COST action FP 0703 – ECHOES

Expected Climate Change and Options for European Silviculture

DRAFT Country Report

CYPRUS

Forestry Department

Ministry of Agriculture, Natural Resources and Environment

Cyprus

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INTRODUCTION

The aim of this report is to present the situation of climate change and forestry in Cyprus. Furthermore it could be used as a source of facts and ideas regarding climate change and the overall situation in a typical Mediterranean country.

Cyprus is the third largest island of the Mediterranean with a total area of 9.251 km ^{2} and is situated at the north-eastern end of the Mediterranean basin. The longitude of Cyprus is 33°20'' east and the latitude is 35°12'' north.

In relation to its size, Cyprus has one of the richest floras in the Mediterranean region (a total of 1907 taxa were recorded from which the 7% are endemic to the island). This is due to a number of factors, including its geographic location (situated at the boundary of tree continents), its insular character, the surrounding sea and the topographical configuration. Extensive plains, mountain masses, wetlands, coasts, sand dunes, gorges and cliffs provide a home for many indigenous and endemic species.

Geomorphologically, Cyprus lies in a mountainous terrain composed by two mountain ranges, the Troodos and Pendadactylos and the alluvial plains of Mesaoria between the two ranges. The highest peak is Olympus at the Troodos Range with an altitude of 1952 m.

An 18,55% of the island is covered by forests which are very important because of their direct and indirect use values. Forests in Cyprus are mainly covered by Pinus species, the endemic Cedar and the riparian vegetation of the oriental plane and alder. Maquis cover the 13,63% and are defined as areas covered mainly by sclerophyllous evergreen shrubs (2-5m height) such as Quercus alnifolia, Quercus coccifera, Arbutus ssp. Pistacia ssp, Laurus nobilis, Myrtus communis, Olea europea and Juniperus spp. Phrygana cover the 9,49% and are defined as areas covered by lower shrubs such as the Cistus spp, Thymus capitatus, Sarcopoterium spinosum and Salvia fruticosa.

Phrygana Maquis Forest

The lead agency is the Forestry Department, responsible for the formulation of policy, legal framework and the actual management of state forest resources. Private forests

are not managed to a great extent and actually the private forestry sector is insignificant.

CLASS	State Forest Land		Private and other state land (hali-land)		TOTAL	
	Area (hectares)	Percentage %	Area (hectares)	Percentage %	Area (hectares)	Percentage %
FOREST	105 801	11.44%	65 814	7.11%	171 615	18.55%
MAQUIS	35 771	3.87%	90 319	9.76%	126 090	13.63%
GARIGUE	14 969	1.62%	72 800	7.87%	87 769	9.49%
TOTAL	156 541	16.92%	228933	24.75%	385 474	41.67%

Table 1: Classification of natural vegetation according to FRA 2010 – Country Report, Cyprus

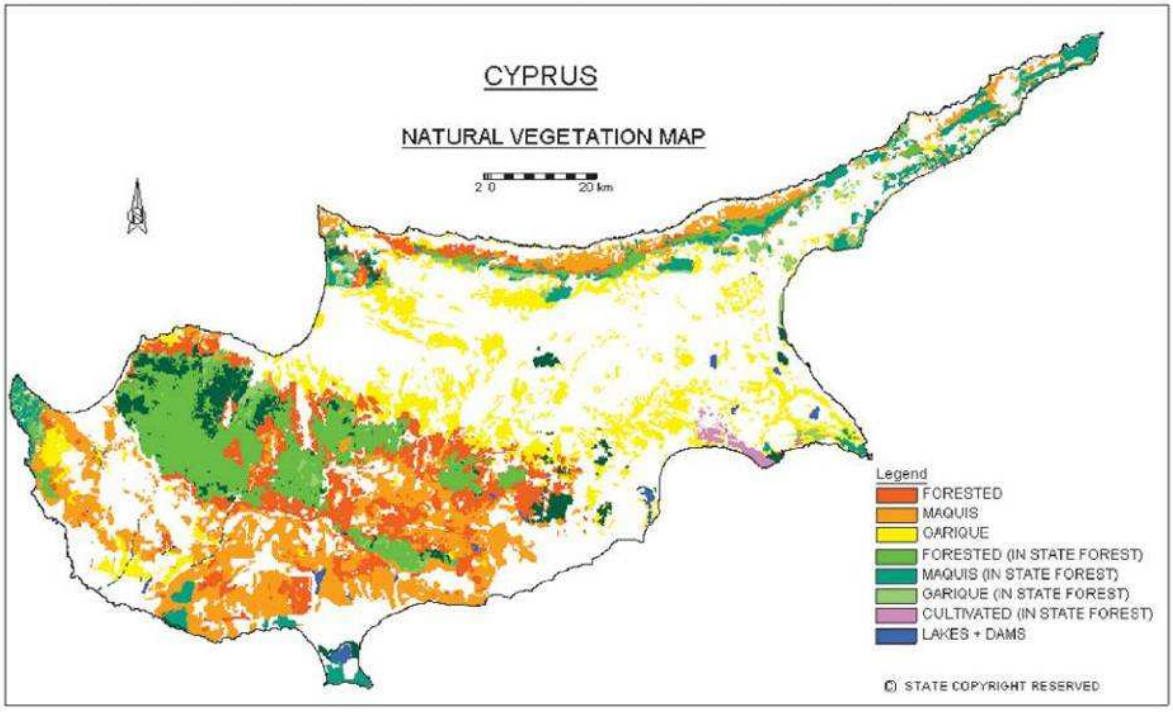

Figure 1: Cyprus natural vegetation map

Climate

Cyprus has an intense Mediterranean climate with strong seasonal characteristics with respect to weather, temperature and rainfall. Hot dry summers from mid-May to mid-September and rainy, rather changeable winters from November to mid-March are separated by short autumn and spring seasons with rapid changes in weather conditions. Generally, summer is a season of high temperatures and almost negligible rainfall.

Rainfall

Rainfall is geographically unevenly distributed, greatly determined by the island's pattern of relief, with maximum precipitation falling on the island's two mountainous masses and minimum precipitation observed in the eastern plain and the coastal areas. The average annual total precipitation increases from approximately 450 millimetres in the southwestern windward slopes to nearly 1100 millimetres at the top of the central Troodos massif. Snowfall is usually restricted to altitudes above 1000 meters.

Rainfall in the warmer months contributes little or nothing to water resources and agriculture. The small amounts that fall are rapidly absorbed by the very dry soil and soon evaporated in high temperatures and low humidities. The average rainfall for the year is about 480 millimetres, but it was as low as 213 millimetres in 1972/73 and as high as 800 millimetres in 1968/69. Statistical analysis of rainfall in Cyprus reveals a decreasing trend of rainfall amounts over the last decades.

Temperature

Like rainfall, temperature is also influenced by island's relief and the surrounding sea. Cyprus has hot summers and mild winters, and the seasonal difference between mid-summer and mid-winter temperatures is quite large at 18℃ inland and about 14 ℃ in coastal areas. In July and August the mean daily temperature ranges between 29 ℃ on the central plain and 22 ℃ on the Troodos mountains, while the average maximum temperature for these months ranges between 36℃ and 27℃ respectively. In January the mean daily temperature is 10℃ on the central plain and 3℃ on the higher parts of the Troodos mountains with an average minimum temperature of 5℃ and 0℃ respectively.

I. IMPACTS

The following part is dealing with observed changes in temperature and precipitation regime, observed (past, present) impacts on Cyprus forests, expected impacts, impact monitoring (NFI, Level I and II) and impact management (short term action plan against the drought effects in State Forests, measures taken direct after forest fires).

I.1 OBSERVED IMPACTS

A changing climate is affecting Cyprus forests in several ways, ranging from direct effects of temperature and precipitation on tree growth and water use, to altered fire regimes and changes in the range and severity of pest outbreaks. Along with soils, inclination, aspect, elevation climate determines what will grow where and how well. Changes in temperature and precipitation regimes therefore have the potential to dramatically affect forests therefore all the observed changes are presented bellow.

Temperature and Precipitation

During the 20th century remarkable variations and trends were observed in the climate of Cyprus, particularly in the two basic climatic parameters, precipitation and temperature. Specifically, the precipitation presented a decreasing trend and the temperature presented an increasing one. The rates of change were greater during the second half of the century. Over the last few decades the number of years presenting low precipitation and long standing droughts is greater than before and as a result the semi-arid conditions have deteriorated. Most of the warm years of the century were observed in the last 20 years.

The decrease in the amount of precipitation has been remarkable. While the average annual precipitation in the first 30 years of the century was 559 mm, the average precipitation in the last 30-year period was 463 mm, which corresponds to a decrease of 17% (see Figure 2). The rate of decrease in the average precipitation in Cyprus during the 20th century was 1 millimetre per year.

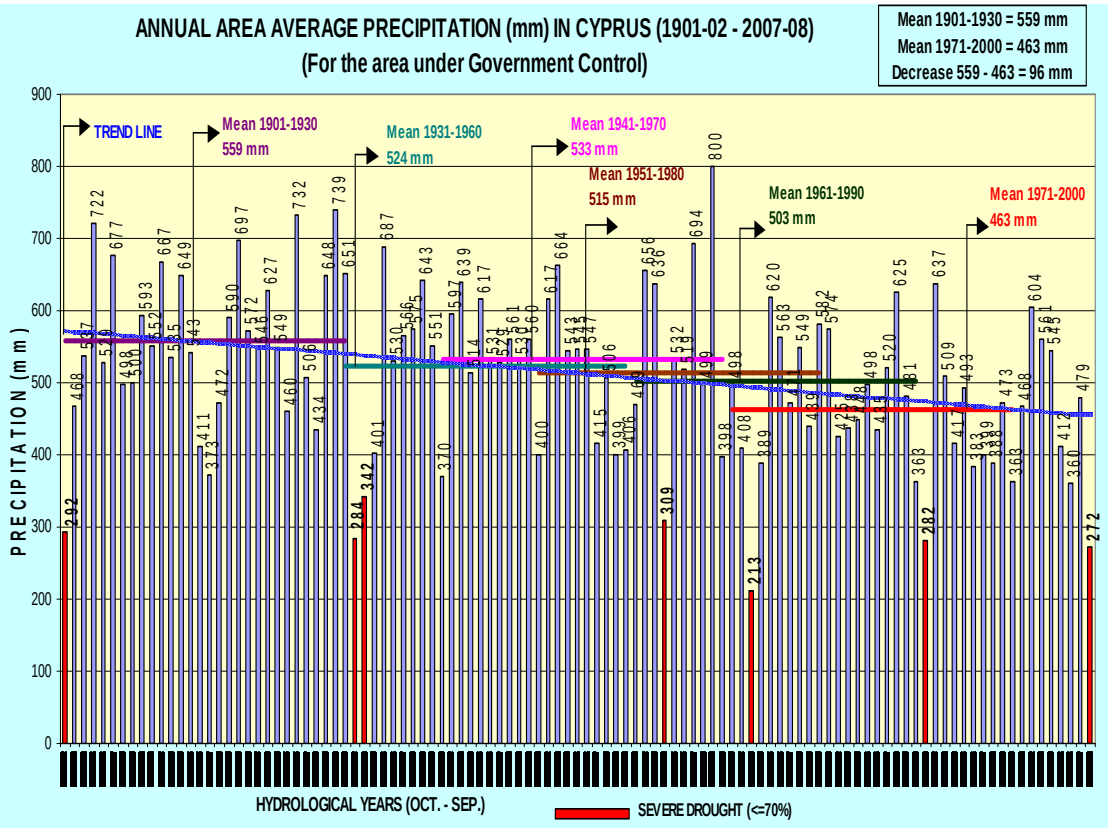

Figure 2: Annual area precipitation (mm) in Cyprus (1901-02 _ 2007-08) (Meteorological Service Cyprus)

On the other hand, the average annual temperature, both in urban and in rural areas, presented an increasing trend. The greater increase in temperature in the towns is due to the urbanization effect, however, the fact that an increase is also observed in

rural areas, is indicative of the general increase in temperature in the region as well as globally. In Nicosia the average annual temperature increased from 18.9℃ in the first 30-year period of the century to 19.7℃ in the last 30-year period, an increase of 0.8℃. Temperature in Cyprus during the 20th century followed a reverse trend than precipitation, with a rate of increase of 0.01℃ per year. This rise concerns more the minimal temperatures than the maximal.

Several models predict further changes in frequency, intensity, and duration of extreme events with more hot days, heat waves, less precipitation, heavy precipitation events and fewer cold days. **In Cyprus, rising temperatures and decreasing rainfall will lead to increased occurrence of drought periods, which are the main limiting factor to tree growth.**

The period 2005 - 2008 was extremely dry (see Figure 3) causing a lot of problems on the ecosystems of Cyprus, in particular those located at low elevations in the foothills of Troodos mountains. The immediate symptoms were the loss of needles and leaves, the desiccation of twigs for conifers and deciduous trees and sudden dieback of both young and mature trees. Maquis and garigue were also concerned by an intensive dieback. Even drought adapted, typical Mediterranean species like Quercus alnifolia, Cistus sp., Olea europaea, Arbutus andrachne died on poor sites.

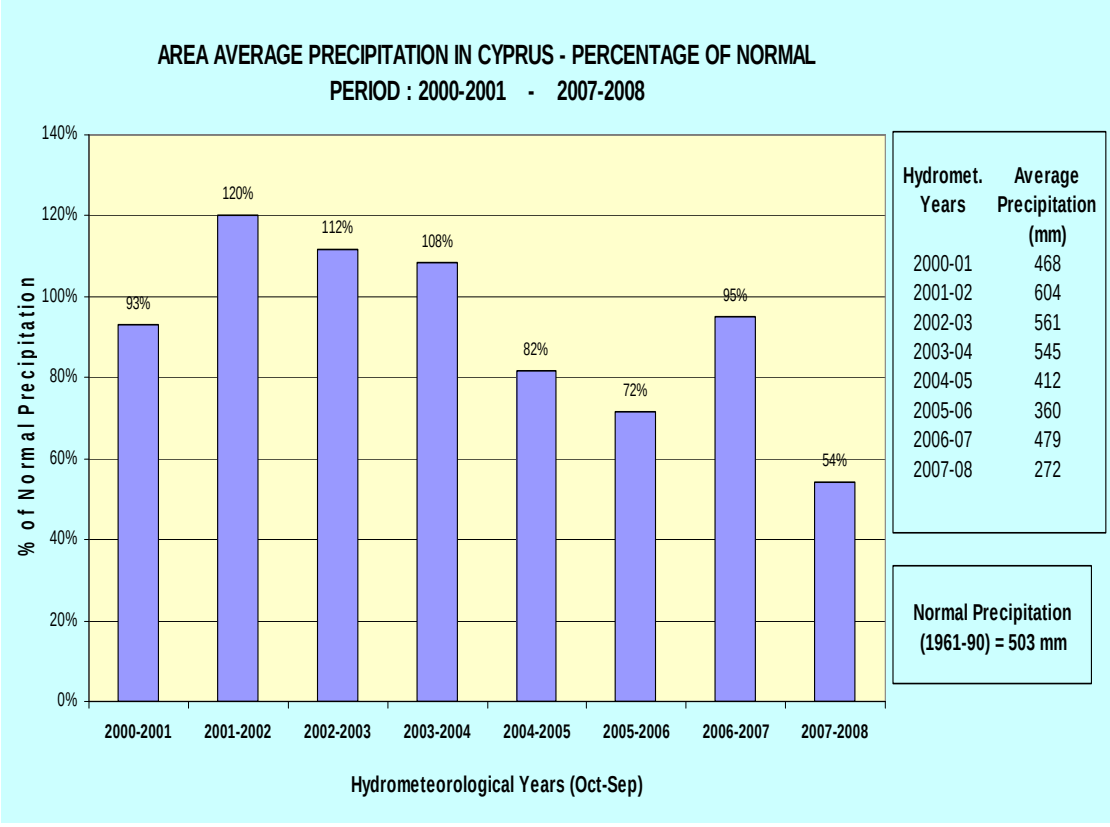

Figure 3: Percentage of normal precipitation for the period 2000-01 _ 2007-08 (Meteorological Service Cyprus)

The last months, many empirical observations were carried out in the state Forests. Diebacks were observed mainly at poor, steep and rocky sites where the water holding capacity of the soil was very small. Scattered dead trees and scrubs were also observed at all altitudes in all the different types of stands (age classes and admixtures). (see pictures 1 to 8 below)

The reasons for the sudden dieback are not totally elucidated but drought could be the major factor.

It was also observed that dead and dying trees were attacked by insects and pathogens. The observations on the population of insects showed that there was an increased number of Mediterranean pine engraver beetle (Orthotomicus erosus Wollaston), goldenhaired bark beetle (Hylurgus ligniperda Fabricius), pine shoot beetle (Tomicus piniperda Linnaeus) and longhorn beetle (Acanthocinus griseus Fabricius).

Picture 1: Dieback of Pinus brutia

Picture 2: Dieback of Pinus brutia

Picture 3: Dieback of Pinus brutia reforestations

Picture 4: Dieback of young and mature trees

Picture 5: Dieback of Pinus brutia reforestations

Picture 6: Intensive dieback of shrubs

Picture 7: Dieback of scattered Pinus brutia trees at low elevations in the foothills of Troodos mountains

Picture 8: Drought effects on the entire stand

The most immediate and obvious repercussion of climate change for Cyprus is the increase in fire hazard. Fire is the most important abiotic disturbance for the forest in Cyprus and its prevention and extinction is of upmost importance for the Forestry Department. It is predicted that the length of the season with fire risk will increase. The last years no changes in the total number of fires or the burned area were observed due to the fact that very good preventive management measures were adapted (creation of fire belts, forest roads for the inspection of forests and quick access, forestry telecommunications, fire lookout points and fire guard-houses, forest stations, etc.). Furthermore, a number of departments and local authorities are cooperating in an elaborate fire protection system covering all areas outside the state forests.

Cyprus has a high diversity of habitats and species, ranging from semi/desert habitats to peat grasslands, and pine and oak forests in the mountains. This diversity is boosted by a varying landscape and relative isolation, which has resulted in a high rate of endemic plants. Consequently has to be taken into account when studying climate change impacts as well as when implementing adaptation and mitigation action plans.

Most plants have adapted to survive and complete their biological functions within a certain range of temperatures and other climatic parameters. In general, many researchers point out that extreme temperatures determinate the distribution of a species and any change may induce changes to the floristic composition of an ecosystem. This observation creates questions for the future of several endemic species in Cyprus, which are growing in the limits of their natural spread. Fifteen endemic plants (*Acinos troodi, Cynoglossum troodi, Allysum troodi, Lactura tetrantha, Crypsis hadjikyriakou, etc*.) are growing at high altitude sites (above 1600 m) and they will not have the possibility to move upwards.

I.2 EXPECTED IMPACTS

Regarding the impact of climate change on non-wood forest products and services (recreation, etc.) little or no information is currently available. The effects of climate change on one social aspect of forests, forest-based recreation are complex. Some activities will witness a net benefit while others will suffer, depending on the type of activity, the seasonal nature of the activity, and the incidence of extreme weather events.

Drought and altered fire regimes will lead to more shrub dominated landscapes, especially in the coastal and low altitudes areas, increasing the risk of desertification.

Changes in climatic factors could increase the susceptibility of the high mountain pine zone (*Pinus nigra ssp. pallasiana)* to disturbances such as the pine processionary caterpillar *Thaumetopoea wilkinsonii Tams* and the bark beetle *Orthotomicus erosus.*

An upward shift of Pinus brutia tree line is expected, causing difficulties to the *Cedrus brevifolia* ecosystem. The current high mountain pine zone (*Pinus nigra ssp.*

pallasiana) will probably disappear and will be occupied by *Pinus brutia*. An accelerated upward movement of *Pinus brutia* may pose a major treat to many endemic species growing in Troodos mountains.

The experience of past droughts showed that the effects could persist during 3 to 7 years. More mortalities are expected during the next years either due to physiologic constraints on non favorable forest sites or insect outbreaks. The drought period 2005 - 2008 will seriously affect the growth for the next years (size of needles and leaves, desiccation of roots and branches, defoliation because of caterpillars) but also the natural regeneration (fructification).

I.3 IMPACT MONITORING

NFI - Level I and II

The main objective of forest inventories in Cyprus is to obtain qualitative and quantitative information about the forest resources and their physical environment for a specified time. Their main goal is to report the status of the forests with respect to volume and volume distribution by diameter class, volume increment, number of stems, regeneration, and expected changes and trends. Because of increasing multiple uses of forest resources in recent years, the inventory aims have been expanded to include collection of information that can be used to evaluate the potential of the forests for wildlife habitat and other uses.

The NFI provides information for national and international reporting to bodies such as the United Nations/FAO Forest Resources Assessment and the Ministerial Conference on the Protection of Forests in Europe (MCPFE). Also, the NFI provides information to estimate **carbon pools and biodiversity**.

In Cyprus the Continuous Forest Inventory is in application since 1981 (randomly selected circular units of 0,2 ha). It is applied in the productive State Forests only and has an interval of 10 years. The foremost aims of the first two inventories of the exploitable area were:

- To provide estimates of timber volume and other relevant statistics used in forest management planning;
- To provide data for calculation of annual allowable cut;
- To monitor forest changes and trends.

Field work for the third forest inventory (2001—2002) was augmented by collecting information on the ecology and environment of the productive areas as a means of monitoring ecosystem changes and trends.

In 1996, a forest inventory was conducted for Tripylos Nature Reserve in which the protected endemic species *Cedrus brevifolia* is distributed. The protected area covers an area of 823 ha. Stratified random sampling was applied with circular permanent sample plots of 0.1 ha. The main purposes of this inventory were to estimate the present state of *Cedrus brevifolia* and to establish a network of permanent sample plots for monitoring ecosystem changes and trends.

The Forestry Department has exclusive responsibility for forest inventories including planning the design, methods, field measurements, calculating estimates, and publications.

For the last five years, information gathered by the various forest inventories has been used either directly or indirectly to estimate carbon pools. In future forest inventories the field work will be augmented with the variables necessary to estimate parameters related to LULUCF under the United Nations Framework Convention on Climate Change.

Many forest variables assessed by the forest inventories are related indirectly to biodiversity such as diameter distribution, height distribution, age distribution and volume distribution as well as numbers of trees and regeneration. In addition, since 1995 information for the following variables were collected in order to broaden the forest biodiversity assessment.

- All shrubs found in a concentric circle with a radius of 10m from the center of the sample plot are recorded and the percentage of the crown cover of each shrub is estimated.
- The degree of crown cover of the main stand is estimated and recorded in one of the following classes: 0-30, 31-60 and 61-100%.
- Stand type is recorded and classified into one of two classes: pure or mixed. In mixed stands, neither the coniferous nor the broadleaf component accounts for more than 75 percent of tree crown cover.
- The stand origin is recorded as artificial or natural regeneration.
- Stand structure is recorded as even-aged, uneven-aged, or all-aged.
- The degree of erosion is described and classified into one of the following classes: none, negligible, medium or intensive.
- Trees with resin signs are recorded.
- All information regarding fauna and historical monuments are recorded.

Cyprus has joined the ICP – Forests program in 2001. The adoption of the program was the result of the increasing necessity for a better monitoring and understanding of forest ecosystems in Cyprus.

The Cyprus Department of Forests, of the Ministry of Agriculture, Natural Resources and Environment, has been nominated as the National Focal Centre of the ICP-Program in Cyprus, being responsible for the collection, validation, evaluation, storage and management of the monitoring data. The National Focal Centre

collaborates with the Coordinating Centers of the Program in Europe, which have the responsibility of aggregating, processing and presenting the research part of the program on a European and an international level.

In addition to the national character, the program has a pan-European and global dimension with the following objectives:

- to provide a periodic overview on the spatial and temporal variation in forest condition in relation to anthropogenic (in particular air pollution) and natural stress factors (insects, diseases, drought, frost, flood etc),
- to contribute to a better understanding of the relationships between the condition of forest ecosystems and anthropogenic (in particular air pollution) / natural stress factors,
- to contribute to the calculation of critical levels / loads of various chemical substances which are accumulated in forest ecosystems, as a result of atmospheric pollution, and to the development and improvement of cooperation with other agents dealing with environmental monitoring programs,
- to contribute to a better understanding on forest ecosystem process and the interaction between its various components through the available data and observations of the program,
- to contribute by means of the monitoring activities to other aspects of relevance to forest policy at national, pan-European and global level, such as climate changes on forests, sustainable forest management and biodiversity in forests,
- to provide policy-makers and the general public with relevant information.

The following research activities have been developed for the achievement of the objectives of the program:

- Visual assessment of the forest crown condition,
- Sampling and analysis of forest soil,
- Sampling and analysis of forest soil solution,
- Sampling and analysis of needles and leaves of forest trees,
- Estimation of growth and yield of forest stands,
- Sampling and chemical analysis of deposition (precipitation, snow, hail),
- Meteorological observations,
- Assessment of forest ground vegetation,
- Monitoring of air quality and assessment of ozone injury on forests.

A systematic network of 19 permanent plots has been established in Cyprus State forests aiming at the collection of the necessary data, relevant to the above activities. These plots are divided in two categories according to the type of observations to be done and data to be collected:

“Systematic large scale monitoring plots”

Fifteen plots, covering an area of 0,1 ha each, have been established for monitoring Calabrian pine (Pinus brutia), Black pine (Pinus nigra), and Cyprus cedar (Cedrus brevifolia) ecosystems. In these plots, annual observations of crown conditions and periodic sampling and analysis of soil and needles are carried out.

“Intensive monitoring plots”

Four plots, covering an area of 1ha each, have been established for monitoring Calabrian pine (Pinus brutia) and Black pine (Pinus nigra) ecosystems. In two of these plots, all research activities, mentioned above, are carried out. These plots are furnished with appropriate instruments and equipment for the collection of samples, data and information. The other two plots are partially equipped and only some research activities are carried out.

Forest fires cause significant economic damage to the environment. Early warning and the fast extinction of fires are, apart from preventive measures, the only way to avoid major casualties and damage to nature. For this purpose a “Forest Fire Early Warning System” was introduced in Cyprus, aiming the monitoring of fire risk. The data and the information can be used for the evaluation of fire risk and adapting precautionary measures in time.

I.4 IMPACT MANAGEMENT

Forest management can play a very important role in minimizing the negative impacts of climate change on forests. The need for controlling and managing the impacts of climate change is being given primary consideration. Activities and measures to combat the impacts of drought are currently pursued by Forestry Department. A short term action plan for mitigation of the impacts was prepared and a long term action plan is under preparation. The different foreseen measures and actions are presented in chapter II.3. “Forest adaptation measures”.

In 2008 the government due to shortage of fresh water imposed a series of restrictions, including bans on hosepipes to water gardens and the filling of swimming pools. Several million cubic meters of fresh water were transferred from Greece by tanker. The Department of Forest tended all the forest springs and placed watering spots for fauna species within the forest.

Thaumetopoea wilkinsonii is the major defoliator of pine trees in Cyprus. Natural forests, plantations and individual trees are subject to periodic outbreaks. During the outbreaks, the defoliation is more severe on lowland where artificial young plantations are present. While few trees die as a result of recurrent defoliations, infected trees suffer from decreased growth and they also have increased susceptibility to secondary attacks by bark beetles. Aerial and ground application of chemical and

biological insecticides is widely used every year in Cyprus for controlling the population of Thaumetopoea wilkinsonii. In recent years only biological insecticides such as bacterium Baccilus thuringiensis (Foray 48) and Spinosad (Tracer) have been used in Cyprus.

II. ADAPTATION

Due to the evidences of climate change and the impacts on Cyprus forests, the challenge for the forest sector to understand these impacts and to develop adaptation measures has been recently a high priority for the Forestry Department. The Forestry Department elaborated measures aiming mainly at reducing the vulnerability to climate change via management actions taken as immediate response to sudden impacts in forest ecosystems. Indirectly adaptation measures to climate change may also considered actions taken through other policy documents such as the National Forest Program.

II.1. VULNERABILITY OF FORESTS AND FORESTRY

Because of the high degree of uncertainty of currently available climate change scenarios for Cyprus, the temporal judgment of the vulnerability of forests and forestry through expert opinion should serve mainly as hypotheses for directing future exploration and research.

a) Until 2020

Tree and seedling resilience
The weakness of forest trees to withstand continuous adverse conditions and increased insect and pathogens attacks will lead to increased primary and secondary mortality of individual trees. The mortality of trees involves various species including native dry tolerant species. Extreme events, such as drought and heat waves, will also affect natural regeneration and mortality of seedlings and the resilience of forest stands will decrease.

Forest Fires:
The high forest fire risk period is likely to increase towards late Spring and early Autumn. The frequency, intensity and extent of forest fires will increase due to lower soil moisture, increased evaporation and increased frequency and intensity of extreme climatic events and droughts combining to increased dry vegetative dry matter. The increased frequency of fires may offset the potential of many forest species for regeneration, and hence forest ecosystems may be critically damaged.

b) Until 2050

Biodiversity

A complex of climatic and non-climatic factors such as land use change, forest fires, fragmentation, loss of forest springs will possibly affect various species of flora and fauna and their habitats. Some effects might be the changes in competitive interactions among species, and the structure and composition of communities and ecosystems, changes in distribution and abundance of species, decreased adaptation capabilities of species to respond to climate change and finally species loss. The invasion of exotic species is another potential negative effect.

Forest Recreation
The climate change and the change in the synthesis of species in forest ecosystems might alter the habits of local people to recreate in forests both in temporal and spatial term.

c) Until 2100

Depending on the extend of the previously periods effects, the ecosystem restoration might not be feasible. Thus forest and biodiversity loss, extinction of species and desertification might be possible effects of climate change.

II.2. GENERAL ADAPTATION STRATEGY OR POLICY

Climate change is indirectly faced through the Forest Strategy and the Cyprus Forestry National Program (2000 – 2009) but due to the adverse climatic conditions prevailing in the area the last years the Forestry Department developed a Short-term Action Plan with activities focusing on trees, stands and higher management units aiming to reduce the vulnerability to climate change.

The Forestry Department's strategy namely the Rural Betterment Strategy, aims at safeguarding and expanding forest resources through sustainable forest management for the benefit of the whole community while capturing the advantages of development based on ecotourism. It recognizes the importance of forest resources, including biodiversity, climate amelioration, water, amenity and scenery and the sustainability concept has been expanded to cover them. The National Forest Program aims on the protection of forest resources, so that their capacity to continue to provide goods and services of all kinds, for future generations, is not impaired.

II.3. FOREST ADAPTATION MEASURES

Due to the impacts on forest ecosystems of adverse climatic conditions the last years in Cyprus the Forestry department elaborated a Short-term Action Plan against the drought effects in State Forests. This Action Plan is considered as an immediate action to drought effects taking into consideration the uncertainty of climate change and as a basis for future action.

- Record and monitoring of the problems caused by the adverse climatic conditions for better future decision making and valuation of the drought tolerance of forest species in areas mostly hurt by drought
- Make use of the information collected via the ICP-Forests Program for the condition of forests, such as defoliation, discoloration, primary and secondary insect attacks etc
- Monitoring of cleaning and thinning in regard to soil moisture, defoliation, needles number and length, discoloration and insect attacks in pilot plots of Pinus brutia reforestation areas aiming to the elaboration of cleanings and thinnings plan
- Extraction of dried forest trees in visible areas for aesthetic purposes
- Trapping of harmful insects in areas with high degree of tree diebacks aiming to the control of their population
- Irrigation plan for distress trees especially in Forest Parks as well as giant trees and tending of forest plantations aiming to the retention of increased soil moisture
- Postponement of reforestation and aforestation activities except in burnt areas
- Emphasizes on the production of native dry tolerant species in forest nurseries and record of the provenances of forest reproductive material
- Decrease of the extracted timber volume from Cyprus forests to 4000m^3
- Increased measures for fire fighting and forest fire precautionary measures including a system of “Forest Fire Early Warning System”
- Tending of forest springs and placing of watering spots for fauna species

Other adaptation measures specifically for forest types included in the short term action plan, otherwise suggested by expert opinion are shown in the following table:

Foresttype	Measure
Broadleaved evergreen forest Quercus alnifolia, Arbutus andrachne combined objective/ multi-purpose forestry fuelwood, maintainance of biodiversity, provision of drinking water, protection against rockfall, protection against soil erosion, Recreation	Improve infrastructure for fire detection, control and suppression (roads, firebreaks, fire lookout stations and remote sensing, water tanks, hydrants, fire brigades, aerial means, vehicles, meteorological stations etc.)
Coniferous forests of the Mediterranean, Antolian and Macaronesian regions Cedrus brevifolia, Quercus alnifolia unmanaged/ nature reserve maintainance of biodiversity	Fire prevention & control measures
	Maintain ex-situ conservation (seed bank / orchard)
	Various silvicultural treatments should be applied for controlling die-back and possible insect attacks
Coniferous forests of the Mediterranean, Antolian and Macaronesian regions	Irrigation in Forest Parks, roadside plantations and giant trees

Pinus brutia, Pinus pinea combined objective/ multi-purpose forestry maintainance of biodiversity, Recreation, Aesthetic purposes	
Coniferous forests of the Mediterranean, Antolian and Macaronesian regions Pinus brutia, Quercus alnifolia combined objective/ multi-purpose forestry timber, fuelwood, maintainance of biodiversity, provision of drinking water, protection against soil erosion, Recreation	Felling and export of dead trees
	Produce of native & dry tolerant species in nurseries
	Decrease timber volume & extraction operations
	Adapt the timing of planting (e.g. early planting to take advantage of spring humidity)
	Using continuous cover forestry in mountain areas
	Investment in fire prevention policies (e.g., increasing private and public awareness, education campaigns of forest managers, etc.)
	Establish monitoring infrastructure aimed at climate change and forestry
	Improve infrastructure for fire detection, control and suppression (roads, firebreaks, fire lookout stations and remote sensing, water tanks, hydrants, fire brigades, aerial means, vehicles, meteorological stations etc.)
	Improved monitoring systems & networks (ICP, LTERP, Forest Focus, National Forest Inventory, etc.)
Coniferous forests of the Mediterranean, Antolian and Macaronesian regions Pinus nigra, Juniperus foetidissima close to nature forestry (C2N) maintainance of biodiversity, provision of drinking water, protection against soil erosion, Recreation, Research	Maintain ex situ conservation for the main species
	Promote natural & artificial regeneration
	Apply silvicultural treatments in high risk stands to reduce fire danger
	Removal of Pinus brutia invading trees & seedlings
Floodplain forest Alnus orientalis, Platanus orientalis close to nature forestry (C2N) timber, fuelwood, maintainance of biodiversity, provision of drinking water, Recreation	Felling and export of dead trees
	Increase of water volume released downstream of dams

II.4. RESEARCH STUDIES OF FOREST ADAPTATION

Currently, there are not any research studies specifically focusing on forest adaptation related to climate change.