - Design soft and hard measures to protect vulnerable areas
	Increase resilience of small holders to be able to adapt to climate change impacts	- Improve access to information by developing a database for national indicators and establishing monitoring systems for coastal zone indicators, such as sea water temperature, sea water level, monitoring of high tidal waves and frequency and intensity of storm surges - Develop of financing mechanisms to support small holders
	Establish an institutional mechanism to follow up on coastal zone impacts from climate change	- Initiate dialogue between MoWT, MoE, MoA, syndicate of fishermen, municipalities, etc. - Set up task force committee to coordinate adaptation efforts
Increase in the cost of beach erosion and degradation and loss of coastal habitats	Increase resilience of natural/historical coastal areas to climate change impacts	- Enforce coastal land use plan defined by CDR in the NPMPLT to ensure a sufficient buffer zone - Develop a management plan for key natural/historical sites taking into consideration climate change impacts - Set up an institutional mechanism to protect the remarkable sites

temperature of the hottest month and mean minimum temperature of the coldest month.

Methods of Assessment

In order to better assess the expected impact of climate variability on vulnerable forest hot spots in Lebanon, the following approach was adopted:

- Overlaying the derived forest map (MoA and FAO, 2005b) on the grid map of Lebanon (25 km x 25 km);
- Identifying for each grid the dominant forest type (current - for the period 1960-2000), and the Quotient of Emberger (Q), for the periods 1961-1980; 2025-2044; and 2080-2098;
- Selecting the most vulnerable forest types with respect to Q, and their ability to withstand future climate change; i.e., the forest types were designated as “most vulnerable” when the shift in bioclimatic level would overbear the tolerance of the forest type with reference to climagramme of Emberger for Lebanon (Abi Saleh et al., 1996);
- Assessing the impact on vulnerable forest types with respect to the expected change in Q and therefore in the bioclimatic condition and the ability of the ecosystem (valence écologique) to cope with the projected change (Figure 4-40);
- Assessing for each forest type the margin of tolerance with respect to temperature and rainfall in reference to Table 4-11 adapted from Quezel (1976), Abi Saleh (1978) and M’Hirit(1999);
- Highlighting grids where the shift in bioclimatic level (Table 4-11) surpasses the ecological tolerance of the dominant forest type. In this case, the selected grids show the location of the most vulnerable forest types that would be most impacted by climate change. They represent grids where the

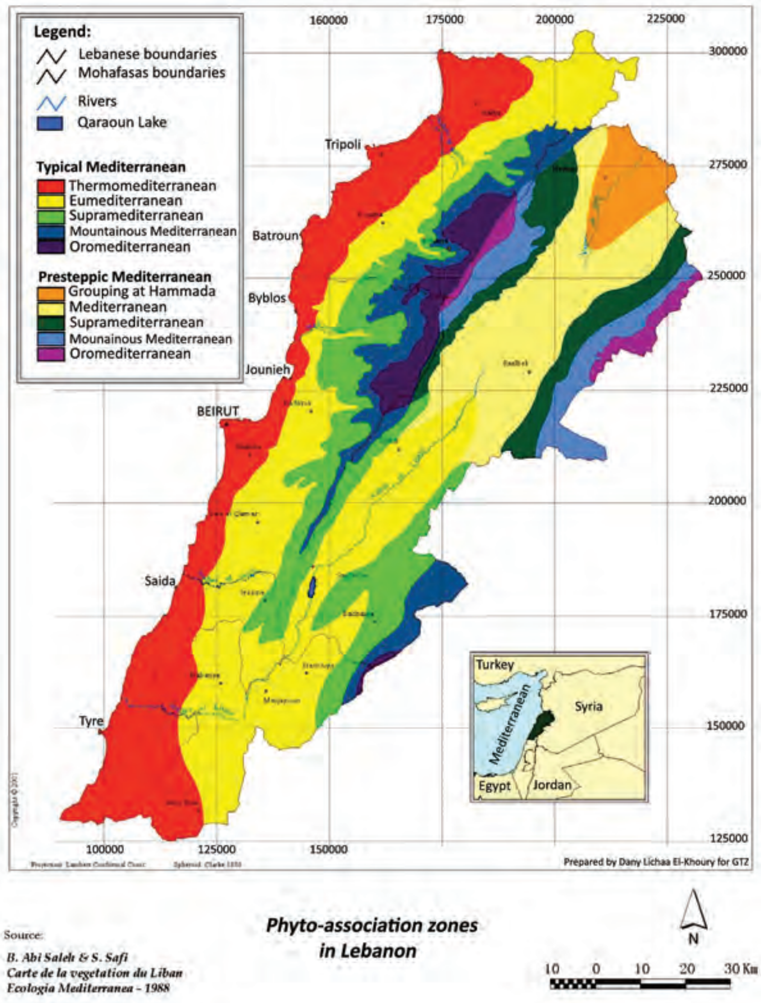

Figure 4-39 Phyto-association zones in Lebanon
Source: Abi Saleh and Safi, 1988

shift in bioclimatic level will be from humid or sub-humid to semi-arid, and subsequently areas where the survival of the species will be challenged (Figure 4-41);

- In order to represent a geophysical continuous distribution for the Q factor over Lebanon, a GIS spatial prediction method (Kriging) is used. Accordingly, the future potential presence of forest types with regard to the projected changes in climatic factors is mapped using ArcGIS facilities.

Assessing future response of forest to expected climate change holds an important number of uncertainties and assumptions because Mediterranean forests are already adapted to adverse climatic conditions and sustained human pressure, the response of natural ecosystems is multi-factorial and does not only respond to climatic parameter and forests need a very long term to react to climate variability (more than 50 - 100 years). The major assumptions in the assessment are the consideration that forests will shift to adapt with climatic variation and that the policies and strategies that are currently in place will be on the course of implementation by 2030.

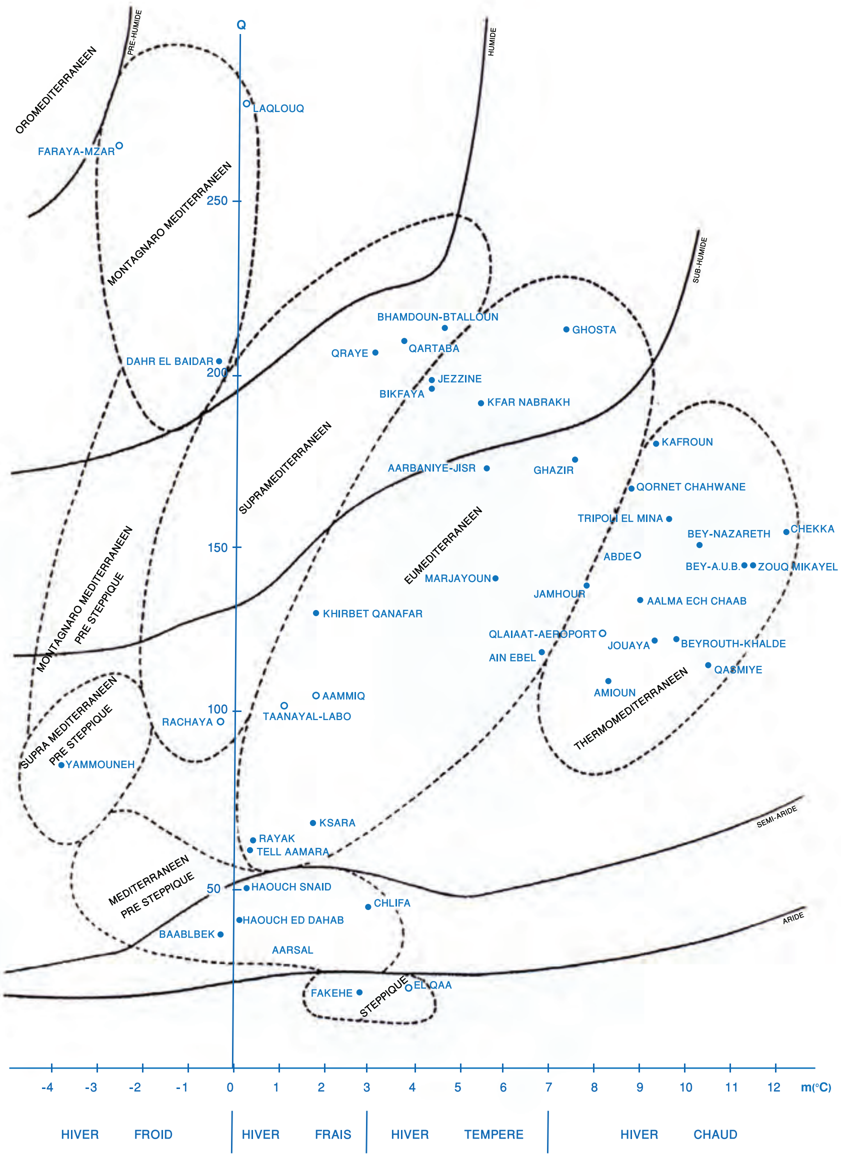

Figure 4-40 Distribution of bioclimatic levels in Lebanon with respect to Emberger Quotient
Source: Abi Saleh et al., 1996

Table 4-11 Forest types' tolerance to precipitation variability in Lebanon

Bioclimatic level	Climate and vegetation level		
	Precipitation (mm)	Variability tolerated (%)	Dominant forest type
Semi-arid (Thermomediterranean)	300 <P<600	25-50%	*Pinus halepensis, Quercus calliprinos; Ceratonia siliqua; Pistacia lentiscus*
Subhumid (Eumediterranean)	600<P<800	10-25%	*Pinus pinea ; Pinus brutia ; Quercus calliprinos, Cupressus sempervirens*
Humid (Supramediterranean Mountainous Mediterranean)	P>800	10-25%	*Quercus spp. ; Cedrus libani, Abies cilicica*
Perhumid (Oromediterranean)	P>500	10-25%	*Juniperus excelsa*

Source: adapted from Quezel (1976), Abi Saleh (1978) and M'Hirit (1999)

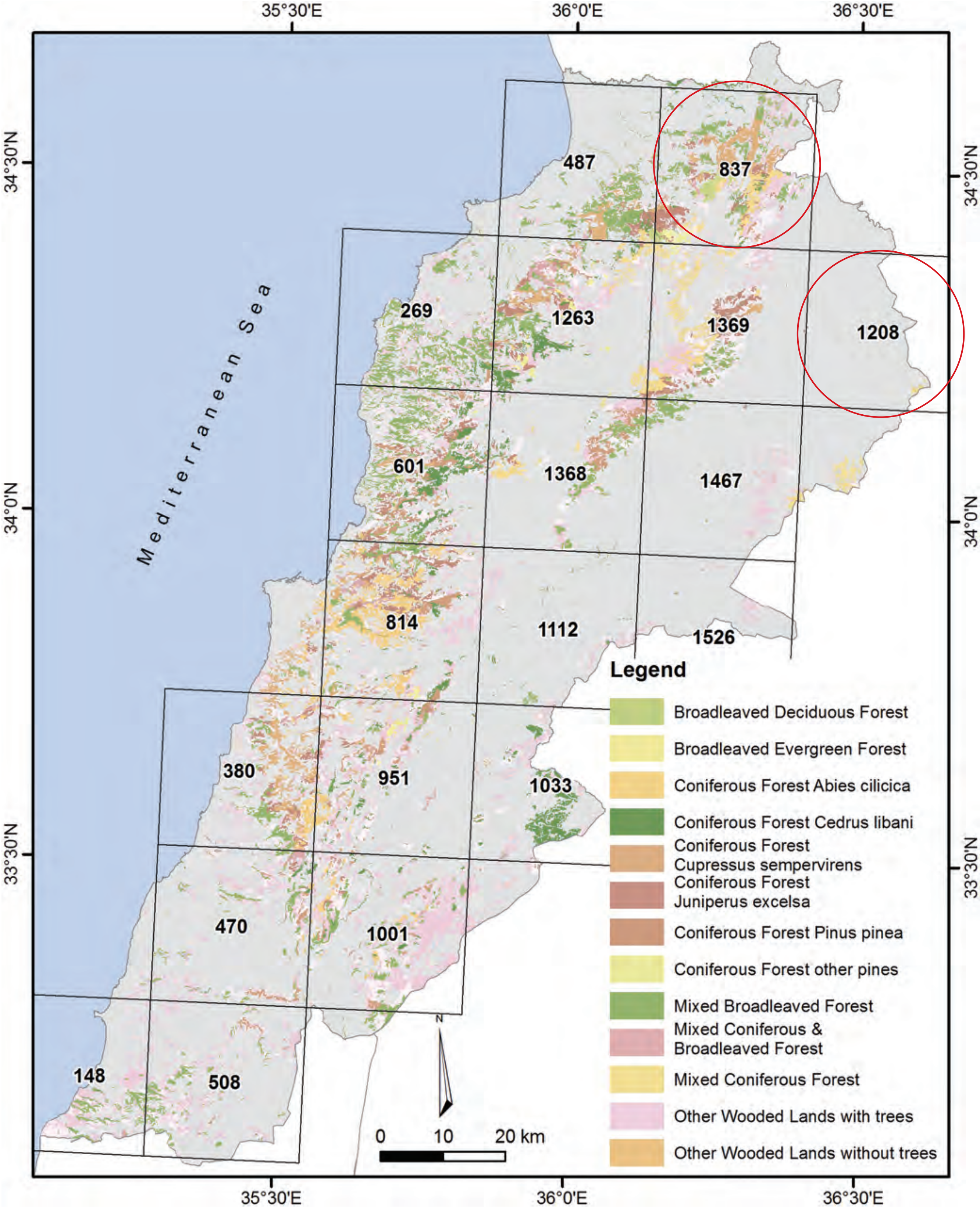

Figure 4-41 Areas (encircled) expected to be most impacted by climatic factors

Policies and strategies

Several public institutions are involved in forestry-related activities, namely the MoE and MoA, who are launching initiatives to save the natural patrimony and promote protection and proper management of natural resources. The MoE through its National Reforestation Plan has increased the surface area of forests by around 600 ha from 2001 to 2007 and is currently developing a strategy for safeguarding and restoring Lebanon's woodland resources, as a follow-up on the National Reforestation Plan. MoE has also prepared in 2009 the National Strategy for Forest Fire Management with AFDC and IUCN and in cooperation with other line ministries. In Parallel MoA has set its own priorities and strategies for forests and forestry until the year 2020 which include the application of a "natural management" approach and a global sustainable development plan through forest plantation and reduction of forests exploitation, the implementation of modern multidisciplinary management tools, and the creation of a forest research and the development of an independent forest authority.

Development of the sector under socio-economic scenarios

Under scenario A, forest development will replace abandoned agricultural lands. The expected rural migration under this scenario might benefit forest stands as pressure (illegal logging, over grazing/ undergrazing, unsustainable harvesting, collection of medicinal and aromatic plants) on existing forests will be reduced. Non-wood forest products resulting from agro-forestry products (such as pine nuts, carob pods and honey, etc.) might be negatively affected due to the lack of labor, open market strategies and absence of agro-forestry policies. Law enforcement and the increased awareness of the recreational value of forests will lead to a better interest in ecotourism and nature-based activities, as well as in the value and associated services such as landscape and biodiversity. The risk from forest fires will probably decrease with the adoption of improved and innovative integrated management practices (improved fire fighting techniques, pre- and post-fire management, sustainable grazing within forest areas, etc).

Under scenario B, an increase in forest fragmentation is expected due to urban sprawl. Decrease in forest resources, soil degradation, desertification, loss of biodiversity, forest fires, pests and insects outbreaks and a severe decrease in land's productivity will result from an increase in the demand for fuel wood, and from unsustainable practices such as intensive agricultural production, absence of land use planning, urbanization of rural area etc. The loss of economic value of existing forests (non-wood forest products) will probably result from the lack of awareness of the value of forests and the lack of labor.

4.7.2 Vulnerability assessment

Various uncertainties exist on the extent and speed at which climate change will impact biodiversity and ecosystem services, as well as the thresholds of climate change above which ecosystems are irreversibly changed and no longer function in their current form. Therefore, there is a strong need to measure and model adequately land surface fluxes, soil moisture and vegetation dynamics for a sufficiently long time, including years characterized by different hydro-meteorological conditions, before being able to properly assess the effects of climate change on forest ecosystems.

The adaptive capacity of a forest ecosystem to changing environmental conditions is determined by its size, biological and ecological diversity, as well as by the condition and character of the surrounding landscape. Species migration as a response to climate change is not "new" as analysis of pollen deposits in sediments and vegetation macrorests have shown pronounced and sometimes rapid response (sometimes in less than 20 years) of terrestrial vegetation to past climatic changes, with sudden collapse of a number of species and the rapid expansion of others. However, species migration may not be fast enough to cover dispersal requirements under the predicted rate of climate change (Tinner and Lotter, 2001). The assessment of the adaptive capacity of different forest types in Lebanon, in terms of the impact of climate variability, socio economic importance, resilience to forest fires and pest attacks, ability to migrate upward, and the resources needed to adapt to climate change, reveal that the upper zone coniferous forests (*Cedrus libani; Abies cilicica*) and high mountain formations (*Juniperus excelsa*) have the lowest natural adaptive capacity to current and future trends (Table 4-12).

Various threats and in particular landscape fragmentation, have increased vulnerability of natural patches to various pressures and are seriously challenging their resilience and adaptive capacity. In view of existing pressure on natural ecosystems (whether forested or non-forested) future expected climate change will mainly exacerbate

Table 4-12 Vulnerable hotspots in the Forestry sector

System	Sensitivity to climate change	Root cause	Natural Adaptive capacity	Overall vulnerability
Juniperus excelsa	Very high	Absence of effective protection, pressure of overgrazing and the demanding physiological requirements for regeneration	Low	Very High
Cedrus libani	High	Forest fragmentation and the location of forest stands on mountain crestline, which limits their ability the migrate upwards	Low-Moderate	High
Abies cilicica	High	Absence of pure fir stands, forest fragmentation and illegal logging	Low	High
Quercus cerris, Fraxinus ornus & Ostrya carpinifolia	High	Limited geographical extent and forest fragmentation	Low	High

their consequences. Some of the major threats on terrestrial biodiversity can be summarized as follows:

Forest Fires: Forest fires constitute a serious threat on the vegetation cover and influence the decline of Lebanese forests. Forest fire prone areas in Lebanon are usually near urban complexes and below an altitude of 1,200 m and encompass three main forest types: broadleaved forests (mainly *Quercus spp*.), *P. pinea* and *P. brutia* pine forests (Masri et al., 2006). The forest sector will have to face the impact of increased frequency and higher periodicity of fire events due to increased drought periods and the replacement of forest stands with fire prone shrub communities (Figure 4-42). High mountain forest stands (*Cedrus libani*, *Abies cilicica* and *Juniperus excelsa*) are considered little vulnerable to fire occurrence due to humid bioclimates. However, the *Juniperus* stands are already very vulnerable stands because of various pressures occurring in their habitats (drought, overgrazing), and consequently any shift in bioclimatic level might seriously jeopardize their ability to face eventual fire events. As for Pinus halepensis, since most stands are on sloping lands and usually develop dense understory, their vulnerability to fire is considered moderate to high and inversely their potential resilience to fire events is considered varies from low to moderate.

Ecosystem fragmentation and land use changes: Urban expansion and road network development, human intervention by logging and overgrazing activities are the serious causes of ecosystem fragmentation in Lebanon where forests have been broken into isolated small pieces that are more susceptible to external disturbances. The number of forest patches on the eastern flank of Mount Lebanon has increased from 131 to 730 patches between 1965 and 1998. With the disappearance of the forest cover, rock outcrops have appeared within patches due to soil erosion. Almost 50% of the total forest cover has been lost in 33 years, mainly affecting juniper stands (Jomaa et al., 2007). In addition, the important fragmentation of forests and natural habitats is also seriously challenging the migration of the cedars forest upward or northward, especially that most of existing stands are already present at the mountain peak line (Hajar et al., 2010).

Pest attacks: Increased levels of CO_2 in the atmosphere prompt an increase in the C/N balance of plant tissues, which in turn results in a lower food quality for many defoliating insects which sometimes respond by increasing the level of leaf consumption and consequently damage trees. In addition, an increase in temperature may alter the mechanism by which the insects adjust their cycles to the local climate (diapause), resulting in faster development and a higher feeding rate. This has already been witnessed in Lebanon with the attack of Cedar stands in Tannourine forest by *Cephalcia tannourinensis*, an outbreak that has been closely correlated to the length of the snow cover period over the last

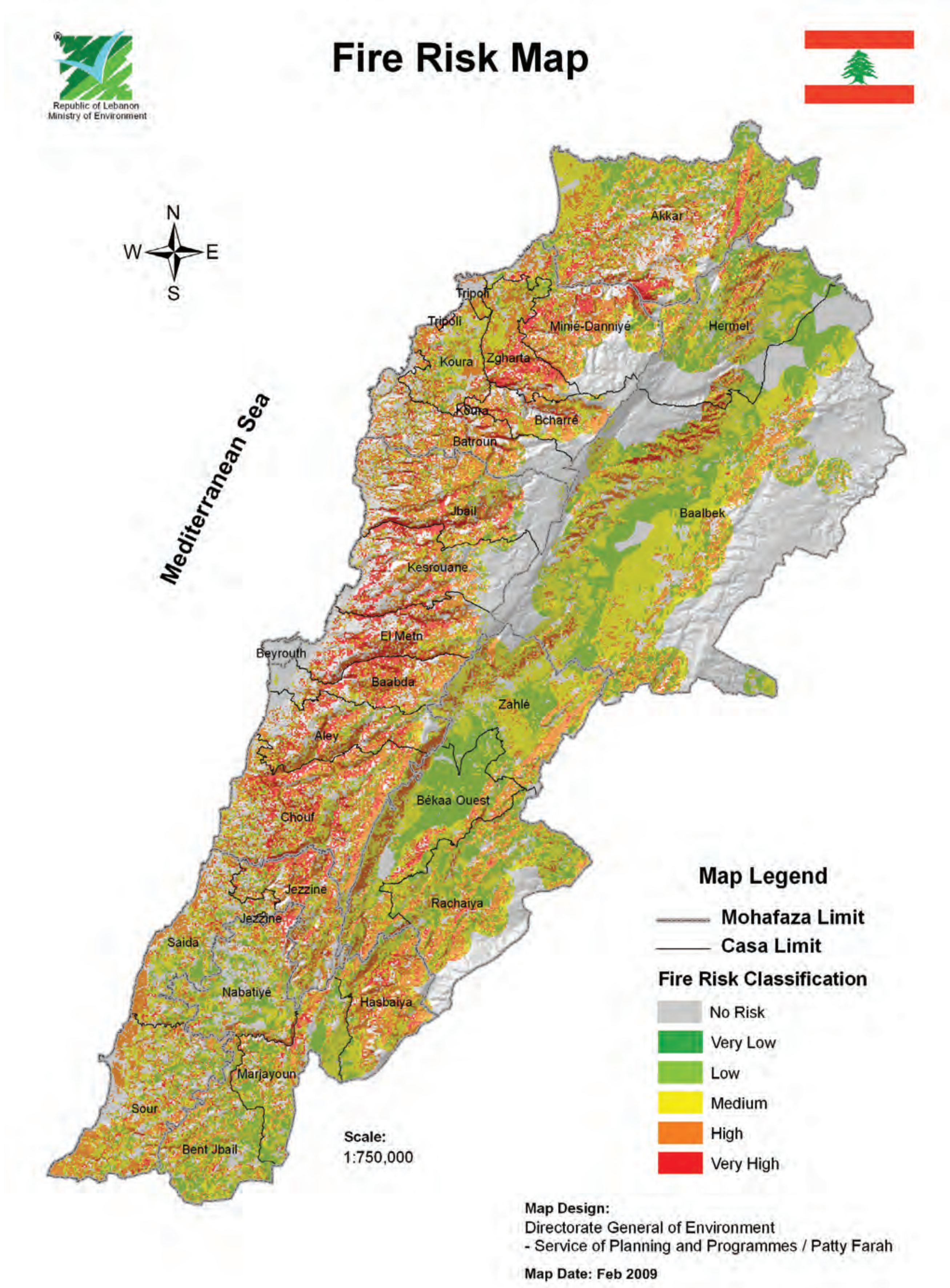

Figure 4-42 Forest fires risk map

decade (Nemer and Nasr, 2004). While pests on cedar forests have been studied, little is known about the pest attacks on junipers and firs.

Quarries: Between 1996 and 2005, the number of quarries increased from 711 to 1,278 with a simultaneous increase of quarried land from 2,875 to 195,283 ha. The majority of quarries in Lebanon are developed with no consideration for their environmental impact, thus causing the destruction of vegetation and important natural habitats and the permanent loss of biodiversity and natural resources, especially that 25% of existing quarries developed within forested land (Darwish et al., 2008; AFDC, 2007).

Grazing: The decline of grazing activities during the past decades has favoured uncontrolled development of forest understory which in turn has resulted in an increased fire risk on forests. The conservative policies (Law 558/1997: Forest code) aggravated the situation as grazing has been prohibited in forested areas, which increased the overgrazing pressure on OWL.

4.7.3 Impact assessment

The expected changes in temperature and rainfall are expected to be accompanied by a significant change in bioclimatic levels in Lebanon, particularly their geographical extent in terms of percent of total cover. The Oromediterranean level is projected to disappear from Lebanon by 2080, while the Arid bioclimatic level is expected to increase from 5 to 15 % in area (MoE et al., 1999; UNEP-MAP, 2009). In addition to the need for the species to migrate upward/northward, other impacts on forests in Lebanon related to climate change could be expected as follows:

- The need for trees to physiologically adapt to pollinators' appearance and adequacy with their blooming period;
- Reduced migration and dispersal opportunities with increased landscape fragmentation
- Slower tree growth increments;
- Increased forest dieback as a result of temperature rise and reduction of precipitation rate, which might severely limit the gross primary production of forests. During dry periods with extremely low annual rainfall, the respiratory cost is compensated by using the mobile carbohydrates stored in the plants. Once this pool has been used up, the visible symptoms of dieback become evident;
- Increased invasiveness of alien species. The number of alien species in the Mediterranean region has grown considerably during the last decades, but to date no relevant study has been conducted in Lebanon to assess the risk related to invasive species;
- Increased recrudescence of pest outbreaks.

All forests in Lebanon deserve attention and investment; however, based on the above analysis, Figure 4-41 confirms that the most vulnerable forest stands which are expected to be the most impacted by climate change are located in north Lebanon (Akkar) and in Hermel areas, due to the shift from sub-humid to semi-arid bioclimatic level (Table 4-13). Adaptation efforts should therefore target those areas in priority.

As *Cedrus libani* is highlighted as one of the most vulnerable species to climate change in Lebanon and as Tannourine and Arz el Chouf nature reserves are mainly composed of cedar forests, it is expected that both of these nature reserves will severely be impacted by climate change. As for Horsh Ehden, which hosts diverse tree communities, the most important of which are *Cedrus libani*, *Abies cilicica* and *Juniperus excelsa*, it will also be impacted by climate change, but the presence of other species such as *Malus trilobata* make it less vulnerable than Tannourine and Horsh Ehden nature reserves.

The identified impacts are expected to be more significant under scenario B where they will be complicated by non-climatic and anthropogenic pressures; while under scenario A, with increased awareness of the value of forests and the participation of civil society in forest protection, the impacts would be attenuated.

4.7.4 Adaptation measures

As forest resilience refers to the capacity of a forest to withstand and absorb changes in the environment, adaptation will imply understanding and influencing these conditions to increase forest resilience (Regato, 2008), with the overall perspective of increasing and conserving forest ecosystem services. However, since the forestry sector is considered as a sink and a vulnerable sector, many measures proposed for mitigation (to increase carbon sequestration) can be applied for adaptation. Additional measures could be recommended to assist the natural resilience of forests, anticipate future changes and promote landscape scale in the adaptation options.

Table 4-13 Changes in Q and in bioclimatic levels for the different forest types in Lebanon from 1960 - 1981 to 2080 - 2098

Grid box	Dominant forest type	Av Q1 1960-1981	Bioclimatic level	Av Q2 2020-2044	Bioclimatic level	Av Q3 2080-2098	Bioclimatic level
148	*Quercus spp.*	150	Humid	120	Humid	105	Humid
269	*Quercus, mixed pinus*	165	Humid	150	Humid	90	Sub-humid
380	*Quercus, Pinus pinea and Pinus brutia*	240	Humid	150	Humid	90	Sub-humid
487	*Juniperus, Quercus*	90	Sub-humid	90	Sub-humid	60	Sub-humid
837	*Juniperus, Cedrus, Abies, Mixed Quercus/ Pinus*	75	Sub-humid	75	Sub-humid	45	Semi-arid
951	*Juniperus, Quercus and Pinus brutia*	345	Perhumid	195	Humid	120	Humid
1001	*Quercus, Pinus brutia*	225	Humid	120	Humid	90	Sub-humid
1112	*Quercus*	404	Perhumid	330	Perhumid	180	Humid
1208	*Juniperus*	75	Sub-humid	49	Semi-arid	34	Semi-arid
1368	*Cedrus, mixed Juniperus and Quercus*	315	Perhumid	255	Perhumid	135	Humid
1526	*Juniperus*	240	Humid	195	Humid	120	Humid

Highlighted rows (grid box 837 and 1208) indicate the grid boxes where the shift in bioclimatic level is mostly significant for species survival.

Table 4-14 below shows the major physical impacts corresponding to the vulnerable hotspots and the proposed adaptation action plan for the forestry sector. Each of the mentioned activities requires an in-depth assessment to determine its actual cost at the time of planning and implementation. In addition, legal and regulatory measures as well as financial and economic incentives are needed to implement the proposed activities.

The cost of vulnerability and adaptation in natural ecosystems is inherently problematic. The Lebanese government spends on nature conservation around USD 300,000 per year, mainly dedicated for the management of nature reserves, while the action plan for protected areas has foreseen a sum of USD 4,685,000 over 5 years (MoE, 2006) to encompass ecological conservation, extension of protected areas, diversification of protected area types as well as awareness, institutional capacity building and ecotourism promotion. This action plan aims to reduce the threat form habitat fragmentation and the vulnerability of ecosystems and species to the pressures of climate change. This cost, considered as vulnerability and adaptation costs, is underestimated as the adaptation activities adopted to reduce the vulnerability of species and ecosystems should account for different extra actions needed such as land acquisition for corridors and the fluctuation of land prices with time. It should also include the costs of pest management to fight pest infestation resulting from climate change implications on nature reserves in Lebanon.

Table 4-14 Forestry adaptation action plan

Impact	Proposed Adaptation Strategy	Activities
Decrease in the regeneration rate, population rate and overall area for the most vulnerable species identified: *Juniperus excelsa* *Cedrus libani* *Abies cilicica* *Quercus cerris* *Fraxinus ornus, Ostrya carpinifolia*	Strengthen the legal and institutional framework to integrate climate change needs	Revise protected areas legislation: - To broaden the classification system to account for and orient existing land use practices related to natural resources use, grazing, wood cutting, etc. - To include natural parks and protected landscapes - To base local classification systems on international systems (e.g., cultural heritage sites) Amend the forest code to allow controlled pruning, wood harvesting and grazing as means of conservation in forest ecosystems Revise construction law to ensure protection of sensitive ecosystems Revise Urban Development Code to request a strategic environmental assessment study on every development plan, which should properly take into consideration the sensitivity of vulnerable ecosystems Expand protected areas (in number and areas) to include more sensitive habitats and more vegetation/bioclimatic zones Mainstream biodiversity conservation and ecosystem management in policy making and legislation development related to quarrying, construction, water use, education, etc. Revise relevant legislation to reduce non-climatic stresses on forests: fragmentation, pollution, habitat loss Encourage private initiatives promoting forest protection and sustainable use of forest resources Reduce habitat fragmentation through controlled monitoring of urban expansion with respect to forested ecosystems, and through planning of natural corridors, especially towards promoting the development of OWL into forested cover Initiate the creation of an official forest body as an independent and unique unit with special mandates on forest conservation and sustainable use. This body should coordinate with MoA and MoE
	Integration of climate change and landscape levels planning in local/ regional development plans in Lebanon	Higher Council for Urban Planning should endorse urban planning guidelines that require due consideration of climate change and landscape levels in urban planning, including the following requirements: - Maintain and restore connectivity within the landscape - Plan for fire smart landscapes, i.e., include easier access to forests with water points; water pipes around and across vulnerable fire spots, fires breaks across vulnerable forest spots, in order to deal more efficiently with increased fire intensity and frequency Enhance the ability of species to move and migrate within their climatic envelops. through: - Planning the extension of existing protected areas to cover higher altitudes in order to facilitate tree line migration

		- Promoting the protection of existing OWL to enable their future development into forest cover - Promoting landscape connectivity in terms of natural corridors between forests and OWL Emulate long distance dispersal through habitat restoration Diversify habitat type, forest types and land uses at landscape level Modify existing legislation to increase buffer zones around protected areas and to minimize the impact of future climate change
	Strengthen the awareness and education and support research	Increase awareness on ecosystem services and climate change to key target groups such as government agencies, order of engineers and architects, universities (introduction of related courses), schools (revision of curriculum) Collect, conserve and disseminate traditional and local knowledge, innovations and practices related to biodiversity conservation Promote research and implementation of soil conservation, as soil carbon not only constitutes a carbon sink, but also improves site productivity Promote and inform on forest ecosystems services
	Develop forest management plans	Prepare management plans for the most vulnerable ecosystems to climate change, with due consideration to the following needs: - Implement effective fire management strategies through forest management - Adopt an ecosystem/community philosophy for reforestation activities: tree and understory species should be reintroduced on carefully planned sites - Explore and cultivate drought tolerant ecotypes (when needed) - Increase genetic, species and landscape diversity within the limits of ecological composition (vegetation series) - Establish collections of seeds for the main forest tree species and understory species (seed/gene banks) - Establish natural and ecological corridors to promote protected areas networks - Adopt effective land management practices, such as sustainable grazing, to prevent large reductions in ground cover - Conserve and/or restore biotic dispersal vectors: birds, insects, and migratory species - Plan reforestation activities including future migration anticipation