FLORISTIC COMPOSITION, PHYSIOGNOMIC AND STRUCTURAL ASPECTS OF THE FAGUS SYLVATICA L. FORESTS OF THE MT. ETNA NATURAL PARK (SOUTHERN ITALY)

E. Poli Marchese and V. Puzzolo

Istituto di Biologia ed Ecologia Vegetale, via Etnea 440, 95128 Catania-Italy;
Fax: +39 095 553273, e-mail: polim@tin.it

Abstract - This study was carried out on all the Etna beech distribution area and consists of a phytosociological analysis. Moreover data relating to various pysiognomical and structural aspects was collected from 12 sample areas selected on the different expositions of the volcano. From the phytosociological analysis it emerged that it is very difficult to define the Etna beech forests syntaxonomically: in most cases it can be seen that they belong to the class *Querco-Fagetea*, but it is not always possible to identify the association, the alliance and the order. Some communities seem to belong to the *Quercetalia pubescentis* rather than to the *Fagetalia sylvaticae*. Other communities do not even belong to the class *Querco-Fagetea*. These are in fact relict forests surviving in extreme life conditions. They are at the southern limit of its distribution area and are subject to unfavorable environmental conditions: a volcanic substrata, the Mediterranean climate, the high level of man's intervention.

The study of the tree and stump density, stem diameter, basal area, litter cover and litter thickness and seedling density, carried out on 12 sample areas, shows that these forests have a very variable physiognomy and structure. The forests with a more balanced physiognomy and structure are made up of forests with high trunks of different ages. The seedling density, correlated with the litter thickness and cover, was found to be significant in areas located on the east side of Etna, where there are better light conditions and greater rainfall.

This study brought to light the presence of a species: *Monotropa hypopytis* L. not previously reported as having been found on Mt. Etna.

Key words - *Fagus sylvatica* forests, Mt.Etna Natural Park, syntaxonomy, physiognomy and structure.

Introduction

The beech forests of Mt. Etna are of particular interest from a chorological, syntaxonomical and ecological point of view, as they are situated at the southernmost limit of the area occupied by this species in Europe.

There is little knowledge about the Etna beech forest vegetation. Some data are to be found in the studies carried out by Hofmann (1960) on the beech in Sicily and by Gentile (1969) on the beech forests of southern Italy. Other data are provided by the studies carried out on some aspects of the vegetation of Mt. Etna (Pirola & Vecchio, 1960; Pirola & Zappalà, 1960; Poli, 1965; Poli *et al.*, 1978; 1979; 1981; 1983). It was therefore decided to undertake a detailed study of these woodlands in order to describe both the floristic aspects and the physiognomic and structural ones.

The phytosociological study and the vegetation map (at a scale of 1:10.000) will be the subject of another paper. The aim of this paper is to give a survey of the floristic composition of the Etna beech forests and to know, on selected sample areas, some of their physiognomical and structural characteristics. The results obtained provide some indications for the management of these forests which are situated in the Mt. Etna natural Park. Given that most of the woodlands are in the most carefully protected area of the park (zone A) it is extremely important that there should be some information available about them.

STUDY AREA

The study was carried out on Mt. Etna within the beech belt, which is mainly situated between 1,400 m and 1,900 m a.s.l. with the exception of some higher stations (at up to 2,300 m a.s.l.) and others lower down at 800-1,040 m a.s.l. (Poli *et al.*, 1978; 1979). Within this altitudinal belt the beech has a rather scattered distribution because of the destructive action of the volcano, the edaphic and climatic conditions of the slopes and the effects of man's intervention.

The Etna beech forests, like other European beech forests are subjected to different environmental conditions. They are located on slopes with a comparatively low temperature regime and on the oldest substrates. They are mostly located on the northern and north-eastern facing slopes where both the climate and the soil are most favourable for the species. Some beech forests are located on the south-eastern facing slopes, but in particular sites, for example little valleys. The study areas for the physiognomical and structural analysis are located on the sample surfaces selected on different Etna slopes.

CLIMATE AND SOIL

In the study area there is only one meteorological station situated in the astronomic Observatory of Serra la Nave (1738 m a.s.l.) on the southern slope, where the beech is represented only sporadically by a few isolated trees spread over its higher altitudinal limit. Data collected at this station and at those located lower than the beech belt on different volcano faces, show that the Etna territory has a Mediterranean climate, with hot dry summers and cool-to-cold winters. The warmest months reach a mean of 16 °C at the Serra La Nave station (Blanco, 1969-1983) and of 24-26 °C at the other stations; the coldest month (January) reaches a mean of 1 °C at the former station and 8-10 °C at the latter stations. The mean annual

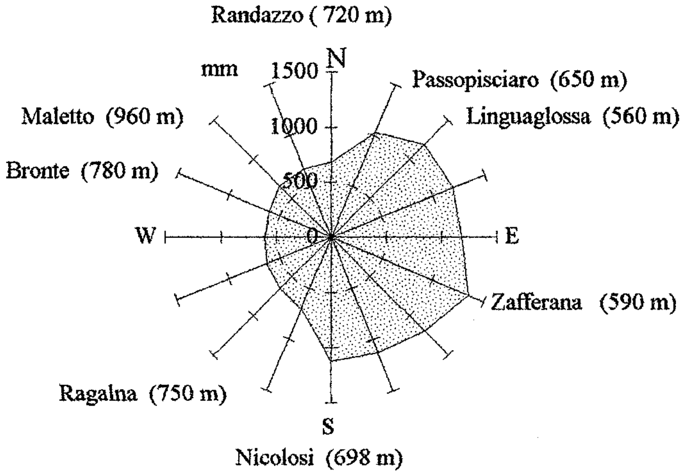


Fig. 1 - Mean annual precipitation (mm) outside the beach belt, near the volcano basal belt

precipitation is 759 mm and 600-1200 mm respectively. The highest rainfall occurs during the autumn and winter period. The rainfall changes irregularly with altitude on the different volcano slopes: it is heavier on the eastern slope because of its exposure to the sea (Fig.1).

This influences the beech distribution on the volcano. The Etna territory is sometimes subject to summer moisture (fog and dew), which is a possible reason for the survival of the beech. This was pointed out by Braun-Blanquet (1964) for the beech forests of Southern Europe.

The volcanic substrata are very variable: they originate from the lava flows or from loose material called ejecta. The beech forests are mostly located on old and undatable volcanic substrata. According to Ballatore and Fierotti's (1968) classification the area occupied corresponds to the soil association regosols-lithosols-andosols and, to a very small extent, to the brown soils.

MAN'S INTERVENTION

The beech forests have been frequently subjected to fire, cutting and grazing, although for the last decade, since the Etna natural park was founded, they have been protected. However, sometime in these forests fires occur and there is grazing. Cutting has altered the physical structure of most of the Etna beech forests, which probably had higher and larger trees originally. Some forest samples may be particularly aberrant in their structure and understorey composition due mostly to man's intervention. Also low intensity disturbance (Pickett & White, 1985; van der Maarel, 1993), including fire, grazing, forest management or recreational use, can also strongly influence these forests.

Methods

The vegetation was analysed using the method of Braun Blanquet (1964): 266 phytosociological relevés were made in the different habitats occupied by beech forests. An attempt to typify the vegetation was made on the basis of these relevés. A synthetic table was drawn up to show the forest types as well as their floristical differences. The results obtained were used to select representative sample areas to analyse the physiognomy and structure of the beech forest stands.

Twelve plots of 150-250 m^2 were chosen on the different volcano slopes, three for each slope. These sample areas were chosen within large beech woodlands, where the canopy cover value was 95-100% and where the tree height was 12-20 m.

The following data were collected from each area: site characteristics, altitude, exposure, side; phytosociological relevé; stem diameter (dbh) at breast height, about 1,4 m from the ground, for stems > 5 cm; tree density (number of stems > 5 cm/ha) for each diameter class: 6-20 cm, 21-40 cm, 41-70 cm; stump density (number of stumps/ha) for each diameter class: < 80 cm, 80-160 cm, >160 cm; basal area in m^2/ha, calculated using the dbh.

In order to obtain an indication of the possibilities of natural forest regeneration the following were also taken into consideration on each area: the density (number of seedlings/100 m^2) of one-year and more than of one-year-old seedlings; litter cover (% of the total area) and litter thickness (cm). The data were organised into tables and graphs.

Results

Floristic composition of the vegetation

Different forest types dominated by *Fagus sylvatica* can be distinguished. They will be illustrated in another paper, here only the synthetic data are given.

From Table 1 it can be seen that in the beech forest stands of Mt. Etna characteristic species of the association, the alliance and the order are rather rare. Only in rather few stands (columns 1a and 1b), which represent less than of 10% of the total, are there some characteristic species of the *Aquifolio-Fagetum* Gentile 1969. This association was described by Gentile (1968 and 1969) for the Southern Appennines and Sicily, but the species of alliance (*Geranio-Fagion* Gentile, 1969) to which the association belongs are absent, the species of the order and class are few. These forests are really relict forests, which today occur as fragments of association. Similar situations have been described for relict beech forests in Spain in the Sierra de Finestres (Hofmann op.cit.).

Most of the stands (columns 2a and 2b) can only be classified up to the level of the order or class; characteristic species of the association and of the alliance are completely absent and there are not any species that could be used as characteristic or differential species of new association or alliance. In some sites the presence of species of the *Quercetalia pubescentis* might indicate that such beech forest stands belong to the order *Quercetalia pubescentis* Br.-Bl 1931. This was pointed out by Bonin (1980) for the beech forests of the Southern Appennines and by Thiébaut (1984) for the beech forests of the French Mediterranean region too.

TABLE 1 - FAGUS SYLVATICA COMMUNITIES AND PURE POPULATIONS (4B) ON THE MT. ETNA

	Column no.	1a	1b	2a	2b	3	4a	4b
	Number of relevés	17	10	112	40	20	53	14
	Char. of the Ass. (Aquifolio-Fagetum)							
P	Daphne laureola L.	III	II					
G	Lathyrus venetus (Miller) Wohlf	I	II					
P	Ilex aquifolium L.	I						
	Char. and differ. of the Ord. (Fagetalia sylvaticae)							
	and the Class (Querco-Fagetea)							
P	Fagus sylvatica L.	V	V	V	V	V	V	V
H	Brachypodium sylvaticum (Hudson) Beauv.	III	III	II	I	I		
G	Cephalanthera longifolia (Hudson) Fritsch	II	I	II	I	I		
NP	Rubus idaeus L.	III	III	I	I	I		
P	Populus tremula L.	I	I	I	I	I		
G	Neottia nidus-avis (L.) L. C. Rich.	I	II	I	II			
NP	Rosa canina L.	I	III	I	II	I		
P	Quercus pubescens Willd. s.l.	I	II	I	I			
G	Cephalanthera rubra (L.) L. C. Rich.	I	I	I	I			
P	Castanea sativa Miller	I	I	I	I			
H	Clinopodium vulgare L.		II	I	I			
P	Sorbus aria (L.) Crantz	I		I	I			
P	Acer campestre L.			I	I			
H	Galium rotundifolium L.			I	I			
P	Malus sylvestris Miller			I				
H	Viola sylvestris Lam.			I				
P	Quercus cerris L.			I				
G	*Monotropa hypopytis L.			I				
G	Dryopteris filix-mas (L.) Schott.			I				
P	Pinus laricio Poiret			I	I			
P	Betula aetnensis Rafin.			I	I			
	Char. of the Quercetea ilicis							
H	Luzula forsteri (Sm) DC.		II		II			
H	Viola alba ssp.dehnardtii (Ten.) W. Becker		IV		I			
H	Teucrium siculum Rafin.				II			
P	Quercus ilex L.				II			
	Char. and diff. of the Rumici-Astragaletea siculi							
Ch	Astragalus siculus Biv.					I		
H	Rumex scutatus L. fo.aetnensis L.					I		
Ch	Senecio aetnensis Jan.					I		
H	Viola aetnensis Parl.					I		
	Other species							
NP	Pteridium aquilinum (L.) Kuhn	III	V	II	II	I	I	
H	Trifolium pratense Schreber var.semipurpureum (Strobl) Pign.	III	I	II	II	I	II	
H	Festuca circummediterranea Patzke	II	I	II	II	IV	I	
NP	Juniperus hemisphaerica Presl	II	III	I	I	III	I	
H	Festuca heterophylla Lam.	III	IV	II	II		I	
H	Calamagrostis epigejos (L.) Roth.	I	II	I	I	II	I	
H	Silene italica (L.) Pers.	I	I	I	I	II	I	
H	Anthriscus nemorosa (Bieb) Sprangel	I	II	I	I		I	
H	Dactylis glomerata L.	I	I	I	I	I		
H	Aremonia agrimonioides (L) DC.	II	IV	I	I			
H	Lathyrus pratensis L.		I	I	I		I	
H	Galium aetnicum Riv.			I		II	I	
H	Secale montanum Guss			I		I	I	
G	Epipactis meridionalis H.Baumann et R.Lorenz			I	I		I	
H	Hypochoeris laevigata (L.) Ces.			I	I		I	
H	Achillea ligustica All.			I	I		I	
T	Acinos granatensis (Boiss at Reuter) Pign. subsp.aetnensis (Strobl) Pign.			I	I	I		
H	Fragaria vesca L.			I	I			

1a,1b - Aquifolio-Fagetum Gentile 1969

2a, 2b, 3 - Beech communities of the class Querco-Fageta Br.-Bl. et VI 1937

4a - Beech communities not belonging to the class Querco-Fagetea Br.-Bl. et VI 1937

4b- Pure beech populations

* it is the first finding of this species on the Mt. Etna.

Species with a low frequency : 1a - *Sorbus aucuparia* L. subsp. *praemorsa* (Guss.) Nyman, *Teucrium chamaedrys* L., 2a - *Sorbus aucuparia* L. subsp. *praemorsa* (Guss.) Nyman, *Lolium perenne* L., *Leopoldia cumosa* (L.) Parl., *Teucrium chamaedrys* L., *Silene vulgaris* (Moench) Garcke, *Petrorhagia saxifraga* (L.) Link., *Carex otrubae* Popd., *Aquilegia vulgaris* L., *Genista aetnensis* (Biv.) DC., *Crepis leontodontoides* All., *Linaria purpurea* (L.) Miller, *Epilobium angustifolium* L., *Vicia hirsuta* (L.) S. F. Gray, *Galium aparinae* L., *Luzula sieberi* Tausch, *Cerastium tomentosum* L. var. *aetneum* Janka, *Lathyrus grandiflorus* S. et S., *Isatis tinctoria* L. var *canescens* L., *Galium lucidum* All.; 2b - *Leopoldia comosa* (L.) Parl., *Lathyrus grandiflorus* S. et S., *Isatis tinctoria* L. var *canescens* L.; 3 - *Berberis vulgaris* L. var. *aetnensis* Presl., *Tanacetum siculum* (Guss.) Strobl, *Sorbus aucuparia* L. subsp. *praemorsa* (Guss.) Nyman, *Sedum tenuifolium* (S. et S.) Strobl, *Bellis perennis* L., *Rumex acetosella* L.var. *multifidus* (L.) DC., 4a - *Petrorhagia saxifraga* (L.) Link., *Carex otrubae* Popd., *Silene vulgaris* (Moench) Garcke, *Aquilegia vulgaris* L., *Cerastium tomentosum* L. var. *aetneum* Janca.

In some stands (columns 1b and 2b), the beech forests are penetrated by species of evergreen forests of the class *Quercetea ilicis* Br.-Bl. 1947 with which they come into clare contact.

In the higher elevated stands (column 3) the floristic composition of the forests becomes remarkably impoverished. They are in contact with the herbaceous vegetation of the higher belt (of the *Rumici-Astragalion siculi* Poli, 1965) of which some elements are present.

In the stands represented in columns 4a and 4b (25% of the total), the beech forests can no longer be ascribed even to the class of which no species is present. These beech forests are situated at the highest altitudes (2280 m a.s.l.) at which *Fagus sylvatica* L. occurs in Europe. It is a vegetation dominated by beech but can't be called a beech forest from an phytosociological point of view.

In the stands of the column 4b there are extensive, pure beech populations. This kind of beech population has been found in other regions like for example Northern Spain in the Basque country (Olano *et al.*, 1998) too.

It is clear that the classification of the Etna beech forests is associated with a lot of problems. This was pointed out by Hofmann (op.cit.), Pirola and Vecchio (1960), Pirola and Zappalà (1960), Gentile (1969) and subsequently confirmed by Poli *et al.* (1978; 1979; 1981).

The site data and the main physiognomical data of the communities, grouped according to the types of vegetation identified (see tab. 1), are shown in tables 2 and 3.

From these data is clear that the beech forests on Mt. Etna prefer the slopes exposed to the north and north-west. Slopes with a moderate gradient are particularly favoured. From the table 2 it can be seen that the forests are multi-layered and that they have a high canopy cover and a variable height between 7 and 25 m.

Physiognomic and structural aspects

TABLE 2 - SITE CHARACTERISTICS OF THE 266 RELEVÉS (SEE TAB. 1): LOCALIZATION ON THE DIFFERENT SLOPES CORRELATED WITH THE ALTITUDE, EXPOSURE AND SLOPE

Column No.	Relevé sites (%) on the Etna slope				Altitude (m a.s.l.)		Exposure	Relevé sites (%) on different slopes slope classes (°)		
	N	W	S	E	range	average	prevalent	5-15°	15°-30°	30°-45°
1a	18	65	18		1425-1685	1579	N-NW	53	24	24
1b		70	30		1430-1645	1539	N-NW	60	20	20
2a	45	23	25	7	1400-2070	1713	N	65	27	8
2b	36	39	16		1385-1755	1516	N	50	38	12
3		65		35	1810-2130	1872	NW	45	50	5
4a	34	32	2	32	1395-2280	1764	N-NW	42	42	17
4b	41	34		25	1425-2270	1878	NW	29	36	36

The data collected from 12 selected areas show that the forests have (Tab.4) high values of canopy cover and a height between 12 and 25 m. Forests with high trunks, coppices and mixed formations are involved.

From an analysis of tab. 5 and fig. 3 it can be seen that it is possible to identify

TABLE 3 - MEAN COVER AND HEIGHT OF THE VEGETATION LAYERS: CANOPY (A), LOWER TREE LAYER (A1), SHRUB (A) AND HERBACEOUS (E) LAYERS ON THE 266 RELEVÉ SITES (SEE TAB. 1)

Column No.	Mean cover (%) layers				Height (m) layers					
	A	A1	a	e	A		A1		a	e
					range	average	range	average	average	average
1a	96	40	20	31	8-20	12	3-6	5	1,3	0,37
1b	95	22	17	33	8-25	13	4-6	5	1	0,30
2a	97	40	40	11	7-25	13	2,5-6	4	1	0,25
2b	96	31	19	26	8-20	13	3-6	5	1,2	0,27
3	95	50	37	24	7-15	8	2,5-6	3	0,9	0,26
4a	95	5	35	19	7-25	11	2,5-6	3	1,2	0,19
4b	97	35	24	13	8-15	11	5-6	6	1,4	0,19

TABLE 4 - SITE SAMPLE CHARACTERISTICS AND VEGETATION COVER (%) AND HEIGHT (M) OF THE DIFFERENT VEGETATION LAYERS: CANOPY (A), LOWER TREE LAYER (A1), SHRUB (A) AND HERBACEUS (E) LAYERS

Sample no.	Etna slope	Altitude (m a.s.l.)	Exposure	Slope (°)	Cover (%) layers				Height (m) layers			
					A	A1	a	e	A	A1	a	e
1	E	1890	E-NE	10	95		20	20	12		1,5	10
2	E	1870	NE	15	95		30	30	12		1,5	30
3	E	1855	E-NE	15	95			30	12			40
4	S	1445	E-NE	35	95		30	40	15		1,5	30
5	S	1415	SW	25	95	20	40	20	12	3	1,2	30
6	S	1435	E-NE	35	95	40	20	40	20	3	1,5	30
7	W	1540	N	30	95	20		30	20			30
8	W	1585	NE	25	95	30		20	25	3		40
9	W	1515	N-NW	10	98	40	20	30	20	5	2	40
10	N	1460	N-NE	20	98	30	20	10	20	4	2	30
11	N	1460	N	15	98	50	40	20	20	5	1,5	30
12	N	1465	N	15	95	30	10	15	15	5	0,8	20

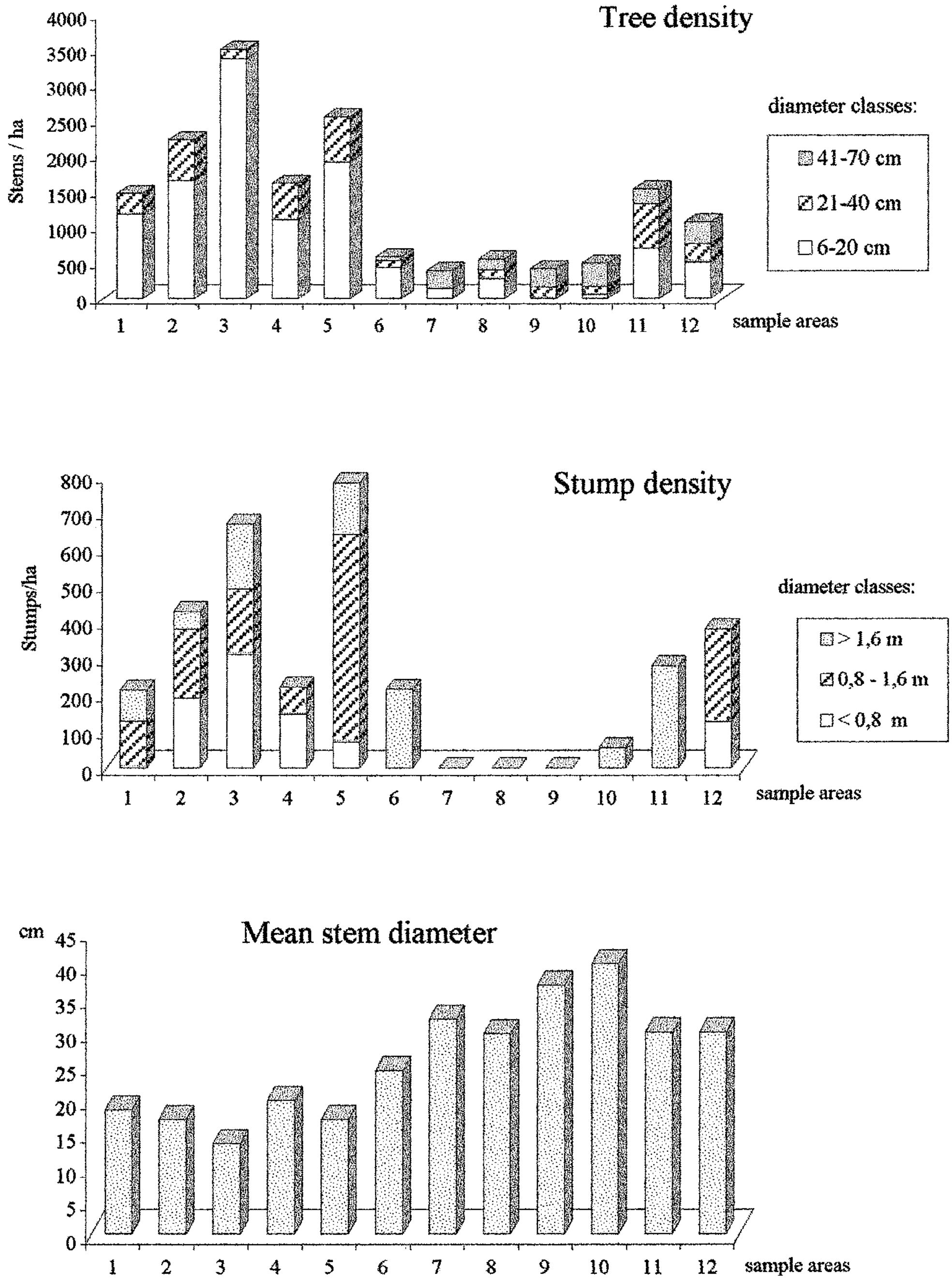
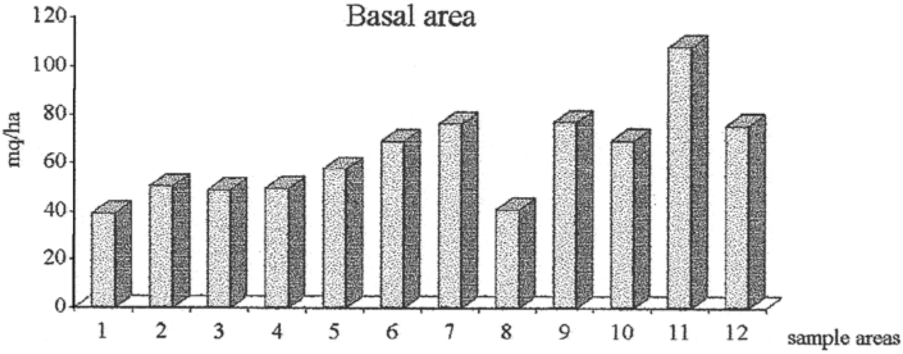


Fig. 2 - Stem and stump density (number/ha) per diameter classes and mean stem diameter of the vegetation on the sample areas



Sample no.	1	2	3	4	5	6	7	8	9	10	11	12
Basal area (mq/ha)	39,4	50,5	49,0	49,8	57,7	69,3	76,5	40,9	77,2	69,6	108,2	75,6

Fig. 3 - Basal area on the sample areas

three different situations. Big trees are absent in the first 5 sample areas, where there is a high number of small trees with the lowest mean diameter values (fig. 2). This explains a high total density that is also related to the presence of all diameter class stumps. This can be explained by the fact that these forests were used for coppicing until not long ago. The highest density value was found in area no. 3 where there is the lowest mean stem diameter and a very high stump density. The values for the basal area are relatively low in this area group in comparison with the other plots.

In areas 6-10 there are lower tree density values - between 391 and 585 trees/ha. This reflects the absence or near absence of stumps as these are forests with high trunks. The trees have a correspondingly high mean diameter and a basal area between 69 and 77 m^2/ha.

In sample no. 8, where the basal area has an inferior value (40,9 m^2/ha), there are more trees with a lower diameter. This is a forest with high trunks of various ages, which might represent a more stable state than the others considered. The basal area value found there is similar to those of some forests of North-Eastern America: of the beech forests (*Tsuga canadensis-Fagus grandifolia-Betula alleghanensis* community) of the Finger Lakes region (Mohler & Marks, unpubl.) and of a mesic forest in Tennessee (Skeen 1973).

In the last two sample areas (no. 11 and 12) the density values are intermediate (between 1075 and 1540 trees/ha) in comparison with the other sample areas and the mean diameter is about 30 cm. The high basal area value can be connected to the relatively high density of all the diameter class trees. The unusually high basal area value in sample no. 11 reflects the high stump density (280/ha), with all the stumps having a diameter > 160 cm and stems with a large diameter. These are mixed forests: forests with high trunks and coppice.

In order to investigate the forest regeneration possibilities two important parameters - litter and seedlings - were considered. The litter cover and thickness are important factors in the germination of the seeds as well as the growth of the seedlings and, therefore, for the natural forest regeneration. In fact the litter can reduce not only the loss of water from the soil but also the changes in temperature, therefore, where other factors permit, it favours the germination of the seeds and, where it is not very thick, the growth of the seedlings, which it supplies with protection and nutrient substances.

The greatest number of seedlings – both those one year old and those older – is to be found in sample areas 1-3 (tab. 6 and fig. 4), with the highest values in sample areas 2 and 3, where the litter has a cover of 60-70% and a thickness of 6-8 cm, the slope is low and where there are stumps (tab. 5) that, having a protective role for the soil, favour the preservation of the litter and of the seedlings. It is significant

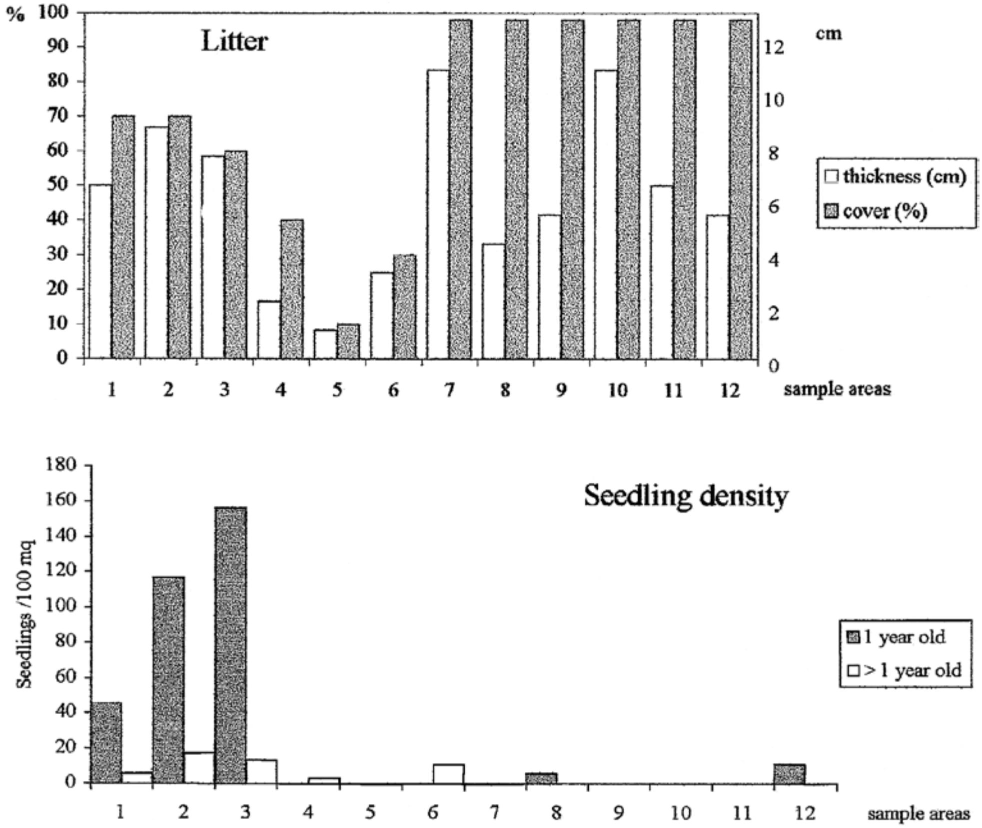


Fig. 4 - Litter thickness (cm) and litter cover (%) and seedling density (seedlings/100 mq) per sample

TABLE 6 - LITTER AND SEEDLING VALUES PER SAMPLE AREA RELATED TO THE SLOPE

Sample no.	Slope (°)	Litter Thickness (cm)	Litter Cover (%)	Seedling density (100^{-1} mq) 1 year old	Seedling density (100^{-1} mq) > 1 year old
1	10	6	70	46	6
2	15	8	70	117	18
3	15	7	60	156	13
4	35	2	40	0	3
5	25	1	10	0	0
6	35	3	30	0	11
7	30	10	98	0	0
8	25	4	98	6	0
9	10	5	98	0	0
10	20	10	98	0	0
11	15	6	98	0	0
12	15	5	98	11	0

that these sample areas are located on the eastern slope of the volcano (see tab. 4), where there is enough light and the mean annual rainfall reaches the highest values (fig. 1). This is particularly significant for the more than one-year-old seedlings that have to survive the summer dryness.

In the other sample areas there are very few or no seedlings. This might be explained, above all in areas 4 and 5, by the low values of litter cover and the litter thickness. The litter is easily taken away by the flowing surface waters given that the gradient is high. Other factors, however, such as for example temperature, rainfall, the maximum soil water available (Forte *et al.,* 1995), soil moisture, soil carbon content (Madsen & Larsen, 1997) and other nutrient contents (Minotta & Pinzanti, 1996) could have an important role in limiting or blocking germination and seedling growth. This is probably the case for area no. 6, where more than 1-year-old seedlings are present, but the 1-year-old seedlings are absent. In this case it is, perhaps, the soil water content in the driest period that plays a certain role, considering also that this area is located on the southern slope of the volcano.

In the remaining six areas, despite the presence of a good litter cover and thickness there are either an absence of seedlings or a very low density of one-year-old seedlings. In this case, beside the factors indicated above, the importance of light should be mentioned. Its importance for *Fagus* seedlings has been pointed out by various authors including Johnson et al. (1997), Minotta and Pinzanti (1996) and Beandet and Messier (1998).

Despite this, as stated by Welander and Ottosson (1998) and confirmed by us, the beech seedlings seem to be well adapted to low light conditions and they would thus be able to regenerate under a dense canopy. It may be supposed that in areas nos. 10-12, which are located on the northern volcano slope, it is the very low light condition under a dense canopy that contribute to the almost total seedling absence.

The same could be said for areas 7-9 on the western slope.

From the above, it become clear that in most of the areas, even where there are the best conditions of litter and slope, the seedlings density is low or non-existent. The appearance and survival of seedlings is in fact dependent on many environmental factors. Of great importance among these are those connected with man's interventions such as grazing and the removal of litter and dead material, which is caused by the normal forestry practices as well as by mushroom collecting. This affects the regeneration success of the forests.

Conclusion

Now some characteristics of the beech forests of Mt. Etna can be pointed out. The following results can be drawn from the phytosociological survey: the floristic composition of these forests depends on the climatic and edaphic conditions, as well as on man's intervention. These forests, including those which seem mature and well structured, cannot be phytosociologically typified. With reference to this Hofmann (op. cit.) pointed out: "the phytosociological survey was completely negative".

Bearing in mind the tendency of the vegetation floristic composition to vary, it was possible to distinguish some communities. These include those really belonging to the deciduous forests of the class *Querco-Fagetea*, but not generally to the beech forests of the association *Aquifolio-Fagetum*, of the alliance *Geranio-Fagion* and of the order *Fagetalia sylvaticae*, those even less common in these forests and those with beech, but totally without any associate species. The beech in most cases constitutes forests that could be said to belong to another order (*Quercetalia pubescentis*) of the class *Querco-Fagetea* or forests where the beech gives arboreal cover in an herbaceous vegetation or forests with pure populations.

This reflects the extreme life conditions in which the beech is obliged to live on Mt. Etna, where, as stated above, it reaches the southern limit of its distribution area in Europe. These are relict forests which have to adapt to live on an active volcano in very difficult soil conditions and in a very hostile climate and where, as on all active volcanoes, the flora is species poor (see Poli, 1965).

The vegetation survey also brought to light the presence of a species: *Monotropa hypopytis* L. not previously reported as having been found in the Mt. Etna territory.

From the results obtained from the study carried out on 12 sample areas it can be seen that the structural and physiognomical characteristics of the beech forests on Mt. Etna are very variable. This variability is connected to the type of management these forests have been subjected to. Consequently it is possible to distinguish forests with high trunks, mixed forests with high trunks as well as coppices and coppices. In the forests with high trunks there seems to be greater structural equilibrium. This is the case where the forest reaches its maximum height (20 m) and has the most homogeneous structure with trees of various ages, some of which are remarkably big, where stumps are absent and the basal area reaches values of about 40 m^2/ha.

This value is similar to those found in other deciduous forests in the North-Eastern American temperate region. For this region Held and Winstead (1975) suggest that 30 m^2/ha is approximately the basal area value in forest systems that can be considered to represent climax stands in mesic habitats. Perhaps also in our forests it might be possible to find basal area values that could be used as an indicator of the climax status or of the other dynamic stages. Further studies are called for to find this eventually correlation.

The best conditions for the natural regeneration of the forests are to be found in the areas located on the eastern slope, which is the wettest slope of the volcano and where the slope is gentle, litter cover and litter thickness are relatively high, there is a certain number of large stumps and man's intervention is less significant.

From these results it would appear to be necessary to manage the Etna beech forests more carefully in the Etna Natural Park. Steps must be taken to control man's intervention concerning: cutting, grazing and the removal of litter, dead material and the herbaceous layer. Further steps must be taken to promote a gradual change of forest structure from coppice to forest with high trunks and to safeguard the slopes from soil erosion. Moreover, monitoring with the collection of further data should be organised for the future, perhaps from permanent plots, to obtain further information which could be useful for the management of these valuable forests.

Riassunto

È stata condotta un'indagine a carattere geobotanico nei boschi di Faggio del Parco Naturale dell'Etna allo scopo di poter definire la vegetazione dal punto di vista fitosociologico e di conoscerne alcuni aspetti fisionomico-strutturali.

Dall'analisi fitosociologica è emerso che è difficile definire sintassonomicamente tali boschi in quanto, anche se vi sono presenti le specie caratteristiche della classe *Querco-Fagetea*, mancano in molte stazioni quelle proprie dell'associazione, dell'alleanza e dell'ordine. Solo frammentariamente sono presenti comunità riferibili all'*Aquifolio-Fagetum*. Ciò è da correlare con le difficili condizioni ambientali in cui il Faggio è costretto a vivere sull'Etna, ove ricade l'estremo limite meridionale del suo areale e ove sono presenti suoli vulcanici poco maturi.

Dallo studio sui caratteri fisionomico-strutturali della vegetazione, condotto su 12 aree campione, è emerso che questi boschi presentano una struttura variabile essendo costituiti da fustaie, da cedui o da cedui e fustaie, di diversa età. I valori della densità media degli alberi e delle ceppaie sono stati correlati con il diametro medio degli alberi e con la relativa area basale. La densità delle plantule di Faggio è stata messa in relazione allo spessore e alla copertura della lettiera.

Dai dati ottenuti è emerso che i boschi meglio strutturati sono localizzati sul versante nord-ovest, e che presentano buone possibilità di rinnovazione naturale quelli ubicati sul versante est, ove le precipitazioni sono più elevate e le condizioni di illuminazione sono migliori.

L'indagine ha consentito inoltre il rinvenimento della *Monotropa hypopytis* L., specie non ancora segnalata per il territorio etneo.

I dati acquisiti potranno costituire utili elementi di conoscenza per una più attenta gestione dei boschi di Faggio nel Parco naturale dell'Etna.

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