# THE MAREMMA REGIONAL PARK

## 1. General Information

The Maremma Natural Park, in the Province of Grosseto, was established by the Region of Tuscany in 1975. In 1994 it received a new statute and a new denomination of Maremma Regional Park (from now on Park).

Object of the Park, according to the law which established it, is "the conservation of natural, environmental and historical characteristics of Maremma serving the social purposes of such values, as well as the promotion of scientific research and naturalistic didactic."

## 2. Geography and Land Use

The Park is located along the coast of southern Tuscany, in the Province of Grosseto. The northern section is a sandy plain formed near the estuary of the Ombrone river and is covered by stone pine (*Pinus pinea*) stands. The central and southern section is hilly (the so-called Monti dell'Uccellina; highest point 417 m a.s.l.) and the main ridge stretches parallel to the coast. Slopes are usually steep (frequently over 30-40%), and minor valleys cut the slopes on both sides. Water flows in the creeks only during heavy rain periods, but there is evidence of erosion on the upper part of the mountain, and soil deposits fill the lower part of the small valleys.
The Monti dell'Uccellina are covered by *macchia* vegetation: on the sea side the vegetation cover is frequently degraded and small shrubs dominate large areas, whereas on the slopes facing the interior plain the *macchia* shows its typical physiognomy.
The Park has a surface of approximately 20.000 hectares. It features many Mediterranean ecosystems: the evergreen sclerophyllous broadleaf woodlands (locally called *macchia)*, pinewood, humid areas, as well as farmed areas and meadows.
The Park is bounded by the tourist resort of Principina a Mare on the north, agricultural and wooded grounds on the east, the village of Talamone on the south and the sea on the west. The coast is rocky in the southern section and sandy in the north.
The territory included in the Park, as well as that in its immediate vicinity, bears the testimony of human presence in Etruscan times. This presence is virtually permanent for 20-25 centuries and may be considered spread on the entire territory.
Archaeology can provide indirect information on land clearance and forest exploitation. Etruscan settlements (Talamone), ruins of Roman buildings (Talamone, Alberese) and roads (Via Aurelia), earthenware remnants and more recent buildings, like the medieval S. Rabano monastery documented since 1102, but probably dating back to the 8th century, and the 8 watch towers along the coast, dot the territory now covered by woodland or pastures. The important Via Aurelia of Roman times, now a road used by local traffic, used to skirt the slopes facing east of the Uccellina mountains. More roads, linking the watchtowers and connecting the Monastery of San Rabano and the harbors, criss-cross the mountain. The cadastry map of 1824 shows the distribution of some olive groves and one chestnut grove, which now have disappeared; additional relict olive groves can be found today overgrown by *macchia* species. Tilling, planting, and abandonment took place at the turn of the century as well.
Concerning *macchia* use in the recent past, little information is available, deduced from the 1824 cadastry. Territorial distribution of forest is higher than today, but grazing was widespread and forests were supposedly not as thick as today. Chestnut was present in the Talamone area.
Additional documents signal tillage with olive grafting between 1832 and 1839, followed by more tillage in the period 1869-82.
Between 1882 and 1887 approximately 100 ha are tilled in the plain, and olive grafting is carried on.

Some place names reveal the existence of cork oak (*Quercus suber* L.) stands or agricultural cultivation. Soil terracing is still evident in some places. The map (Fig 2) gives a concise idea of spatial distribution of human activities other than forestry or grazing, both involving the destruction of the forest cover. Some of these may perhaps have lasted a short period, but others, like the monastery, lasted several centuries.
All this information outlines a picture which is coherent with that resulting from charcoal remnants and pollens analysis: intensive, widespread and prolonged land use by means of grazing, agriculture, quarrying and settlement interested the Park territory as a whole. The woodland cover is therefore secondary in many places, even if the time of its re-establishment is not known. It can be conceived that spontaneous reforestation started on eroded land, especially in the upper part of the hills, and that some species, spontaneous or introduced by man, disappeared through time. Abandonment of agricultural practices may have been accompanied by grazing which resulted in the selection of invasive tree or shrub species, such as juniper (*Juniperus oxycedrus* L. and *Juniperus phoenicea* L.) as rotten stumps testify. It is also possible that some trees (stools) derive from seeding done by forest workers: according to written records it was compulsory practice to seed some acorns where heath (*Erica* spp.) stools were uprooted, a practice maintained until the late Sixties.
Nevertheless, some woodlands located on steep terrain can be considered as primary, i.e. forest cover has been continuous over time, even if wood exploitation and grazing have been elsewhere a frequent and common disturbance.

## 3. The physical environment

### 3.1 Climate

The variability of the Mediterranean climate is a key factor for forest vegetation dynamics: plant individuals and populations must be adapted not only to the mean climatic conditions of the environment, but also to its heterogeneity.
The rainfall and temperature time series of some meteorological stations, situated inside or in the vicinity of the Park, have been analyzed for the 1938-88 period. Average rainfall and temperature data are typical of Mediterranean climate. Data of Tab 1 refer to the Alberese site.

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 66.2 | 65.1 | 54.2 | 44.7 | 34.2 | 20.4 | 15.3 | 50.4 | 65.2 | 85.2 | 74.9 | 63.1 |
| T C° | 7.3 | 7.8 | 9.3 | 11.8 | 15.5 | 19.4 | 22.7 | 22.8 | 20.3 | 16.1 | 11.3 | 8.3 |

TAB. 1: Climatic data for the Park territory
Location: Alberese
Altitude: 17 m a.s.l.
Latitude: 42°37'
Precipitation, yearly: 638.9
Temperature, yearly average: 14.0

The area is included in the phytoclimatic zone of intermediate Lauretum according to Pavari, and in the Mediterranean subhumid zone according to Emberger.

Data collected at Alberese meteorological station show a slight trend towards a decrease both in the mean annual temperature and in the annual thermal range (particularly during the summer). The analysis of the water balance shows that, at the Alberese site, recent years until 1984 are wetter than average, with a change towards a sub-equinoctial character in the rainfall. The situation has changed recently: during the period 1988-1993 the total precipitation amount was approximately 60% of long term average. Also 1995 has been a relatively dry year. The reduction in precipitation was especially strong during the winter months, and the dry period started in coincidence with the beginning of the vegetation period.

3.2. Geology

The geology is quite complex: various rocky materials can be found combined in a complex pattern. The following scheme (Tab 2) shows the different geologic formations in the Park (quaternary formations are not present) and their age:

Tab 2. Geological formations in the Park territory

| Geological formation | Era |
|---|---|
| quartzite, schists | Permian |
| limestone | Trias |
| limestone | Lias |
| quartzite, schists (pseudoverrucano) | Paleogene |
| brecce, limestone with flint, schistose marls | Paleogene |
| sandstone (macigno) | Oligocene |
| sea sand, alluvium, detritus | Quaternary |

The alluvial zone, occupied by pinewood and marshy areas, benefited in the past of a hydraulic organization that ensures draining. A canal built in 1906 that ends near the Ombrone estuary serves the backlands. Improvement and reclamation took place between 1928 and 1932. The land of the Alberese farm, owned by the Lorena family, was assigned to the "Opera Nazionale Combattenti" (State agency assisting ex service men) in 1926, while colonization with farmers of the Veneto region, took place mostly in 1931. The draining system of the pinewood was created in the same period, served by the water-scooping machine that pours the water in the Ombrone, near the mouth. During the past decades, sea erosion has upset the structure of coastal dunes, and modified the northern coastline, while the beach deposit has moved the coastline toward the sea in the southern section of the alluvial zone.

3.3 Pedology

A pedological analysis of the northern part of the Uccellina hills has been carried out. It is possible to recognize soil types that are not very developed, with only a slight boundary line between different layers. These soils show a great abundance of skeleton fragments, and the slow evolution is due both to the erosion processes (Typic xerochrepts) and to a slow alteration of the calcareous substratum (Lithic xerochrepts). The latter type is shallow and the depth increases only in the presence of depressions, where there is soil accumulation.

In other sites the soil evolution has a very long history (Paleosoils) and soils show argillaceous layers variously recognizable and different characteristics from the parent material: from calcareous and siliceous colluvial deposits to sand originated by quartzose conglomerate alteration.

Hydromorphic features are clearly recognizable (Acquitic Palexeralf); sometimes they are rather faded all along the profile because of a past influence of the water presence (Typic Palexeralf).

In some cases clay movements from the surface to deeper layers are still at the beginning (Typic Haploxeralf), determining a lower degree of development.

3.4 Fire.

As in all Mediterranean areas, fire is an important environmental factor. Records of fires regarding the Uccellina Mountains are incomplete. The northern section of the territory, approximately 3700 ha, suffered between 1910 and 1950 some 8 fires that destroyed the forest cover on 600 ha. Since then, no remarkable fires have been recorded. In 1912 a great fire swept 300 ha of the pinewood. For the period before 1912 there are no records, but literary sources describe a very large fire in 1891.

## 4. Vegetation

4.1. Forest types and their use

Three major vegetation groups can be recognized, specifically wood, marsh, and farmed areas.
Woods can be divided in:

| | |
|---|---|
| - stone pine and cluster pine woods | 677 ha |
| - mixed evergreen coppices | 4700 ha |
| - holm oak woods | 32 ha |
| - mixed oak woods | 55 ha |
| - cork oak woods | 10 ha |
| - juniper woodlands | 226 ha |
| TOTAL | 5700 ha |

Wild grazing of cattle and horse is widespread, and this utilizes meadows and woods. More specifically, cattle is brought in the pinewood from the end of November to the middle of March, then in the *macchia* until the middle of May (grazing in coppice is allowed only if it has been cut at least 5 years earlier).
Farming and breeding interests mainly the northeastern section of the Park. Traditional agriculture has been partially replaced by the cultivation of tree species for ornamental purposes. Part of the land has been "set aside" in order to take advantage of the E.U. subsidies.
The base of the hills is occupied by vast olive groves, part of which are abandoned.
Forest utilization is controlled by a management plan.

4.2. Evergreen broad-leaved woodland (*macchia).*

The vegetation is heterogeneous due to the different habitats present in the Park (both mesoclimate and soils) and to different human influence, both past and present.

Dynamic vegetation series can be present at different stages: from the driest sites on rocky outcrops facing the sea with juniper stands, to shrubs, woodlands with holm oak and some deciduous trees (*Quercus cerris, Quercus pubescens, Fraxinus ornus*), to the more suitable sites at the base of the slopes with deep colluvial soils which are dominated by deciduous species. Locally cork oak (*Quercus suber*) grows, usually on acidic soils. Evergreen shrubs are *Phillyrea spp.,*

*Pistacia spp., Mirtus communis, Arbutus unedo, Rhamnus alaternus*.
The most common type of mixed evergreen woodland formation has been classified as *Viburno-Quercetum ilicis ericetosum.* Where deciduous species become more abundant the vegetation can be classified as *Orno-Quercetum ilicis.*
In order to acquire some information on vegetation dynamics of the *macchia* formations, pedoanthracological investigations have been undertaken. Three soil profiles have been examined at different depths. Results show that at year 4510 +/- 44 BP deciduous oaks, together with *Ulmus, Quercus ilex* and *Erica* sp. were the dominant species. *Olea* was also present. Given the human presence in this area since Paleolithic times, the abundance of *Erica* can perhaps be explained with the spread of fires.

In the early Middle Age (approx. 1540 BP) the situation is apparently the same. Remarkable changes can be seen between approx. 740 and 480 BP: sclerophyllous species such *Pistacia* L., *Arbutus* L., and *Phillyrea* L. were dominant. The vegetation seems to be more similar to that of today.

*Olea* can be considered spontaneous in this area even if its distribution and abundance in later times is certainly modified by human influence.

More data about the history of vegetation cover have been obtained through pollen analysis in three small wet sites. These data reflect the situation of an area larger than the one described by the pedoanthracological analysis.
In general, forest species increase from the oldest to the youngest sample. Deciduous oaks decline through the profile and are replaced by holm oak and cork oak. *Olea* is represented all along the profile as well as cereal and chestnut pollens.

Among shrub species, the taking over by *Cistus salvifolius* and *Cistus monspeliensis* coming from the surroundings has been relevant, despite the poor soil conditions. Sometimes the development of the vegetation cover is slower or halted by the lack of an adequate topsoil layer or by a very stony ground.

Management.
a. Coppice with standards.
The *macchia* is managed as coppice with a 20-year rotation, but at the moment, as a consequence of the reduction of cut areas and the interruption of cuts in the period between the Sixties and the Seventies, stands over 30-40 or even 50 years of age are cut. 150 and more standards per hectare are left, old pollards and eventual dead plants. The number of stumps can vary much: frequent density is 2000- 6000 stumps/ha, with peaks of 14.000.
Production, constituted mainly by fuel wood, is much variable, and can change in the range of a few dozen meters. Areas occupied by heath and other small shrubs are no longer exploited, while those largely covered by holm oak provide between 400 and 800 (seldom 1000 and more) q per ha. Highest trees (standards) range between 4-5 and 12-15 m.

Re-establishment of vegetation cover has been observed after a clear cut in the Poggio al Pino site. The process started slowly with shoots appearing from stumps, but then speeded up during the spring of the second year. The vegetation, originally covering 97% of the area, covers 50% after one year and 90% after 3 years, but the new stand composition is different from the previous one. Tree cover is temporarily absent, shrub presence is increased, and the herbaceous layer, which was nearly absent before cutting, occupies 25% of the area.

Cork oak growing near other species is exploited approximately every 10 years. This species requires much light and it is therefore necessary to periodically eliminate other plants casting a shade on its crown.
Olive trees are present in some spots of the *macchia*, and the stump layout suggests these are not always wild elements, but ancient plantations abandoned in an unspecified period an recolonized by spontaneous species.

b. Coppice to be converted into high forest, in order to create areas suitable for grazing and recreational purposes.

c. Areas not to be exploited:

c.1. Reserve areas for scientific purposes
A few areas of *macchia* close to rotation age (40-50 years), totaling a few hundred hectares, have been set aside as a total reserve with the purpose of studying the evolution of this type of wood, once regular coppicing ceases.

c.2. Extremely degraded areas.
Low *macchia* formations, or *gariga*, occupy wide areas of the Park: dominant species of these areas are *Cistus, Rosmarinus* and, often, *Ampelodesmos tenax*. On this low height formation isolated shoots of holm oak stumps appear, most probably the remains of woodlands in which this species was much more spread. *Macchia* degradation in these sites often dates back to the past since these formations were already present 170 years ago. Regeneration of holm oak though seed is substantially absent.

4.2.2. The pinewood

The origin of the Alberese pine (*Pinus pinea* L.) stands is mainly artificial. The first report of the Alberese pinewood dates back to the end of the 18th century: in 1778 isolated pines on meadows are mentioned. The 1824 cadastry describes the presence of 95 ha of pines in the innermost area (east) of the sandy plain near the Ombrone estuary today occupied by the pinewood. A 300 ha plantation was supposedly realized in the 1835-40 period by means of direct seeding on dunes.
In 1840 the pinewood area was 287 ha, in 1870 it is reported as 343 ha, and only around 1882 it reaches 830 ha. This amount includes stone pines stands and the much smaller stands of cluster pine *(Pinus pinaster),* planted along the coast to protect stone pine stands from salty winds damages.
This type of wood does not appear to have been managed specifically, until this century in the Thirties. Still in 1925, in the entire estuary plain as well as in the areas behind the Uccellina Mountains farmed today, the land was defined as "permanently marshy", and in 1932 the pinewood area resulted as “still to be reclaimed”. The draining of the pinewood area took place only starting in 1938 when the water-scooping machine became operative.
Around 1933 the land was cleared from scrubs and ploughed. During the Second World War and in the years immediately after a reduction of pastures took place, with an invasion of scrub_species and, apparently, a significant regeneration of stone pine.
In 1941, then in 1945, and again in 1950, the pinewood suffered fires, apparently of little importance. The situation returned to normality in 1951 when land was cleared once more and cleaned on a yearly basis. Since 1975 cleaning of the pinewood undergrowth ceased, and started again in the early Nineties.
Episodes of natural regeneration of pine reported in the past are difficult to explain. After the seeding carried out toward the middle of the previous century, other plantations are reported between 1934 and 1957, often, though, in areas of limited size. On the other hand, records of the farm management mention in one occasion spontaneous regeneration.
Probably natural regeneration of stone pine was affected, in a positive or negative way, by more than one element: scrub clearing and ploughing, fires, grazing, harvesting of cones, seed distribution by animals, wild boar predation of pine-seed.
The present structure of the pinewood is partially multistory, and partially one layered, with few old stands and almost total absence of young stands (i.e. less than 20-30 years old). From 1984 to 1993 investigations have been carried out in permanent study areas in order to gain information on the

mechanisms and bottlenecks regulating the natural regeneration process of *Pinus pinea* L.

Management

Currently forest utilization carried out in the stone pine wood is limited to thinning and, if necessary, to the removal of trees attacked by *Tomicus destruens*. Pruning is also carried out.
Where cluster pine invades stone pine wood, the first species is subject to thinning, or else patch clear cuts of a few thousand square meters are made, followed by artificial regeneration.
Main production consists of cones collected by workers who climb on the trees and use a hook attached to a long pole to remove the cones. The use of mechanical shakers is forbidden.

## 5. Fauna

The Uccellina hills host a wide variety of animal species such as wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*), indigenous to the territory, and fallow deer (*Dama dama*), introduced for hunting purposes around 1957.
Other species include porcupine (*Hystrix Sp.*), badgers (*Meles meles*), foxes (*Vulpes vulpes*), hares (*Lepus europaeus pallas*) beech-marten (*Martes faina*), and other species. Fairly recent is the appearance of the squirrel (*Sciurus vulgaris*). Wild cats (*Felis silvestris*) are rare. There is a strong decrease of the wild rabbit population (*Oryctolagus cuniculus*), a species introduced in the past for hunting purposes. A population of coypu (*Myocastor coypus*) has established itself in the past decades in the Ombrone.
Hunting is prohibited. Surveillance staff by means of captures and shooting carries out control of ungulate populations, specifically fallow deer and wild boar.
Marshy areas shelter many birds during winter and migration period. Among these the most rare and interesting can be mentioned: the roller (*Coracias garrulus*), the stone-curlew (*Burhinus oedicnemus*) the great spotted cuckoo (*Clamator glandarius*), the grey-lag goose (*Anser anser*), the stork (*Ciconia sp.*), the flamingo (*Phoenicopterus sp.*). There are many birds of prey, limicolous, different herons (*Ardea sp.*), and ducks (both *Anas sp.* and *Aythya sp.*).

## 6. Research

The Park encourages research on several subjects dealing with the functioning of natural Mediterranean ecosystems. In recent times studies on health conditions of pinewoods and on the influence of wildlife on coppice regeneration have been carried on.

### 6.1 Pinewoods

Starting in 1990 a series of researches has been undertaken with the purpose of identifying the cause of the unsatisfactory vegetating conditions of stone pine in the Alberese pinewood.
Symptoms of pine suffering are expressed by needle reddening during spring-summer period (particularly evident during the summers of 1990 and 1993) and by their reduced length and longevity (limited to one year instead of the usual two or three). These phenomena as a whole result in crowns that are less thick than usual, commonly described as more transparent.
Researches have interested the following subjects:

a. Study of the relationship between rainfall and vegetative conditions of pines.
The relationship between climatic trend and vegetative conditions has been studied by comparing the rainfall of different period of the year and the length of needles. The relation between the two quantities was highest for rainfalls of the March-August period, and pointed out how in dry years, particularly when winter and spring rainfalls in 1989 and 1990 are very scarce, the length of needles is very strongly reduced.

Observation of needle length carried out on plants growing in different ecological situations, have pointed out that this feature does not appear to be genetically determined but reflects the environmental differences among various sites.

b. Measurement of water availability during vegetative the period in pine plants subject to different silvicultural treatments.
Water availability has been determined with R.W.C. measurements (relative water content, i.e. the amount of water present in wood tissues).The measurements have been carried out in the period between May and September of 1993, 1995, and 1996 in two study plots set in a stretch of pinewood constituted by a stone pine stand approximately 50 years old. In one of these plots a thinning leaving approximately 60% of basal area and the scrub clearing was carried out in the spring of 1993(treated plot), while the other plot remained untouched (control plot).
The R.W.C. is a reliable index of the xilem embolization, therefore a low R.W.C. level is a symptom of difficulty of the needles in water supplying.
In 1993 and 1995 the R.W.C. trend was similar in both areas studied: there was a decrease during the summer (with a minimum in July) and an increase in September. The year 1997, probably because of the anomalous rainfall trend, shows instead a minimum value in May and a maximum in July. Figures referring to the same date are different in the two areas, and are constantly lower in the control plot, left untouched, than in the treated plot. The difference is around 7-10% with maximum differences during the dry period.
Therefore, a reduction of vegetation density, both of the tree and the shrub layer, is believed to affect positively the water availability of the remaining stand.

c. Water table conditions and its effect on the vegetative conditions of stone pine.
Salinity level and conditions of the water table have been studied inside 5 wells 1993.
The water table level varies irregularly from one year to the other in relation with the rainfall trend. The minimum level is reached during the period of July-September with figures around -110 cm, while the maximum level can be reached both in the fall-winter period and in spring and varies more in figures from one year to another (depth of the water table is 20-70 cm).

6.2 Wildlife damages to coppice shoots.

In the Park there is a substantial number of fallow deer and roe deer. Roe deer is an autochthonous species whilst fallow deer was introduced to the Uccellina hills around 1950, 25 years before the institution of the Park. Starting in the late 1970's, the number of Fallow deer has increased due, at least partly, to the end of hunting and to the increase of available food, in the form of new shoots. Coppice shoots represent, in fact, an important source of food during the first 3-4 years after coppicing.
Fraying causes only a minor damage. Fallow deer and wild boar, also common in the *macchia*, feed also on acorns.
Fallow deer estimated density in 1997 was approximately of 2.000 individuals.
Coppicing started again in the Uccellina woods during the winter of 1979, after a break of about 20 years, and has since continued on a regular, yearly basis.
A research has shown that there are strong preferences towards different plant species: *Fraxinus ornus, P. latifolia, Arbutus unedo, Rhamnus alaternus, Paliurus spina-christi, Quercus ilex* have proved to be the species most consumed while other species (*Pistacia lentiscus, Myrtus communis*) have been refused.
Seasonal variations in browsing are apparently influenced by the phenological characteristics of each plant species and particularly by their ability to produce more shoots in a year. Intense browsing does not always correspond to serious damage to the plant. Generally, the damage is greater in the first two years after coppicing when the apical sprouts are browsed, while damage is

smaller in older coppices where only lateral shoots, epicormic branches and dominated shoots are browsed.
Comparing the relative data on browsing during the year with the data on grass availability, it is possible to suppose that there is a connection, at least during the summer period, between the increase in browsing of the coppices and the reduction in the availability of grass.
Studies carried out in the Park area between 1993 and 1994 have shown a constant reduction in the intensity of browsing (and of damage) as the years pass because:

. The apical sprouts and the first order of branches of the shoots grow to a height beyond the reach of the deer. This phenomenon, together with the drying out of the lower branches, could cause a reduction in food availability and a greater difficulty in access and transit, especially for the male deer.

. The coppicing of the successive years, carried out in adjacent areas, has greatly increased the surface area of food available to the deer, hence decreasing the browsing pressure on the previously cut areas.

Further researches have been carried out in 1995 and 1996 examining most stands coppiced in the entire Park territory in the past 10 years.
Browsing of stump shoots is at very high levels, and reaches its maximum during the first year after the cut, when the shoots are, at least during most of the year, completely accessible to ungulates. Even though food availability decreases, deer continue to exploit in some cases also the 10 year old and older coppices, at least during certain periods of the year.
Damages on shoots decrease with increasing coppiced areas, apparently because available food is in excess and because animals do not dare pasturing on large open areas. Grazing damage is higher along forest edges.
Branches remaining in cutover area after utilization and covering stumps protect young shoots.
Mortality caused by browsing is very low. Usually stumps react vigorously to browsing repeated for one year and keep alive, so that their shoots can form a new stand as soon browsing pressure decreases due to the availability of new clearcut. Vitality decreases when browsing continues for 3-4 years. Shoots produced by stumps browsed repeatedly, as in *Fraxinus ornus,* have their crowns dominated by the crowns of species less palatable, and therefore can succumb because of competition.