

Management of biotic resources in ancient Greece

V. P. Papanastasis

School of Forestry and Natural Environment, Aristotle University, 541 24 Thessaloniki, Greece

M. Arianoutsou

Department of Ecology and Systematics, Faculty of Biology, School of Sciences, University of Athens, 157 84 Greece

G. Lyrantzis

National Agricultural Research Organization, Aigialeias 19 & Halepa, 151 25 Athens, Greece

Keywords: agriculture, climate, forestry, hunting, livestock husbandry, landscape

ABSTRACT: Biotic resources and their management in ancient Greece has been a considerably studied and widely debated issue. To some scholars, ancient Greece was a land of noble forests and crystal fountains which were subsequently destroyed by human activities to result in the present day arid and degraded landscape. Others argue that the present landscape is not much different from the ancient one. Nevertheless, all agree that the climate was Mediterranean-type, perhaps a little cooler and less arid than today. Flora and fauna were not much different from the present ones. Forests were regularly exploited but mainly produced wood rather than timber. Agriculture was based on cultivation of small fields (2-4 ha). Production aimed at self-sufficiency and involved multiple cultures as well as crop rotation. Livestock husbandry was based on forage resources produced both in arable and wild lands. Hunting was practiced for social (e.g. prestige) and political rather than economic reasons. It is concluded that the physical environment of ancient Greece was complex and diversified and Greeks had learned to live quite well within its limitations.

1 INTRODUCTION

The 10th MEDECOS Conference, organized in Greece at the dawn of the 3rd millennium AD, coincides with another major event, also occurring in Greece this year, the return of Olympic Games to their birth place. Such a return provides a sense of continuity with the Olympic Games of antiquity while at the same time it raises the need and curiosity to compare the modern Games with the old ones.

Mediterranean-type ecosystems date back several thousand years ago. Yet, the MEDECOS conferences hardly dealt with their management in antiquity so far. Such an inquiry would have been an interesting scientific endeavor and could provide important insights for their study in our times.

The return of the Olympic Games in Greece this year gives us an opportunity to introduce to the Conference the ways that Mediterranean-type ecosystems and biotic resources in particular were managed in ancient Greece, during the period when Olympic Games were held, namely from the 8th century BC to the 3rd century AD. The subject is huge and complicated and several archaeologists and ecologists have studied it. This paper is no more than a modest attempt to connect the past with the present and give MEDECOS conferences the sense of continuity with antiquity that might provide a new dimension to their future scientific inquiries.

2 THE LANDSCAPE IN ANCIENT GREECE

2.1 *General*

There are opposing views as to how the landscape looked like in ancient Greece. The popular belief is that it was greener and much more forested than today and the current landscape is ruined and degraded compared to the ancient one. According to Grove and Rackham (2001), this belief originates in the 16th-17th centuries when Renaissance poets and Baroque painters promoted the idea that the great events in classical Greece occurred in scenery not unlike Normandy and central Europe in general. Later on, in the middle of 18th century, Barthélémy (1788) mentioned by Rackham (1996) visualized ancient Greece as a land of noble forests and crystal fountains, like Marie-Antoinette's France, suggesting that Greece had been destroyed since classical times. From that time on and especially after the classical work of George Perkins Marsh in 1864 about "Man and Nature", the deforestation of the Mediterranean region has been presented as a classical example of man's destructive effects on the environment (Thirgood 1981).

Several scholars tried to scientifically support the "degradation" hypothesis (e.g. Thirgood 1981, Hughes 1983, Tsoumis 1986). They developed the theory that man and his activities (e.g. cultivation, woodcutting, shipbuilding, fire, grazing, etc) were the main agents of deforestation and landscape degradation. Such a degradation has been cumulative up to the present time suggesting that damages done in the classical period were added to the ones done in the Roman, Byzantine, Venetian, Ottoman and so on periods. On the other hand, the "degradation" hypothesis was substantiated by the Clemensian vegetation succession and climax theory of the 20th century, duly developed by the Montpellier school of phytosociology. Followers of this theory consider Mediterranean ecosystems and especially the sclerophyll shrub ecosystems of the region as degraded plant communities and suggest a complete protection from human activities in order to establish the climax forest vegetation (e.g. Tomaselli 1977).

A more critical examination of the written sources, however, does not substantiate that classical Greece was greener and more wooded than today. After carefully examining all these sources, Grove and Rackham (2001) reached the conclusion that modern Greece has surprisingly little changed compared with ancient Greece, except for coasts, deltas and marches, and that Xenophon would not have had any difficulties recognizing most of the country before the recent decline of cultivation and expansion of woodlands in the mountains. Also, Rackham (1983), by comparing ancient authors point by point with 19th century travelers and with present vegetation, came to the conclusion that Athens had roughly as much forest in classical times as in 1920s, and less than it has now.

On the other hand, Naveh and Lieberman (1994), after a detailed analysis of the evolution of cultural landscapes in the Mediterranean basin, suggest that during the biblical and classical times the densely wooded natural landscape was transformed to a more open and much richer cultural one though agro- pastoral human state factors such as burning, clearing, cutting, coppicing, cultivation, grazing, etc. As a result, the natural vegetation was retained only in the least accessible mountain areas. The same authors also question the climax theory for the Mediterranean plant communities since people had already modified these communities in the middle Pleistocene, even before the present Mediterranean climate was established. This means that the current Mediterranean plant communities in Greece do not necessary represent degradation stages of a forest climax with natural (i.e. primeval) vegetation, since such vegetation hardly exists. Also, not all habitats in the Mediterranean region can support trees.

2.2 *Climate*

Different opinions occur for the role of climate on the formation of present-day landscape after 3000 BC. The problem lies on the possible interpretation of the fact that pollen records clearly re-

port an abundance of deciduous trees before that time and their gradual replacement by evergreen flora ever since (Bottema 1994, Willis 1994). This development coincides with the onset of Bronze Age settlements in the Mediterranean region and the increasing influence of the human factor on the environment. This has led some scholars, especially palynologists and archaeologists, to the theory that after the stabilization of the climate, human activity took over and formed the Mediterranean landscape (van Andel et al. 1990, Bottema 1994, Willis 1994, Runnels 1997). Others, however, mainly environmentalists, attribute this development mainly to climatic conditions, which became cooler and less arid allowing a temporary increase of deciduous forest around 4000 BC but their subsequent gradual desiccation favored evergreen species (Sallares 1991, Willis 1994, Grove and Rackham 2001). Probably both views are in their way correct, given that after approximately 3000 BC both climatic conditions and human activities seem to have played an important role on the formation of the landscape.

There is a consensus among scientists, however, that the present-day Mediterranean climate was stabilized around 3000-2500 B.C. (Late Neolithic or Early Bronze Age) (Bottema 1994, Willis 1994, Grove and Rackham 2001). Mild winters, dry summers and increased precipitation in November and December must have characterized the climate of classical antiquity as well (Willis 1994), whereas regional diversity and interannual variability were also traced back in antiquity mainly through their impact on harvest numbers (Garnsey 1988). After reviewing all the written evidence, Grove and Rackham (2001) concluded that the climate during the Classical to Roman periods was a little cooler and less arid than nowadays. This evolution from a wetter to a drier climate is also recorded in pollen diagrams since 1200 BC (Bottema 1994).

2.3 *Geology and geomorphology*

Closely related to the climate is the geology and geographical position of Greece. The extensive coastline and solid relief factors, such as the crystalline massif of the Cyclades block and the mountains of Pindos and Crete, are responsible for large-scale altitudinal variations in temperature and precipitation. Climate and geology have undoubtedly resulted in the richness and diversity of the present-day flora of the whole Balkan Peninsula and, especially, Greece (Willis 1994).

With regard to geology and geomorphology of ancient Greece and the whole Mediterranean, much attention has been drawn on the history of erosion in the last decades. The washing away of soil from slopes to valleys, rivers and coastline has been a subject of controversy among scholars. On the one hand, questions arose as to whether the erosional history of the Mediterranean was completed in the two major phases (the Older and Younger Fill) or in many smaller, with the latter being quite unambiguous nowadays (Grove and Rackham 2001). On the other hand, the reasons causing erosion in historic times remain unclear. Especially in Greece, extensive field-work carried out by archaeologists and geo-archaeologists (e.g. van Andel et al 1990, Runnels 1997, Krahtopoulou 2000) has clearly tried to connect periods of erosion with periods of extensive human activity and to point out deforestation, clearing land for farming and other activities as the main causes of the phenomenon. However, as their results are contradicted by counter-examples, Grove and Rackham (2001) developed the thesis that the primary determinant of erosion is tectonics and the second lithology; when both of them favor erosion; weather determines its extent while vegetation comes fourth in importance.

3 BIOTIC RESOURCES

3.1 *Flora*

The natural vegetation of the Mediterranean region and, especially, of Greece consists of evergreen forest on low altitudes, mixed deciduous woodlands on middle, coniferous forests on high and sub-

alpine and alpine communities on even higher altitudes (Willis 1994). Special reference needs to be made to the incomparable regional diversity of Mediterranean flora (Cowling et al. 1996), as well as to the presence of a significant number of endemic species, owing mainly to relief and climate (Kokkoris and Arianoutsou 2000, Grove and Rackham 2001). This flora, however, has undergone several changes since the onset of Holocene.

The main source of information about the history of vegetation is palynological research carried out during the last decades on various spots, although scholars warn against limitations and interpretation problems of pollen records, especially in the Mediterranean region (Atherden 2000, Grove and Rackham 2001). According to pollen diagrams, the Greek landscape during the Holocene experienced an initial expansion of deciduous oak forest and *Pistacia*, which were then gradually replaced by forests dominated by *Abies*, *Pinus*, *Fagus*, etc. till approximately 2500 BC, with an interval (around 4000 BC) showing an expansion of *Carpinus orientalis*. From that point onward new tree types, mainly fruit-bearing ones, such as *Juglans*, *Castanea*, *Platanus*, *Olea* and others, were established more and more, giving the landscape its present-day form (Bottema 1994, Willis 1994, Gerasimidis and Athanasiadis 1995). This last stage of development is connected with the beginning of Bronze Age civilization and, therefore, to the extensive anthropogenic activity, or to climatic change, but it seems to be a problem of where the emphasis is to be put on (Grove and Rackham 2001). On the whole, there is a clear change from a landscape dominated by deciduous trees to one dominated by evergreen flora, which corresponds with the gradual aridization of the Mediterranean climate and, of course, with an increased human presence. On the other hand, Greece has not witnessed any significant alterations since classical times. This is based both on pollen records but also on ancient written sources, which describe an environment very similar to the present-day one (Rackham 1996, Grove and Rackham 2001).

3.2 Fauna

According to Sallares (1991), the ecosystem of the Mediterranean with its plants and animals had not yet fully developed in classical Greece, since the climate was still changing till the end of the Neolithic. Some well-known species had not yet reached Greece, e.g. the rabbit, native to the Iberian Peninsula. Others had reached Greece but were still at the beginning of their development, e.g. the domesticated horse, which came from Southern Russia, and was small in size and relatively weak as an animal throughout classical antiquity.

Wild animals existed in the Mediterranean since at least the Pleistocene and till classical times. Wolves, bears, boars, leopards and foxes are mentioned in ancient writers and sometimes depicted in art (Dalby 1996, Fox 1996). All these animals were reduced in numbers by the 4th century B.C., owing mostly to human population density and hunting. Lion in particular was a common symbol in the Mycenaean world and a widespread royal symbol in the Persian, Macedonian and the Hellenistic kingdoms. Lion bones were found in Tiryns (end of the 2nd millennium BC). In classical times, it was restricted in Macedonia and Thessaly and it had probably become extinct two centuries later, not only because of human activity but also because of the lack of extensive grasslands and potential prey in the Mediterranean (Sallares 1991).

4 ATTITUDE OF ANCIENT GREAT WRITERS TO BIOTIC RESOURCES

In general, all ancient writers had an interest in natural environment but few of them went as far as providing a detailed description of biotic resources and their management. Starting from Homer, there are several references to plants and animals in his epic poems, especially *Odyssey*. Although most of them provide insights about vegetation and biotic resources in general, they cannot be exploited scientifically since Homer is describing a heroic rather than a real world. In fact, Hesiod was the first author in antiquity (7th c. BC) to give us a detailed account of a farmer's life and ac-

tivities in his poem *Works and Days*, where he provides useful information on agriculture, animal labor, wood-cutting, food, etc.

In the classical period, Xenophon and his *Oikonomikos* help us restore ancient management practices, especially those related to agriculture and livestock husbandry, of a wealthy landholding, while his *Kynegetikos* is a whole book on hunting, which he himself practiced a lot. The great philosopher Aristotle showed a keen interest, among others, in animals, to which he devoted ten books describing their anatomy, physiology and reproduction. His pupil Theophrastos, with his written work on plants (*Aetiology of Plants* and *Enquiry into Plants*), stands at the beginning of a scientific approach to the subject and is regarded as the father of botany. His classifications and descriptions of plant species are even nowadays a useful source of information.

Sporadic descriptions of natural environment and scattered information about management practices are also contained in several other ancient Greek writers, such as Sophocles and the other tragedians, historians like Thukydidēs, Strabo, Pausanias etc.

However, the writer who was much associated with the “degradation” hypothesis of antiquity is the great philosopher Plato. Several contemporary scientists have used his famous and frequently cited passage about erosion in Attica, contained in *Kritias*, as an evidence of mismanagement of biotic resources, especially forests.

Despite the interest of all these writers to natural environment, very few of their writings imply ecological concern, at least the way we mean it nowadays. They do imply, though, ecological awareness. However, it is not known whether their contemporaries also shared this awareness. Rackham (1996) argues that Greeks were less ecologically minded than Romans and Hebrews. Nevertheless, ancient Greeks managed to live in balance with their environment and create at the same time a great civilization.

5 MANAGEMENT ACTIVITIES

5.1 *Agriculture*

When talking about agriculture in antiquity, one must first refer to plants. The cultivated plants are living organisms, which never stop evolving. In the past, scientists tended to think that ancient agriculture was practiced in the same way and with the same plants as in modern times. Recent research (Sallares 1991), however, has shown that the Mediterranean ecosystem was not yet fully developed by that time, since the climate had only recently been stabilized, and that it was constantly changing (and still is) with the introduction of new species, mainly from the East, and the biological evolution of others. Major agricultural products in Greece today, such as rice, sugar beet and cotton, were hardly known in antiquity. Others, like maize, potato and tomato, were introduced, of course, much later. And the well known three crops, i.e. vines, olives and wheat were practically made to fit into the Mediterranean ecosystem only in the first millennium BC. Evidence suggests that even the cultivation of fruit-bearing trees was an innovation of the same time. Wheat, in particular, was till classical times a secondary crop in Attica, in comparison for example to barley, which yielded more in small landholdings, and wheat bread was regarded as a luxury product (Garnsey 1988, Sallares 1991, Dalby 1996). Wheat became the main cereal later, when new, more productive, types of naked wheat evolved (Sallares 1991).

In the last few years, our understanding of ancient agricultural practices has also changed drastically. The conventional view of ancient agriculture based on extensive monoculture of wheat, biennial fallow and no integration of animal husbandry must be revised (Garnsey 1988, Sallares 1991, Halstead 2000). The character of ancient farming was mainly determined by the word *autarkeia*, which means self-sufficiency. Farmers and city-states strived for subsistence, not high productivity, as great urban markets were absent. Moreover, cereals were preferred to pulses or legumes because the latter needed greater amounts of water than the former. Also, the practice of

intercropping was common, especially the mixture of cereals and olive trees or cereals and pulses or legumes, which increased the productivity of the single crops. On the other hand, the average landholding in classical Attica was small and estimated to only 2-4 ha (Garnsey 1988). This means, apart from the fact that many farmers practically did not employ animal labor that farmers had to look for other sources of food supply, too. Such sources could be provided either by small-scale animal husbandry (which is discussed below) or by the various uses of uncultivated land, as suggested by Forbes (1996).

Two more subjects concerning ancient agriculture must be mentioned here, which are controversial. The first is the question of existence of a class of free peasant farmers. Although recent field surveys have uncovered many isolated rural sites in the ancient Greek landscape, many scholars are unwilling to ascribe them to independent peasant farmers, and seem to prefer interpreting them as rural estates of a few wealthy landowners (Garnsey 1988, Forbes 1995). Second comes the long-debated issue of terracing in antiquity. There are scholars that assume their ample existence since prehistoric times (e.g. van Andel et al. 1990, Runnels 1997) and others who do not recognize neither any surely datable ancient example nor they can find a written mention of this particular practice (Foxhall 1996). Recent research thinks that terracing must have been a popular way of facilitating cultivation on steep slopes in ancient times but tends to be more cautious with the dating of the still-existing terraces (Frederick and Krahtopoulou 2000, Grove and Rackham 2001).

5.2 *Livestock husbandry*

Ethnographic surveys and approaches which interpret phenomena of the past on the basis of current perceptions have created a picture of ancient pastoralism quite similar to modern practices, involving independent, self-sufficient herders and movement of the flocks between winter and summer pastures. Recent, more careful, research, however, has clarified and revised several aspects of ancient pastoralism.

Firstly, it has been made clear that the classical world generally lacked specialized pastoralists (Hodkinson 1988, Forbes 1995). Herding animals as a means of subsistence was only an exception and written sources often imply that herding was regarded as a lower-status activity practiced usually by slaves on behalf of wealthy landowners. On the other hand, keeping few animals as a nutritional resource must have been a quite widespread habit of many small arable-based households, whereas larger flocks remained primarily in the hands of rich men, who exploited animal products in order to maximize their wealth. On the whole, animal husbandry did not play a significant role in ancient economy for the additional reason that animals would have to compete with increased human population density within the small territory of ancient city-states (Sallares 1991).

Secondly, there is general agreement that sheep and goats were far more popular than cattle, because they regenerate and grow faster and because they can be fed more easily. Furthermore, sheep and goats are better adapted to the upland terrain of the Greek landscape than cattle (Hodkinson 1988, Sallares 1991). Special reference should be made to horse breeding, an activity practiced by the wealthy people mainly as a means of manifesting superiority. Besides, it has already been mentioned that horses in antiquity were smaller in size and weaker than today and their primary purpose was no other than the competition in various races (Hodkinson 1988, Sallares 1991).

Transhumance in antiquity is an issue still argued. Although small-scale movements of flocks can be supported by references in written sources (Hodkinson 1988) and by the uncovering of ancient settlements on high altitudes on the Pindos mountains (Chang and Tourtellotte 1993), large-scale nomadic movements like the ones practiced in more recent times in Greece and elsewhere were persuasively contradicted by some modern scholars (Hodkinson 1988, Forbes 1995, Halstead 2000). The main argument, apart from the paucity of ancient evidence, is that these movements require strongly developed lowland agriculture, great demand for pastoral products and a politically unified territory, all of which were not provided in classical times. Thus, movement of flocks in antiquity probably concerned only short migrations with the goal of finding available pasture.

The last issue concerning animal husbandry is the degree to which it was integrated in arable farming. All previous statements seem to point towards a close relationship of the two. Hodkinson (1988) has even suggested that animals could be kept in or around cultivated fields (near fens and marshes, on hillsides, etc.) throughout the year, grazing fodder or the waste products of agriculture and providing manure for the fields. Similarly, Forbes (1995) emphasizes the availability of uncultivated areas for the grazing animals, but points out that for a significant part of the year animals must have been held on agricultural estates. Sallares (1991), on the other hand, tends to undermine the degree of integration between ancient animal husbandry and agriculture. On the whole, however, there seems to be no doubt that ancient animal husbandry cannot have existed in complete divorce from arable farming, but it should be emphasized that the ancient Graeco-Roman world presents a large variety of landscapes and socio-political conditions, which would justify many different agro-pastoral practices. The same conclusion is reached by Valamoti (2001) for an earlier than classical period, namely late Neolithic to early Bronze Age, when farmers had adopted a number of various options as far as animal husbandry is concerned, ranging from a grazing pattern confined to settlements to grazing away from them depending on the availability of feed resources. Farmers in contemporary Greece follow similar strategies too.

5.3 Forestry

Forests, along with mountains, meadows and springs, were regarded in antiquity as habitats of nymphs and of the goddess Artemis, as well as the original home of mankind (Hughes 1983). Groves of trees were devoted to various gods and were thus protected as sacred. Ancient mythology tells us about the heavy punishment of Erysichthon, son of the king of Thessaly, who cut off wood in the sacred grove of Demetra, in order to build a big dining hall in his palace, and was punished by the goddess with unlimited hunger (Hughes 1983). Apart from religious reasons, however, there is no adequate evidence to suggest that ancient Greeks or Romans were generally conscious and worried about over cutting of forests or concerned with their protection (Meiggs 1982).

Deforestation has been a particularly popular subject in the last decades. Based on the present-day picture of Mediterranean forests and the references in ancient writers (mainly Plato), some scholars tried to support a theory of continuous depletion of forests throughout human history (Thirgood 1981, Hughes 1983, Tsoumis 1986). Clearing land for agriculture, fire, grazing by goats and woodcutting were presented as the main factors causing deforestation. However, views like that are contradicted and revised (Rackham 1996). The most persuasive arguments that are being presented are the special features of the Mediterranean vegetation and climate, which could never have supported dense deciduous forests (Meiggs 1982, Grove and Rackham 2001), as well as the ability of trees to regenerate and adapt to various conditions (Rackham 1996). It is true that ancient Greeks and Romans needed timber for many purposes, such as building of houses, shipbuilding, army, art, fuel, etc., but the nearby forests provided generally adequate timber supplies. In cases of great demand, such as the 5th century Athens, they had to import timber from more wooded regions of Greece (Macedonia) or elsewhere (e.g. Sicily) (Meiggs 1982). The latter fact was neither something that happened all the time nor is it enough to suggest a serious damage on the forests. Besides, a more critical approach of the ancient sources reveals nothing equal to massive deforestation. In fact, ancient references, which testify depletion of woodlands, are counterbalanced by others implying the opposite (Meiggs 1982), while a comparison of the landscape descriptions by Pausanias (2nd century A.D.) with the modern landscape does not reveal great changes in forest density (Grove and Rackham 2001). On the whole, damage on ancient forests should not and cannot be exaggerated for the additional reason that hardly estimated factors, such as religious restrictions and, mainly, transportation problems would impose automatic checks on the exploitation of timber (Meiggs 1982).

Pollen records are a quite reliable source of information on this subject. In short, such records describe a gradual expansion during the Holocene of evergreen woodland, dominated by *Pinus*,

Abies, etc., at the place of deciduous forests and the introduction of new, fruit-bearing tree-types after 2500 BC (Bottema 1994; Willis 1994; Gerasimidis and Athanasiadis 1995). In historic times and till recently, pollen diagrams show that the human factor has played an important role in the evolution of Mediterranean forests. Human history in general, especially population movements up to the mountains or down to the lowlands, has undoubtedly affected and still affects forests, causing sometimes their reduction, retreat or even destruction. Other times, however, forests are left to regenerate, while more positive effects, such as the introduction, protection and expansion of new forest species, can also be attributed to human interference (Gerasimidis 2000). Thus, evidence from pollen records cannot support a one-sided role of human factor on forest density.

Special reference should be made to the role of goats and, generally, pastoralism on deforestation. The ancient Greeks and Romans, just like modern people, were perfectly aware of the bad habits of these animals, which can eat almost everything but have a special preference for young trees. When left uncontrolled, goats could destroy a vineyard or prevent a young forest from regenerating. Equally, pastoralists are often accused, even in modern times, of causing deforestation with several practices, such as burning of forests in order to create pasture, a practice recorded also in ancient writers (Thirgood 1981, Hughes 1983, Meiggs 1982, Forbes 2000). It has been argued, however, that herders are part of their environment, fully aware of their role within it (Forbes 2000), whereas goats were and still are a very useful animal when managed properly (Meiggs 1982, Papanastasis 1986).

5.4 *Fire*

Fire has a very long history, dating even to the Upper Paleolithic (Grove and Rackham 2001). It has played a decisive role in post-glacial geological and cultural evolution in the Mediterranean basin (Naveh 1975). It is nowadays widely accepted that the Mediterranean ecosystem includes many fire-adapted or fire-dependent species, which can be easily reproduced by sprouting or seeding. Among the greater plant beneficiaries are woody shrubs and pine trees (Arianoutsou 1998, Atherden 2000, Grove and Rackham 2001).

In Greece, the first archaeological evidence of fire occurrence goes back to the end of the Middle Stone age (Higgs et al 1967). After reviewing the history of burning in Greece, Liacos (1973) considers that fire was used as a tool to open up forests and convert them to grasslands for grazing of livestock since the 2nd millennium BC. This fire, also known as occupational or pastoral burning, was practiced in the Roman times, too (Hughes 1983). Since then, landscape changes in the Mediterranean ecosystems were very much influenced by fire (Naveh and Lieberman 1994, Arianoutsou 2001).

On the other hand, ancient writers do not often report forest fires. Among the few references, there is one by Thukydides who states that fires are ignited through the wind rubbing branches together, as well as reports of fires set by armies for military purposes (Thirgood 1981, Hughes 1983).

5.5 *Hunting*

It seems that hunting in ancient Greece was practiced mainly by man as a way of showing bravery and virtues such as *agon* (fight –ruse), *techne* (art), *arete* (virtue). Other reasons, e.g. food supply, military practice, fitness, pest-control, were less important, while reasons that concern ecological consciousness must be excluded (Fox 1996). Human hunting was, of course, in many cases, along with population density and expansion, responsible for the extinction or limitation of animal species (bears, boars, etc.) and there are a few cases where hunting was done on purpose, in order to constrain the expansion of a species. This was the case of the island of Astypalaia during the reign of the Macedonian king Antigonos Gonatas. A man from Anaphe had introduced a pair of hares loose in the island but they very soon became a plague and threatened to drive people out of their

homes. Delphic Apollo was then consulted and he advised them to apply intensive hunting (Fox 1996). In general, however, hunting was practiced for fun, or it was not practiced at all (for example on most islands). Limitations also existed with regard to sacred landscapes.

Hunting was practiced in a variety of landscapes (mountains, forests, hillsides, valleys), depending on the prey. Hunters would be on horseback or on foot and they would use various weapons. Among the most popular games were big animals (boars, bears, foxes, wild goats, deer, leopards etc.), hares and many kinds of birds. Most of them would make a fine meal, considering that the catch was not used in religious sacrifices (Dalby 1996, Fox 1996).

According to Fox (1996), the form and popularity of hunting in the ancient Graeco-Roman world was closely related to political changes. Hunting was very important among monarchic states of any time (Mycenaean, Persian, Macedonian and the Hellenistic kingdoms), whereas the lion hunt always had a royal symbolic meaning (e.g. fresco on Vergina's tomb). In Sparta, hunting involved the sharing of the catch, whereas in aristocratic Athens it was related to personal competitiveness and gift giving. In democratic Attica, it was practiced less and less, owing to population density, heavy cost and lack of good prey, and Xenophon, a well-known fan of the sport, complained for its diminishing popularity. Hunting became once again important in Hellenistic cities, where the newly established class of the rich had to prove its social and political pre-eminence, while in Roman times it was for the first time introduced in theatres and amphitheatres as a popular spectacle.

6 CONCLUSIONS

1. Recent research generally agrees that the landscape and climate of ancient Greece had already been stabilized since late Neolithic, although minor climatic changes and erosional history are still unclear. Flora and fauna, however, were not yet fully established, probably going through their last stages of formation and adaptation. These, of course, do not suggest that they differed significantly from the present-day ones.
2. There is no question that a few great writers such as Plato, Aristotle, and Theophrastos were ecologically minded. It is not sure though if this ecological awareness was wide spread among people both of the ruling class and among peasantry.
3. The Greek landscape is quite robust and resilient and ancient Greeks seem to have known both its strengths and weaknesses. They had learned to live within its limitations and this knowledge helped them to develop one of the most brilliant civilizations of the ancient world.

ACKNOWLEDGEMENTS

The assistance of Mr. Konstantinos Papanastasis, archaeologist, in reviewing most of the literature cited in this paper is gratefully acknowledged. Sincere thanks are also expressed to Dr Soultana-Maria Valamoti, archaeobotanist, for helping us in locating some of this literature.

REFERENCES

- Arianoutsou, M. 1998. Aspects of demography in post-fire Mediterranean plant communities of Greece. In: Rundel, P.W., Montenegro, G. & Jaksic, F. (eds). *Landscape Degradation in Mediterranean-Type Ecosystems*. Ecological Studies 136, Springer Verlag, pp. 273-295.
- Arianoutsou, M. 2001. Landscape changes in Mediterranean Ecosystems of Greece: implications for Fire and Biodiversity issues. *Journal of Mediterranean Ecology* 2: 165-178.

- Atherden, M. 2000. Human impact on the vegetation of southern Greece and problems of palynological interpretation: a case study from Crete. In: Halstead, P. & Frederick, C. (eds). *Landscape and Land Use in Postglacial Greece*. Sheffield Academic Press, Sheffield, pp. 62-78.
- Bottema, S. 1994. The prehistoric environment of Greece: a review of the palynological record. In: Kardulias, P.N. (ed). *Beyond the Site: Regional Studies in the Aegean Area*. University Press of America, Lanham, pp. 45-68.
- Chang, C. & Tourtellotte, P.A. 1993. Ethnoarchaeological survey of pastoral transhumance sites in the Grevena region, Greece. *Journal of Field Archaeology* 20: 249-264.
- Cowling, R.M., Rundel, P.W., Lamont, B.B., Arroyo, M.K. & Arianoutsou, M. 1996. Plant diversity in Mediterranean-climate regions. *Trends in Ecology and Evolution* 11 (9): 362-366.
- Dalby, A. 1996. *Siren Feasts. A History of Food and Gastronomy in Greece*. Routledge, London.
- Forbes, H. 1995. The identification of pastoralist sites within the context of estate-based agriculture in ancient Greece: beyond the 'Transhumance versus Agro-Pastoralism' debate. *Papers of the British School at Athens* 90: 325-338.
- Forbes, H. 1996. The uses of the uncultivated landscape in modern Greece: a pointer to the value of the wilderness in antiquity? In: Shipley, G. & Salmon, J. (eds). *Human Landscapes in Classical Antiquity. Environment and Culture*. Routledge, London and New York, pp. 68-97.
- Forbes, H. 2000. Landscape exploitation via pastoralism: examining the 'Landscape Degradation' versus Sustainable Economy debate in the post-medieval Southern Argolid. In: Halstead, P. & Frederick, C. (eds). *Landscape and Land Use in Postglacial Greece*. Sheffield Academic Press, Sheffield, pp. 95-109.
- Fox, R. L. 1996. Ancient hunting: from Homer to Polybios. In: Shipley, G. & Salmon, J. (eds). *Human Landscapes in Classical Antiquity. Environment and Culture*. Routledge, London and New York, pp. 119-153.
- Foxhall, L. 1996. Feeling the earth move: cultivation techniques on steep slopes in classical antiquity. In: Shipley, G. & Salmon, J. (eds). *Human Landscapes in Classical Antiquity. Environment and Culture*. Routledge, London and New York, pp. 44-67.
- Frederick, C. D. & Krahtopoulou, A. 2000. Deconstructing agricultural terraces: examining the influence of construction method on stratigraphy, dating and archaeological visibility. In: Halstead, P. & Frederick, C. (eds). *Landscape and Land Use in Postglacial Greece*. Sheffield Academic Press, Sheffield, pp. 79-94.
- Garnsey, P. 1988. *Famine and Food Supply in the Graeco-Roman World*. Cambridge University Press, Cambridge.
- Gerasimidis, N. 2000. Palynological evidence for human influence on the vegetation of mountain regions in northern Greece: the case of Lailias, Serres. In: Halstead, P. & Frederick, C. (eds). *Landscape and Land Use in Postglacial Greece*. Sheffield Academic Press, Sheffield, pp. 28-37.
- Gerasimidis, N. & Athanasiadis, A. 1995. Woodland history of northern Greece from the mid Holocene to recent time based on evidence from peat pollen profiles. *Vegetation History and Archaeobotany* 4: 109-116.
- Grove, A. T. & Rackham, O. 2001. *The Nature of Mediterranean Europe. An Ecological History*: Yale University Press, London.
- Halstead, P. 2000. Land use in postglacial Greece: cultural causes and environmental effects. In: Halstead, P. & Frederick, C. (eds). *Landscape and Land Use in Postglacial Greece*. Sheffield Academic Press, Sheffield, pp. 110-128.
- Higgs, E. J., Vita -Finci C., Harris, D.R. & Fagg, A.E. 1967. The climate, environment and industries of Stone Age Greece, Part III. *Proceedings of the Prehistorical Society* 33: 1-39.
- Hodkinson, S. 1988. Animal husbandry in the Greek polis. In: Whittaker, C.R. (ed). *Pastoral Economies in Classical Antiquity. Cambridge Philological Society Supplementary* 14: 35-74.
- Hughes, J. D. 1983. How the ancients viewed deforestation. *Journal of Field Archaeology* 10: 435-445.
- Kokkoris, J. & Arianoutsou, M. 2000. The endemic plants of the fire-prone Mediterranean ecosystems of Greece: ecological profile and implications for conservation. *Book of Abstracts of the International Conference on Mediterranean Ecosystems, MEDECOS 2000, Stellenbosch, South Africa*.
- Krahtopoulou, A. 2000. Holocene alluvial history of northern Pieria, Macedonia, Greece. In: Halstead, P. & Frederick, C. (eds). *Landscape and Land Use in Postglacial Greece*. Sheffield Academic Press, Sheffield, pp. 15-27.
- Liacos, L.G. 1973. Present studies and history of burning in Greece. *Proceedings of the 13th Annual Tall Timbers Conference*. Tallahassee, Florida, pp. 237-277.
- Meiggs, R. 1982. *Trees and Timber in the Ancient Mediterranean World*. Clarendon Press, Oxford.
- Naveh, Z. 1975. The evolutionary significance of fire in the Mediterranean region. *Vegetatio* 29(3): 199-208.

- Naveh, Z. & Liebermann, A. S. 1994. *Landscape Ecology. Theory and Application*. (2nd edition). Springer Verlag, N. York.
- Papanastasis, V.P. 1986. Integrating goats into Mediterranean forests. *Unasylva* 154 (38): 44-52.
- Rackham, O. 1983. Observations on the historical ecology of Boeotia. *Papers of the British School at Athens* 78: 291-351.
- Rackham, O. 1996. Ecology and pseudo-ecology: the example of ancient Greece. In: Shipley, G. & Salmon, J. (eds). *Human Landscapes in Classical Antiquity. Environment and Culture*. Routledge, London and New York, pp. 16-43.
- Runnels, C. N. 1997. Umweltzerstörung im griechischen Altertum. In: Hoepfner W. (ed.). *Frühe Stadtkulturen*. Heidelberg/Berlin/Oxford, pp. 136-140.
- Sallares, R. 1991. *The Ecology of the Ancient Greek World*. Duckworth, London.
- Thirgood, J. V. 1981. *Man and the Mediterranean Forest. A History of Resource Depletion*. Academic Press, New York.
- Tomaselli, R. 1977. Degradation of the Mediterranean maquis. *Mediterranean Forests and Maquis: Ecology, Conservation and Management*. UNESCO, Paris, pp. 33-72.
- Tsoumis, G. 1986. The depletion of forests in the Mediterranean region. A historical review from ancient times to the present. *Scientific Annals of the Department of Forestry and Natural Environment, Aristotelian University of Thessaloniki* 28: 282-300.
- Valamoti, S.-M. 2001. *Archaeobotanical investigation of late Neolithic to early Bronze Age agriculture and plant exploitation in northern Greece*. Ph.D. thesis. University of Sheffield, U.K.
- van Andel, T. H., Zangger, E. & Demitrack, A. 1990. Land use and soil erosion in prehistoric and historical Greece. *Journal of Field Archaeology* 17.4: 379-396.
- Willis, K. J. 1994. The vegetational history of the Balkans. *Quaternary Science Review* 13: 769-788.