11. P.N. da Arrabida

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INTRODUCTION

In this section a general characterization of the coastal area of the Parque Nacional da Arrábida (PNA) is given.
The Parque Nacional da Arrábida located in the most southern part of de Setúbal peninsula, occupies an area of 10.800 Ha. Geographically the PNA is placed between the parallels 38° 27'- 38° 38'northlatitude and 8°55' - 9° 50' longitude west (Trindade, 1988).
The area contains a small chain of limestone outcrops with a maximum elevation of 500 m running parallel to the southern edge of Setúbal peninsula, ending in steep cliffs rising from the sea. (Catarino *et al.*, 1981).

GEOMORPHOLOGY

The geomorphology is extremely complex. It is characterized by a broken relief with a few narrow valleys (Ribeiro, 1935 *fide* Catarino *et al.*, 1981). This and the general E-W orientation of the relief multiply the climatic and micro-climatic possibilities (Catarino *et al.*, 1981).
The principal types of relief that can be seen in PNA are: mountains, which stand out from all the region; the less higher hills and thirdly, the interior cliffs. The first two types are mostly caused by tectonics, the last one is caused by erosion acting on the structure and position of stratigraphic beds. A fourth element are valleys of the small rivers; a fifth are the straight and deep ravine; then we have the tiphonic valley of Sesimbra; and finally the occidental plateau, an erosion surface which cut indifferently into the more or less upright strata. (Ribeiro, 1986).
The Arrábida coast is high with hinterland mountains of more then one thousand of metres heigh. It is the biggest break of littoral Portuguese occidental direction (Ribeiro, 1986). In the end of the cliffs near the sea there are areas of sandy beach.

GEOLOGY

The materials that of which the structures of the Arrábida chain are made, except the eruptive rocks of the veins that exists on the occidental sector, are marine sediments, marine-brackish sediments and riverine sediments (Pedro, 1991).
In the Arrábida sediments from Jurassic up to Miocene age are found (with exception of the Eocene which is represented by a hiatus). The older formations, up to the upper Jurassic, are mostly deposits of chemical precipitation, the other ones until the Miocene are detritic in nature. After this period calcareous sediments were again deposited at the end of the period represented in the strata. During the Pliocene the transported materials reappear (but the Pliocene strata have been removed again by erosion) (Ribeiro, 1986).
Older strata exist only in the outlier of Sesimbra, limited by faults and cut by eruptive dykes. Between

Cabo Espichel and Outão and in one part of S. Luis, there are compact and resistant (to erosion) mountains. In terms of geology this land consists of a base of dolomite, limestone and calcarenites, in general overlain by klastic strata dating from the late Jurassic, Cretaceous and Oligocene. The Miocene exists only in the north and east of the ridge. It is present only in some littoral beds consisting of compact limestone. These layers extend to the north and disappear with an angular unconformity at the base of Pliocene beds. The composition of these beds is purely klastic. The dykes of eruptive rock are usually exposed only along the escarpments of the valley of Sesimbra and near Cabo Espichel and weather to a fertile land (Ribeiro, 1986).
The Arrábida chain is a horst uplifted between faults, bordering in the south and west on marine depressions and in the north on a syncline. (Ribeiro, 1986 andPedro, 1991).

MUNICIPALITY, PROVINCE, DISTRICT

The PNA is limited by the City of Setúbal, the villages of Palmela, Azeitão e Sesimbra and the Atlantic ocean. It includes areas of the municipality of Setúbal, Palmela e Sesimbra. It belongs to the Province of Estremadura and District of Setúbal.

OWNERSHIP/ MANAGING ORGANISATION

The PNA was established by Portuguese law in 1976 (Dec. 622/76 of 28 de July). The responsibility for the management of protected areas like the PNA has been assigned to the Instituto da Conservação da Natureza whish belongs to the ministry of the environment -Ministério do Ambiente e Recursos Naturais.

NATURAL VALUES

Climate

The climate of the PNA is partially determined by its position. To the east it is joined to the continent, and the other sides are surrounded by water (Oliveira, 1991).
The climate of this region is thermo-mediterranean, with annual medium temperatures between 16 and 18 Centigrade, and sub-humid (600 to 1000 mm) (Rivas Martinez, 1990). The north side of the mountains is cold and wet, contrariwise the south side is hot and dry (Rodrigues, 1984).
The climate of the region is partially related with the vegetation (due to evapotranspiration feedback) that exists in the PNA.

Diversity and rareness of vegetation types

In the zone of the Setúbal peninsula it is possible to find rare species and even some endemic species. In the mountains we find following vegetation types (Rodrigues, 1984):
- semi - deciduous forest like the "Mata Coberta", "Mata do Solitário" and "Mata do Vidal" in the hills exposed to the north ,which characterize the climax vegetation of the most wet and cold area of the mountain. These forests are dominated by trees like the oak, the arbutus-tree and bay-tree;
- small areas of wild olive and beach savin that might represent the climax vegetation on the south slopes;

- The shrubby forest consisting for a major part of bushes and which are barely accessible;
- Higher and lower forests depending on more or less favourable environmental conditions for vegetation development, allowing the separation between predominant species in holm-oak forests, heather forest, or rosemary forest .

The diverse environmental factors generate conditions for the potential development of rich forest vegetation ranging from pure formation of *Quercus faginea* or *Acer monspessulanum* at humid temperate northern sites to forests of the *Oleo-ceratonion* in the semi-arid, south exposed slopes (Catarino *et al.*, 1981).
In the rocks epilithic and epiphytic species can be found on crest-sand ravines, like lichen, mosses and other xerophytes, with big differences between the north side and the south side (Rodrigues, 1984 and Pedro, 1991). On the marine littoral rocks a sequence of different species of halophytes is observed (Pedro, 1991).
This region is not very rich in endemic species, although its originality and independence are not questionable. In spite of this there are some like *Ulex densus*, and *Armeria pinifolia*, *Armeria rouyana*, *Thymus capitellatus* and *Juniperus navicularis*. (Rivas Martinez, 1990).
Several sclerophyllous plants (*Quercus coccifera*, *Arbutus unedo*, *Phillyrea latifolia*, *Pistacia lentiscus* and other) can attain dimensions that apparently are not so common in other Mediterranean countries and they probably represent remnants of primeval forest formation developed under the special bioclimatic conditions of Arrábida (Catarino *et al.*, 1981). See further species list in general annex.

Diversity and rareness of fauna types
The ecological diversity of PNA allows the existence of a wide range of Mammals and birds, that are elsewhere rare or have almost disappeared.
In the mammal group (see species list in general annex) the maximum diversity in PNA is represented by three species: *Crocidura russula* (indicating a natural ecosystem), *Mus spretus* and *Apodemus sylvaticus* (indicating a transformed ecosystem). In all areas of the PNA the rodent *Apodemus Sylvaticus* (Trindade, 1988) can be seen.
The communities of rodents and insectivora are found to be abundant in this area due to its ecosystem, that means the rich supply of food and shelter (Trindade, 1988).
The principal natural predators of the little mammals and the reptiles are the birds of prey *Tyto alba Scop*, *Asio otus* and *Athene noctua* and mammals like *Genetta genetta*, *Vulpes vulpes*, *Felis domesticus* (Trindade, 1988).
The birds of prey in the study area are well represented by *Falco tinnunculus*, *Bubo bubo*, *Suturnus unicolor*, *Buteo buteo* and *Hieraetus fasciatus* (Vasconcelos, 1992)) but nesting species and winter visitors are relatively rare (see species list in general annex). The PNA has no migrants and few species like *Circus cyaneus*; *Buteo buteo*; *Columba palumbus* and some are winter visitors. Nesting species include *Cuculus canorus*; *Accipiter nisus*; *Asio otus*; *Tyto alba* and *Falco tinnunculus*. The vegetation and the climate is the reason for the specialization of birds in PNA. The existence of certain bird species in this area is very much related with the existent vegetation (Oliveira, 1991).
The PNA is also rich in Lepidoptera with 130 different species (Vasconcelos, 1992).

Accessibility
There are traffic infrastructures allowing easy access to the PNA. There are four national railways which give access to the Arrábida: Setúbal (EN 104), Palmela (EN 379), Azeitão (EN 10), Sesimbra

(EN 379). There are public footpaths enabling one to visit all the area of the Natural Park.

CULTURAL VALUES

The PNA has archaeologic remains proving the former existence of Palaeolitic man and of Roman colonists in the area.

In Lapa de Santa Margarida in Portinho da Arrábida a Quaternary deposit shows settlements of the first Human beings who lived there (Vasconcelos, 1992). Remains from the copper age (4500 years), are also present, like the funerary monument of "Roça do Casal do Meio" in Calhariz. The Romans left some vestiges in PNA like three Roman tombs in Comenda (Vasconcelos, 1992).
In the serra da Arrábida it is possible to see a magnificent monastery of XVI century - The "Convento da Arrábida" of the Franciscan brothers. This recovered patrimony now belongs to orient foundation (SNPRCN, 1992). Other proofs of built patrimony are churches ("Igreja de S, Simão" in Vila Fresca de Azeitão and "Igreia da Misericordia" and "Igreija de S. lourenço" in Vila Nogueira de Azeitão); the palaces ("Palácio da Quinta da Conceição" - XVIII century, in Aldeia de Irmãos and "Palácio da Bacalhoa" in Vila Fresca de Azeitão); the fortresses ("Forte de Santiago" in Outão and "Forte de Santa Maria" in Portinho da Arrábida) and landfarms ("Quinta de Carralhiz"). (Selecções do Readers Digest, 1992).

The PNA has not only big houses like palaces but also traditional and typical village houses, like small fisherman's houses near the beach (Juna *et al.*, 1989 and Vasconcelos, 1992).
The agriculture occupies half of the area of PNA. The principal products are cereals, wine and olives. The most important products for the economy of the region are the wine ("vinho Moscatel de Setúbal") and the cheese ("Queijo de Azeitão") that is traditionally handmade (Vasconcelos, 1992). Other traditional handmade activities are the manufacturing and decoration of glazed tiles, basket, saddler and tinker work (PNA, 1988). Some of the fishery in the area is still done in a traditional way (Ribeiro, 1986).

LANDSCAPE VALUES

A diversity and rareness of landscape is found in PNA, starting with the forests, as the "Mata Coberta", "Mata do Solitário" and "Mata do Vidal" that are closed to the public as an integral reserve due to its scientific interest; the mountains like the Serra do Risco, Arrábida. S. Luis, Gaiteiros, S. Francisco e Louro in direction of three lines of relief parallel to the coast; the cliffs and ravines that fall in to the sea, and finally the lovely sand beaches.

THREATS

Housing and industries

The geologic richness of Arrábida has led to the existence of quarries that lead to one of the major contributions to degradation. Mineral exploration is going on ranging from the manufacturing of pieces of stone and concrete to gypsum mines and quarries for ornamental stone. To minimize the negative consequences of these industries in PNA, there must be a plan for landscape recovery (Vasconcelos,

1992).

Other kinds of industry that exist in PNA are meat processing, wineries, thermoelectric plants and ore-smelting (Carvalho, 1992).

There used to be some clandestine houses that are now already destroyed (Vasconcelos, 1992).

Traffic infrastructures

The PNA needs roads and railways to access the beaches. The actual and future traffic infrastructure seems not to endanger the landscape of this park. Car-parkings and other supporting constructions are being made with a good planning (Vasconcelos, 1992).

Tourism

The PNA suffers much pressure from the tourism agents due to its beauty, good climate and coastal area. Despite this there are no hotels in this area but the number of visitors to PNA is considerable (Vasconcelos, 1992). If good measures are not taken the tourism can be a powerful threat to the environment protection of this area.

Agriculture

The present extension of maquis and garrigue type formation on Serra da Arrábida result from intensive anthropogenic sources, that have affected most of the vegetation and original soil condition. Most areas were destroyed by agriculture pressure. During the last centuries, with increasing human occupation, widespread clearance and cultivation of arable land and modification of non-arable land by grazing, took place (Catarino *et al.*, 1981).

Fire

The removal of anthropogenic pressures generates dense impenetrable thickets of maquis, uniform in structure, representing an important accumulation of fuel prone to be consumed in catastrophic fires such as occurred in 1978,1981 and 1991, affecting the southern slopes (Catarino *et al.*, 1981 and Vasconcelos, 1992).

Pollution

The pollution of the PNA exists but not on a significant scale. It is mostly because of industries already named. The air pollution is due to quarrying and the thermoelectric plant. Water pollution is due to meat processing, thermoelectric plant and ore-smelting.

Spreading of introduced (allochthonous) species

There is an area of 55 ha of Eucalypus. This forestry area is located where the water available does not allow its expansion (Vasconcelos, 1992). Also *Pinus pinaster* has been introduced (Pedro, 1991).

Erosion

The erosion that exists in this area is due to sea level rise and a decrease of river sediments transport which happens in all the coastal area of Portugal.

PROTECTION MANAGEMENT AND RECOMMENDATIONS

The nature conservation measures are made by the attribution of reserves in PNA, that means the

integral reserve (forbidden public entrance), the botanic reserve, the geologic reserve and the landscape reserve (PNA, 1988).

The PNA is the first protected area which felt the problem of tourism, but it should be the one which best solved it. By demolition of clandestine houses and by thinking of rural tourism due to the fact that PNA with its landscape values, has rich and traditional patrimonies such as palaces, farms and even small traditional houses that are/were in ruins and that can be rebuilt and redecorated with the aim of habitation tourism (SNPRCN, 1990).

The PNA has already established actions of environment education like manifestations, presentations and explanation of the natural values at schools, and guided visits. All these actions are very important for the protection of this natural park. There is also a future project about prevention of forest fires in PNA (Vasconcelos, 1992).

The quarrying industries already have equipment to decrease the pollution in PNA. It is necessary to require that all industries in this area obtain equipment to purify the pollution at the sources.

If the law which established the Arrábida as a natural park is respected, if no more industries are allowed, if regional planning is not neglected, if precautions for forest fires are taken and if pollution and tourism are controlled, it will be possible to maintain this ecological Portuguese value.

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