REGIONE TOSCANA

INTERNATIONAL ASSOCIATION FOR LANDSCAPE ECOLOGY (IALE)

Montecatini April 27 - May 1 , 1992

Landscape Approach to Regional Planning: The Future of the Mediterranean Landscapes

Sponsored by : Regione Toscana, IALE, Società Botanica Italiana, Società Italiana di Ecologia, Società Italiana di Ecologia del Paesaggio

Organized by the Museo di Storia Naturale della Lunigiana - Comune di Aulla

PALYNOLOGICAL CLIMATIC PAST AND FUTURE OF MEDITERRANEAN LANDSCAPES

Daria Bertolani Marchetti
Istituto ed Orto Botanico dell'Universita di Modena.

Summary

Numerous palynological studies investigate the events of mediterranean landscapes. The climatic-vegetational changes of the past can be reconstructed by means of paleopalynological investigations. It is possible to recognize the features of a mediterranean vegetation characterized by marked dry phases of climate, at least since the Messinian (Upper Miocene).

Knowledge of events related to the past can also provide information on the future. It would be very important to study areas now characterized by a dry climate in order to foresee climatic oscillations, as also generated by computer predictions.

The pollen rains from interesting areas of study can be collected by monitoring instruments such as pollen-traps or "natural traps" such as moss polsters. It would be interesting to calculate an index of mediterraneanism on the total percentage of pollens found.

THE PAST

The schematic reconstruction of climatic changes in the mediterranean landscape may be carried out on the basis of pollen analysis. Palynological research shows the past vegetation and consequently the past climate. The interpretation of palynological data requires a good knowledge of the present types of vegetation and their meaning in close connection with climatic features.

To correctly discuss the evolution of climate towards mediterranean conditions on a palynological basis, we must give a working definition to what is meant by "mediterranean.". When we talk about the geografical area of the Mediterranean, the problem of the different vegetational stages arises; these are characterised by different plant formations and climatic features with local wet

conditions, often the site of "rimanenze ecologiche" (Bertolani Marchetti, 1978), that appear in many palynological diagrams. The data available today are abundant but not exhaustive.

It is important to define a working hypothesis on mediterraneanism, in order to utilize palynological diagrams to evidence this climatic/vegetational aspect in successive times.

The characteristic that most strongly affect the mediterranean condition is the long summer-dry period. Only plants adapted to this condition can survive.

Thus we attempted to find dry, in particular hot-dry periods, in the diagrams, which are not always represented by the same species. Indeed, they change according to the age of the sequence but always follow a humid to arid trend.

Many specialists have attempted to identify the first appearance of mediterranean conditions as coinciding with the more of less intense dry periods or at least a yearly dry season, obviously corresponding with periods of increased thermophylous species in the diagram. Some authors have placed it at the post-glacial climatic warming (Follieri, 1984), whereas others at the Pliocene (Suc, 1978, Cravatte and Suc, 1981) or Plio/Pleistocene boundary (Bertolani Marchetti, and others 1979)

The very different times suggest climatic / plants' waves which progressively selected vegetational formations such as schlerophyll, evergreen forests or others requiring a certain degree of wetness, rich in "tertiary" plants.

The lower chronological limits for studies on the mediterranean condition was the late Miocene or Messinian, On the one hand, the Messinian flora is continuous with the present situation, and on the other there was a strong saline crisis with dry periods and availability of large new areas of land suitable for plant settlements. The Messinian occurred from about 6.5 to 5.5 MY before present (Bertolani Marchetti, 1968, 1976, 1978, 1984a, 1984b, 1985; Bertolani Marchetti and Cita, 1975, Bertolani Marchetti and Mariotti, 1988).

However, this lower limit may indeed be older because Bessedik (1983) has described at least two previous dry periods, and these have been documented for southern France: in the early Aquitanian (24-25 MY before present); the other very cool and dry

period, has catastrofic consequences for the megathermal plants of the upper Langhian/Serravalian, prior to the Tortonian/Messinian. This author makes a very interesting discussion on the relationships between the miocene and present day flora, hypotheses on the vegetational stages and the causes of their stratifications and the paleoclimate.

Bessedik (1983, pg.153) states the following;

"Sur le plan climatique l'interprétation de la juxtaposition de la zone semi-aride à saison séche avec les autres zones supérieures de végétation nécéssitant de fortes précipitations se concoit à partir de masses nuageuses humides s'accrochant sur les reliefs a partir de 400/500 métres d'altitude (nébulosité 50% environs) et compensant le déficit des précipitations. Cette compensation resultértait de la dualité entre l'effacement progressif d'un climat humide à précipitations essentiellement estivles (climat de type "asiatique") qui régissait au Paleogène les régions ouest-européennes et thetysiennes vers l'individualisation épisodique d'un climat à saison sèthe, de type subtropical, responsable de la zone semiaride en basses plaines au Miocène dans cette région. Cette adaptation des forêts sempervirente et decidue à des conditions climatiques particulières (nébulosité) semble avoir marqué, sous un climat de type transitoire, les périodes sèches miocènes y compris le Messinien.:

Overall, these remarks are valid for the Messinian, for which the hypothesis of vegetational stages of this type have been advanced (Bertolani Marchetti, 1968, 1975, 1976; Bocquet, Weidler and Kiefer, 1978).

In southern Italy, the messinian layers of Sicily show the start of the formation of a mediterranean shrubs. Mariotti (1937, plate 9, pg. 71) points out the widening of the percentages of the vegetation at progressively younger times in the layers of Eraclea Minoa (Agrigento, Italy)

Progressing towards present times, palynological studies have been carried out on some samples collected by the late Prof. Sergio Venzo in a sequence that seems to contain the conventional Plio-Pleistocene boundary at Le Castella in Calabria (Bertolani-Marchetti, 1975). At the lower levels, the flora is impoverished by the previous marked climatic conditions. Each spectrum presents

two vegetational belts. The basal one records changes from a mediterranean "macchia-gariga" to a steppe vegetation, and then perhaps evolution to a light forest of thermophylous hardwods (Quercus, Juglans, Carpinus, etc.). The upper belt comprised a conferous forest, with predominant pines, formed during the drier and warm period.

THE FUTURE

This topic is harder to discuss. One hand it is based on many climatic features from instrumental data that are hypothetically projected into the future. On the other hand a matter of some importance is the choice of the different kinds of palynological studies suitable for the purpose.

We have considered the climatic waves with a yearly summer dryness favouring the establishment of a mediterranean vegetational condition. Therefore, we must try to find forcasts on climatic trends among the climatological papers and identify the warmer and dryer predicted periods.

We must also consider the past vegetational features testified in the pollen diagnosis to forcast the future behaviour of known areas towards future climatic changes.

We do not know if the paleopalynological data available to date are sufficient to perform computer projections.

In a general view, there are today many problems due to atmospheric pollutants (such as CO2), a topic however that has not met with widespread consensus.

Danksgaard (1984) reports that 6-13 thousand years from now the distribution of summer insolation in the northern hemisphere will lead to cooling-related events, such as glacier advance. The same author cites from Kukla and Berger a prediction of a cooler climate within 3000-6000 years, according to an empirically designed astronomic climat index. Danksgaard questions whether the climatic transition will happen abruptly or gradually. He believes that the future of glaciation depends on natural and anthropogenic impacts, and points out that,

> "...man's impact may result in a climatic warming through the next few centuries, which may overcompensate the foreseeable natural coolong within the same period and perhaps for several

centuries beyond: it. If intense and sustained, the warming might be a threat, for different reasons, to the continued existence of the Greenland and the West Antartic ice sheets.

Flohn (1978), in discussing the different causes of climatic changes (astronomic, terrestrial) states,

"... we need also a reorientation of priorities for funding scientific research. On the risk of displeasing our colleagues from astronomy: we are forced to live (and we are multiplying ourselves) on this planet. Here we have to look ahead at all possible dangers first. The possibility of a shift of planetary rainfall belts by some 500 or 800 kilometers during the next century has so serious consequences for humanity, that we few specialists are indeed horrified by such prospects. Still, it is not too late to consider countermeasures in a concerted effort, in order to avoid misery and famine for probably more than 50 percent of mankind, while the other 30 or 50 percent may perhaps benefit from such change".

But now, remaining on our planet, let's see what can be done using palynology.

To obtain a palynological image of today, it would be very important to study areas now characterized by a dry/mediterranean climate. This image can be obtained through natural pollen traps consisting of moss polsters (Heim, 1962, 1970, 1971a, 1971b). This method allows to make transects through arboreal and non-arboreal formations along one or more segments. Perhaps, it is futuristic to expect to be able to repeat the transects in fixed position in successive years, at a reasonable intervals, to follow the variation of vegetation related to climate. Though this might be plausible for small climatic changes, it is unreasonable for large changes with timespans outside our reach. Also note that the natural evolution of plant communities can influence their future composition.

Monitor networks using spore-traps, that are being applied more and more in Italy, may be utilized to perform surveys and provide data suitable for computer elaboration. Perhaps an index of mediterraneanism could be established on the basis of the total percentage of pollens aspirated. Thus, the list of plant species and

also the number of grains of each, that may bear agricultural significance related to productivity, must be recorded.

But perhaps we are slipping into science fiction.

R E F E R E N C E S

BERTOLANI MARCHETTI D.,1968 - Vegetional features in sediments of Messinian "Formazione gessoso-solfifera" in Emilia and Sicily (Italia). Rep. 23th Sess. Intern. Geol. Congr. Czecosl. Abstr.,Academia,Prague : 271.

BERTOLANI MARCHETTI D.,1975 - Preliminary palynological data on proposed Pliopleistocene boundary type-section of Le Castella. Ateneo Parmense Acta Nat. 5(11):467-485.

BERTOLANI MARCHETTI D.,1976 - Ricerche palinologiche su sedimenti del Messiniano tirrenico provenienti dal pozzo 132 del DSDP. Giorn. Bot. Ital.,112: 296-297.

BERTOLANI MARCHETTI D.,1978 - Possibile significato paleogeografico e paleoecologico delle Taxodiaceae nei diagrammi pollinici del Pliocene terminale e dell'Eo-pleistocene. Giorn. Bot. Ital.,112: 296-297.

BERTOLANI MARCHETTI D.,1984a - Some paleoclimatical and paleovegetational features of the Messinian in the Mediterranean on palynological basis. 4th OPTIMA Meeting Palermo 6-14 June 1983. 3th Symposium Webbia,38:417-426.

BERTOLANI MARCHETTI D.,1984b - Analyse pollinique des intercalations marneuses du Messinien de la "Formazione gessoso-solfifera" (Bologne,Italie du nord). Paléobiol. Continent, Montpellier,14(2): 143-151.

BERTOLANI MARCHETTI D.,1985 - Pollen Paleoclimatology since Messinian Time. In "Geological Evolution of the Mediterranean Basin" Stanley D.J. and Wezel F.C. eds. Springer Verlag,New York:525-543.

BERTOLANI MARCHETTI D.,ACCORSI C.A.,PELOSIO G. and RAFFI S.,1979 - Palynology and stratigraphy of the plio-pleistocene sequence of the Stirone River (Northern Italy). Pollen et Spores,21 (1-2): 149-167.

BERTOLANI MARCHETTI D.,CITA M.B.,1975 - Palynological investigations on Late Messinian sediments revoided at DSDP Site 132 (Tyrrenian basin) and their bearing on the deep basin dessication model. Riv. Ital. Paleont.,81,201-308.

BERTOLANI MARCHETTI D.,MARIOTTI M.,1988 - Le Messinien d'Italie du point de vue palynologique. (Abstr.). Internat. Worksh. Contin. Faunas at the Miocene/Pliocene Boundary. Faenza,28/31 march 1988.

DESSEDIK M.,1983 The estly Aquitanian and Upper Langhian-Lower Serravallian environments in the northwestern mediterranean region. Paléobiologie Continenrale,14(2),Montpellier: 153-179.

BOCQUET G.,WIEDLER B. and KIEFER H.,1978 - The Messinian Model - A new outlook for the floristics and systematics of the mediterranean area. Candollea,33: 269-287.

CRAVATTE J.,SUC J.P.,1981 - Climatic Evolution of north-western mediterranean area during Pliocene and early Pleistocene by pollen-analysis and Forams of Drill Autan 1. Chronostratigraphic correlations. Pollen et Spores,23(2): 247-258.

DANKSGAARD W.,1984 - Past climates and relevance to future. in "The climate of Europe : Past,Present and Future" ed. Flohn-Fantechi, D. Reidel Publishing Company: 208-248.

FLOHN H.,1978 - Summary review and some thoughts on future climatic evolutions. in "Evolution des athmosphères planetaires et climatologie de la Terre." Nice,16-20 oct. 1978. Ed. Centre Nat. d'Etudes Spatiales (France): 569-572.

FOLLIERI M.,1984 - The history of the climate and vegetation in Italy based on palynological and macrofossil record. Webbia,38: 441-453.

HEIM J.,1962 - Recherches sur les rélations entre la végétation actuelle et le spectre pollinique récent dans les Ardennes Belges. Bull. Soc. Roy. Belg.,96: 5-92.

HEIM J.,1970 - Les rélations entre les spectres polliniques récents et la végétation actuelle en Europe occidentale. Mem. n.4 de la Soc. Roy. Belg.: 1-181.

HEIM J.,1971a - Etude statistique sur la validité des spectres polliniques provenant d'échantillons de mousses. Lejeunia,n.s.,58: 1-34.

HEIM J.,1971b - Interêt de l'étude des rélations entre les spectres polliniques récents et la végétation actuelle. Suppl. Bull. de l'Association française pour l'étude du Quaternaire,4: 225-232.

MARIOTTI LIPPI M.,1989 - Ricerche palinologiche sul Messiniano di Eraclea Minoa (AG) nel quadro paleofloristico e paleovegetazionale del tardo Miocene italiano. Webbia,43(1): 169-199.

STANLEY D.J. & WEZEL F.C. Edrs.,1985 - Geological Evolution of the Mediterranean Basin. Springer Verlag,New York: pp. 189.