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Ecology and optimal and heterotopical distribution of *Ilex aquifolium* (*Aquifoliaceae*) in Sicily

Abstract

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In Sicily the presence of *Ilex aquifolium* L., a Tertiary relict, is nowadays limited to mountainous areas under oceanic climatic conditions. Its occurrence is also subject to the substratum. In the region, holly is usually found in beech-woods and in the adjacent deciduous mesophilous woods; sometimes it occurs in yew or holm-oak formations, or in riparian mountainous phytocoenoses. The ecology of this species in the main Sicilian formations has comparatively been surveyed under the phytosociological, bioclimatological and lithological aspects.

This study has allowed to distinguish some heterotopical holly biotopes from the typical ones. Furthermore, the distribution of the species in the Sicilian territory has been updated. Finally, the woody vegetation including holly has been arranged within the relevant known syntaxa and, besides, the mesophilous aspects with *Quercus ilex* have been referred to a new association within the *Pino-Quercion congestae* (*Quercetalia pubescentis*, *Quercio-Fagetea*) alliance, named *Geranio versicoloris-Quercetum ilicis*.

Introduction

Ilex aquifolium is a lauriphyllous species of tertiary origin and presently distributed in part of Mediterranean and Atlantic Europe till the Black Sea (Webb 1968; Greuter & al. 1984; Ehrendorfer 1992). In the Mediterranean area it is confined to areas under favourable climatic and edaphic conditions. *I. aquifolium*, together with other species such as *Taxus baccata*, is considered as a member of late-Tertiary evergreen montane forests of Miocenic type, defined as vegetation of colchic type (Pignatti 1978, 1979). Residual patches of such type of vegetation are today included in deciduous wood, the best adapted to the Quaternary climatic conditions. It is defined as a strongly atlantic species (Bernetti 1985) and requires a high rate of atmospheric humidity, which may partly be replaced by edaphic humidity. Owing to its autoecology, in Sicily holly mainly occurs on mountains of middle altitude and under both high rainfall rate and mist. Within the Mediterranean region, it is considered a riparial species (Rameau & al. 1989). In Sicily, indeed, some aspects of riparial montane vegetation, partly syntaxonomically defined, can be observed. For the British, Isles Peterken & Lloyd (1967) reports *I. aquifolium* in "New Forest", in combination with *Sphagnum* sp. and *Carex pendula*. From the thermic point of view, Inverson (1944) reports its absence in the areas where the mean temperature of the coldest month is lesser than

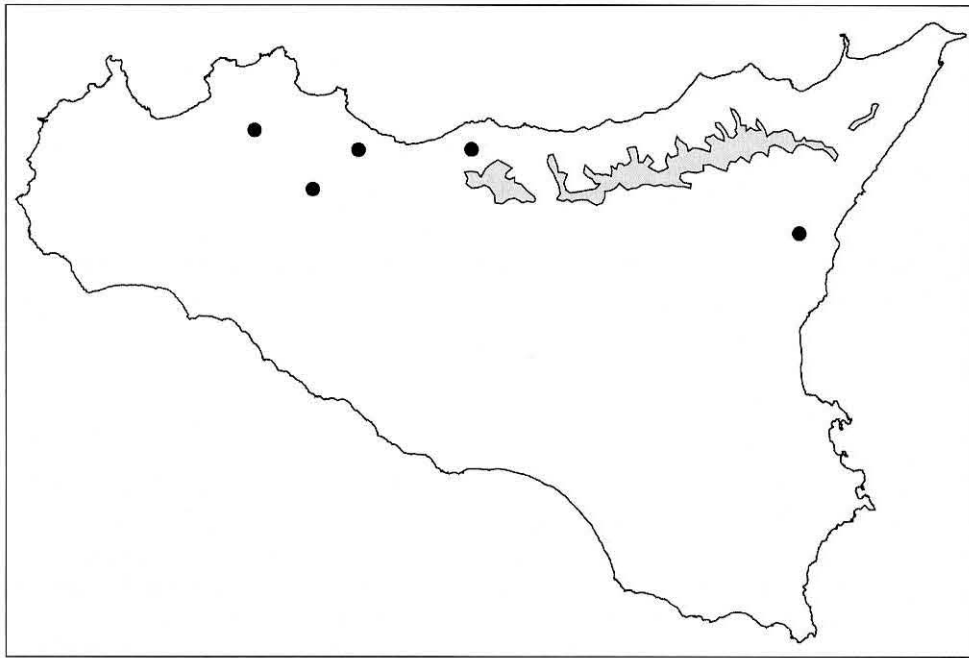


Fig. 1. Typical (■) and heterotopic (●) distribution of *Ilex aquifolium* L. in Sicily.

-0,5 °C. In Germany, for instance, this species, being scarcely cold-resistant, is widespread in the western part and progressively rarefies, till disappearing, in the continental one, to the east. The fossils found in the former URSS may be referred to more temperate geological periods.

In Sicily *Ilex aquifolium* has been recorded on the Etna Mount as well as in many other mountains, from the Peloritani Mountains to the mounts surrounding Palermo, by Gussone (1827), Virga (1878), Nicotra (1878, 1893), Tornabene (1887, 1890), Lojacono (1891), Strobl (1880, 1903) and Zodda (1900, 1904). Several contributions in the phytosociological field deal with wood formations with *I. aquifolium* (Hofmann 1960; Pirola & Vecchio 1960; Gentile 1960, 1968, 1969a, b; Ronsisvalle & Signorello 1977; Raimondo 1977, 1980; Poli & al. 1978; Brullo 1984; Di Benedetto & al. 1983; Brullo & Marcenò 1985; Poli & Lo Giudice 1988; Marcenò & Ottonello 1991; Brullo & al. 1996, 1999, 2001; Gianguzzi & al. 1998, 1999; Poli & Puzzolo 2001; Maniscalco & Cavarretta 2003; Maniscalco 2003).

Through palinologic researches carried out on the Madonie Mountains its occurrence in the course of the last millennia has been ascertained (Bertolani & al. 1984).

Although nowadays such species is found on the main mountains in northern Sicily and on the Etna Mount, mainly the Nebrodi and Madonie Mountains are under the optimal climatic and edaphic conditions to its occurrence (Fig. 1). Notably on the Madonie Mountains, holly, besides being present in monospecific groups, rises to such monumental sizes (Di Martino 1974) as in few other localities in Europe. In this study further ecologic (namely bioclimatic and edaphic), syntaxonomic and distributive data on holly biotopes in Sicily are provided.

Materials and methods

With the aim of studying ecology of *Ilex aquifolium* in Sicily, holly biotopes have comparatively been surveyed. Besides the relevant environmental parameters, also the syntaxonomic correlations concerning different wood types have been surveyed. Accordingly, a synoptic table with the Sicilian mountains and the correspondent *I. aquifolium* localities has been provided (Table 1). The locality toponyms have been mentioned when the biotopes are circumscribed. The occurrence of numerous localities in the same mountainous area is noted by “various localities”. The relevant vegetation types as well as the lithologic, syntaxonomic and bioclimatic aspects are shown in the same table. The original syntaxonomic interpretations are marked by an asterisk. The riparial formations, already mentioned in Sicily, are not included in the table but reported in the syntaxonomical scheme.

As for the syntaxonomic arrangement, reference is made to the association or the syntaxon of higher rank. Inclusion in the various syntaxonomic typologies has been made on the basis of phytosociologic relevés, following Braun-Blanquet (1964) method. The relevant classis has also been included marked with “*Q-F*” for *Quercus-Fagetum* and “*Q i*” for *Quercetum ilicis*. Regarding the formations on the Etna Mt., phytosociologic relevés have been carried out on the eastern slope, being moister than the western one. A syntaxonomical scheme of the various holly wood formations in the Isle has been enclosed.

The nomenclature of the listed taxa is referred to Flora d'Italia by Pignatti (1982), excluding the ones afterwards described.

Under the edaphic aspect, the geo-lithologic matrix, from which the substratum of each biotope evolved (Abate & al. 1978, 1988; Bigi & al. 1991; Catalano & al. 1979; Giunta & al. 1992; Lentini & Mezzani 1974; Liguori 1983), has been taken into account together with other edaphic features ascertained in the field.

Bioclimatic data have been arranged following Rivas-Martinez (1996) and Rivas-Martinez & Loidi Arregui (1999), on the basis of the thermo-pluviometric data by Duro & al. (1996) and the pluviometric data from the weather stations in operation from 1985. The capital letters “S” and “M” are respectively referred to “supra” and “meso” indicating the thermotypes both in the mediterranean and temperate bioclimate (e.g. supramediterranean or supraterperate). The “low” and “up” terms refer to the “lower” and “upper” horizons. Some biotopes, included in high altitude boundaries, are under several bioclimates.

Results

In the field researches has been confirmed the species occurrence on the Trabia Mounts, besides a new biotope recorded in the S. Giorgio wood near Gratteri (Giammarusa Mt., 1064 m a.s.l.), which is at the lowest altitude among the Sicilian biotopes (740 m a.s.l.). These two biotopes, where *Ilex aquifolium* is respectively included in pubescent-oak and holm-oak woods, have been surveyed and included in known syntaxa (Table 1). Besides these formations, some mesophilous pubescent-oak woods with holly on the Madonie and Peloritani Mountains have been surveyed as well as mesophilous sweet chestnut woods with holly on the Etna Mt.

As far as holm-oak woods with *Ilex aquifolium* are concerned, a strongly mesophilous

Table 1. Synoptic table of Sicilian holly biotopes.

MOUNTAINOUS RELIEF	LOCALITY	VEGETATION	LITHOLOGY	SYNTAXONOMY		BIOCLIMATE
				CLASSIS	SYNTAXA of lower order	
Palermo Mountains	A - Punte di Cuti	*holm-oak wood	clayey-arenaceous	<i>Q i</i>	<i>Teucrio-Quercetum ilicis polystichetosum</i>	M e S medit – low humid
	B - (various localities)	holm-oak wood	carbonaceous	<i>Q i</i>	<i>Aceri campestris-Quercetum ilicis helleboretosum</i>	M e S medit – low/up humid
Rocca Busambra	C - Tramontana	holm-oak wood	carbonaceous	<i>Q i</i>	<i>Aceri campestris-Quercetum ilicis</i>	S medit – low humid
Trabia Mountains	D – V. Malafortuna	pubescent-oak wood	clayey-arenaceous	<i>Q i</i>	<i>Quercion dalechampii</i>	M medit – low sub-humid
Madonie	E - (various localities)	beech-wood	carbonaceous	<i>Q-F</i>	<i>Luzulo siculae-Fagetum</i>	S temp – up humid
	F - (various localities)	beech-wood	clayey-arenaceous	<i>Q-F</i>	<i>Anemone apenniane-Fagetum</i>	S temp – up humid
	G - (various localities)	sessile-oak wood	clayey-arenaceous	<i>Q-F</i>	<i>Ilici-Quercetum petraeae</i>	S medit/temp – low/up humid
	H - Bosco, Vicaretto	*holm-oak wood	clayey-arenaceous	<i>Q-F</i>	<i>Geranio versicoloris-Quercetum ilicis</i>	S medit – low humid
	I - Vicaretto	*pubescent-oak wood	clayey-arenaceous	<i>Q-F</i>	<i>Pino-Quercion congestae</i>	S medit – low humid
	L - (various localities)	holm-oak wood	carbonaceous	<i>Q i</i>	<i>Aceri campestris-Quercetum ilicis</i>	M e S medit – low/up humid
	M - S. Giorgio	*holm-oak wood	clayey-arenaceous	<i>Q i</i>	<i>Teucrio-Quercetum ilicis polystichetosum</i>	M medit – up sub-humid
Nebrodi	N - (various localities)	beech-wood	clayey-arenaceous	<i>Q-F</i>	<i>Anemone apenniane-Fagetum</i>	S temp – up humid
	O - (various localities)	yew-wood	clayey-arenaceous	<i>Q-F</i>	<i>Ilici-Taxetum baccatae</i>	S temp – up humid
	P - T. Galati	yew-wood	carbonaceous	<i>Q-F</i>	<i>Ilici-Taxetum baccatae ruscetosum</i>	M e S medit – low humid
	Q - Fossa del Lupo Mt.	*holm-oak wood	clayey-arenaceous	<i>Q-F</i>	<i>Geranio versicoloris-Quercetum ilicis</i>	S medit – low/up humid
	R - (various localities)	turkey-oak wood	clayey-arenaceous	<i>Q-F</i>	<i>Arrhenathero-Quercetum cerridis</i>	S medit/temp – low/up humid
Peloritani	S - (various localities)	beech-wood	clayey-arenaceous	<i>Q-F</i>	<i>Anemone-Fagetum melittetosum</i>	S medit/temp – low/up humid
	T - P. Acqua Bianca	*holm-oak wood	metamorphic	<i>Q-F</i>	<i>Geranio versicoloris-Quercetum ilicis</i>	S medit – up humid
	U - P. Croce, P. Acqua Bianca	pubescent-oak wood	metamorphic	<i>Q-F</i>	<i>Pino-Quercion congestae</i>	S medit – up humid
Etna	V - (various localities)	beech-wood	volcanic	<i>Q-F</i>	<i>Rubo-Fagetum; Epipactido-Fagetum</i>	S temp – up humid
	Z - (various localities)	*sweet chestnut wood	volcanic	<i>Q-F</i>	<i>Pino-Quercion congestae</i>	S medit – up humid



Fig. 2. Wood with sessile oak and holly belonging to the *Ilici-Quercetum petraeae*, at "Sempria", at 1210 m a.s.l. on the Madonie mountains. In the foreground the dense shrubby layer of *Ilex aquifolium*, which is in optimal light, edaphic and microclimatic conditions under the tree layer.

formation (Table 2, annex in the volume) has been recorded on the northern slopes of the Madonie, Nebrodi and Peloritani Mountains, where holly is widespread reaching generally a covering between 5 and 50%. Such formations are found on surface substrata in the altitude belt between ca 1000 and 1200 m a.s.l., with local transgressions, in the most suitable areas, up to nearly 900 m a.s.l. In these formations the *Quercetalia pubescentis* group is strongly present with species such as *Poa sylvicola*, *Viola alba* subsp. *dehnhardtii*, *Quercus congesta*, *Teucrium siculum*, *Asperula laevigata*, *Fraxinus ornus*, *Limodorum abortivum*, *Clinopodium vulgare* subsp. *arundanum*, *Luzula forsteri*, *Tamus communis* and *Crepis leontodontoides*. There is a large number of species typical of *Querceto-Fagetalia* and namely of *Geranio-Fagion* and *Fagetalia* such as *Potentilla micrantha*, *Daphne laureola*, *Aremonia agrimonoides*, *Galium rotundifolium*, *Geranium versicolor*, *Luzula sieberi* subsp. *sicula*, as well as the same *Ilex aquifolium*. Such formations also include scattered members of *Quercetalia ilicis*, among the others *Ruscus aculeatus*, *Asplenium onopteris*, *Rubia peregrina* and *Thalictrum calabricum*.

As for pH, the recorded values in the acidophilous holm-oak and deciduous oak woods are between 5,4 and 5,6 in the holm-oak wood of Punta di Cuti (Palermo Mounts); between 5,8 and 6,3 in the pubescent-oak wood near Pizzo Trigna (Trabia Mounts); between 5,6 and 6 in the holm-oak wood of Giammarusa Mt.; between 5,6 e 6,1 in the holm-oak wood of Bosco countryside near Castelbuono; between 5,3 and 5,9 in the holm-oak wood of M. Fossa del Lupo (Nebrodi). Besides, 5,9 and between 5,4 and 5,7, respectively in the holm-oak and *Quercus congesta* oak woods at Pizzo Acqua Bianca (Peloritani). The pH of the calcicolous



Fig. 3. A particular feature of the holm-oak wood belonging to the *Geranio-Quercetum ilicis* association at the "Fossa del Lupo Mt." (Nebrodi mountains), at 1140 m a.s.l. Note that holly individuals are closely grouped within the holm-oak formation. These plants owing to the lowlight are typically spinning, as shown by their thin trunks and upwords developing crowns.

beech-wood in the M. Mufara area, where the population of the Madonie Mountains reaches the upper boundary, is between 7,2 and 7,6.

Synecology and syntaxonomy

Most wood formations mixed with *Ilex aquifolium* have been referred to syntaxa already known for Sicily (Table 1), while some others, which were not included in the known associations, have generally been referred to syntaxa of higher rank.

The oak woods mixed with pubescent oak and holly are being defined from the syntaxonomic point of view. Notably, the more termophilous ones on the Trabia Mountains have been referred to *Quercenion dalechampii* (*Erico-Quercion ilicis*, *Quercetalia* and *Quercetea ilicis*), while the more mesophilous ones on the Peloritani and Madonie Mountains to *Pino-Quercion congestae* (*Quercetalia pubescentis*, *Quercus-Fagetea*) (Maniscalco & Cavarretta 2003; Maniscalco 2003). The markedly mesophilous sweet chestnut woods with holly on the Etna Mt., owing to the floristic grouping, have been arranged in *Pino-Quercion congestae*. The beech-woods with holly surveyed on the Etna Mt., with a poor occurrence of species, have not been included in the two associations known for the Etna area (*Rubo aetnici-Fagetum* and *Epipactido meridionalis-Fagetum*).

Therefore, the two syntaxa have been reported in Table 1 and in the syntaxonomical scheme (Appendix B). As far as the Rocca Busambra biotope is concerned, the dotted spread holly (Gianguzzi & al. 1995) is only found in vegetation-of-replacement aspects referable to calcicolous holm-oak woods included in *Aceri campestris-Quercetum ilicis*. The acidophilous holm-oak wood with holly at Punte di Cuti (mountains surrounding Palermo), included among the *Aceri campestris-Quercetum ilicis helleboretosum* formations (Marcenò & Ottonello 1991), is referred, taking into account the group of species as well as the occurrence of acidophilous elements, to *Teucrio-Quercetum ilicis polystichetosum* described by Bartolo & al. (1990). The acidophilous holm-oak wood with holly within S. Giorgio wood (Giammarusa Mt.) has been included in the same syntaxon.

There is no correspondence between the orophilous and acidophilous holm-oak woods with holly on the Tyrrhenic slope (Fig. 3) and the syntaxa known from literature. In comparison with the acidophilous holm-oak woods belonging to *Teucrio-Quercetum ilicis* described by Gentile (1969) and emended by (Brullo & Marcenò 1985) and *Teucrio-Quercetum ilicis polystichetosum* (Bartolo & al. 1990), such holm-oak formations are markedly mesophilous, taking into account both the floristic grouping and the bioclimate (Tables 1, 2). Furthermore, *Ilex aquifolium* plays an important role within these formations. Owing to the ecology and the floristic organisation, such holm-oak woods are arranged in a new *Pino-Quercion congestae* association named *Geranio versicoloris-Quercetum ilicis* ass. nov. (Holotype: ril. 10, Table 2, annex in the volume). This association, spread along the Sicilian northern mountain chains, can be extended to southern Italy. It is in contact (to the upper boundary) with the sessile-oak wood of the *Ilici-Quercetum petraeae* on the Madonie Mountains and with the beech-woods of the *Anemono-Fagetum* on the Nebrodi Mountains. The *Geranio-Quercetum ilicis* can be considered as a geographic vicarious of the orophilous and acidophilous holm-oak woods with holly of the *Ilici-Quercetum ilicis* of Corsica by Gamisans (1977) arranged in *Quercio-Fagetum* class. They share the bioclimate type as well as a part of mesophilous species (Gamisans 1977, 1999; AA. VV. 1999). Nevertheless, holm-oak woods with holly in Sicily are well characterised from the geographic point of view, comprising a group of endemic species or with a distribution including, besides Sicily, the central-southern Apennine. Among them there are: *Melittis albida*, *Silene sicula*, *Thalictrum calabricum*, *Euphorbia amygdaloides* subsp. *arbuscula*, *Symphytum gussonei*, *Arrhenatherum nebrodense*, *Doronicum orientale* as well as *Geranium versicolor*. This last species, being markedly mesophilous, is found in the holm-oak woods in the Madonie, Nebrodi and Peloritani Mountains; it is also vicarious of *Geranium nodosum* in the Corsican holm-oak woods.

Discussion and conclusions

On the basis of the data compared in Table 1, the localities on the Madonie Mountains (E, F, G, H, I), the Nebrodi Mountains (N, O, Q, R) and the Peloritani Mountains (S, T, U) can be considered as optimal localities for *Ilex aquifolium*. They are under a humid supra-Mediterranean or supra-temperate bioclimate and the corresponding wood formations are referred to the *Quercio-Fagetum* classis. In the Peloritani localities (T, U) such formations are generally deteriorated and reduced. It has to be noted that the occurrence of *I. aquifolium*

in the calcicolous beech-woods on the Madonie Mountains (E), except when the morphology of the locality is favourable, is generally reduced. Although the biotopes on the Etna Mt. (V, Z) are under the same bioclimates and referred to *Quercus-Fagetum*, they are not to be considered optimal owing to the high permeability of the soil, not favourable to the occurrence of holly.

The localities on the Palermo Mounts (A, B), Rocca Busambra (C), the Trabia Mounts (D) and one on the Madonie Mountains (M) can be considered heterotopic. They are to be referred to the *Quercetum ilicis* classis, even if subject to different bioclimates. The one on the Trabia Mounts (D) and one of the localities on the Palermo Mounts (A) are subject to edaphic conditions linked to the lithology and morphology of the mountain which locally favour the occurrence and growth of the holly individuals.

Finally, the holm-oak woods (L) on the Madonie included in the *Quercetum ilicis* and the yew-wood on the Nebrodi Mountains (P) included in the *Quercus-Fagetum*, both on carbonaceous matrix, can be considered of intermediate ecologic conditions. In fact, within the two formations holly is more abundant in the colder areas, in the watershed and in the sectors at the highest altitude.

Taking into account altitude, on the northern slopes the species occurs between ca 700 and 1500-1600 m a.s.l. In the acidophilous beech-woods on the northern slopes of the Nebrodi Mountains, between S. Fratello and P.Ila Femmina-Morta, it is widespread between 1200 and 1400 m a.s.l., while, above this altitude, owing to the decrease in the mean temperatures, it gradually becomes scattered till totally disappearing around 1500 m a.s.l. At this altitude, the mean temperature in the coldest month is locally about 0 °C. On the south-facing slopes this species can be found at higher altitude. Raimondo (1980) reports the dotted occurrence of *I. aquifolium* on the south-facing Madonie Mountains at 1830 m a.s.l.

At lower altitude, under more termophilous conditions partly balanced by high rainfall, mist as well as edaphic and atmospheric humidity, holly is included in phytocoenosis arranged in *Quercetum ilicis*. Among these formations, the biotope on the Trabia Mounts is noteworthy. In fact, between 910 and 970 m a.s.l., in spite of the low rainfall rate (600-700 mm), it includes monospecific groups of hollies which are some hundred square metres wide and comprise individuals rising to 8 m altitude. In such a case, a pull of factors (edaphic humidity subject to the type of substratum evolved from siliceous shale, frequent mist on the highest part of the mountains and high rate of atmospheric humidity) plays a decisive role for the surviving of the species under extreme climatic conditions. The biotope on Giammarusa Mt. (Madonie) shows the highest mean temperature (14,5 °C).

The relict formations on the Trabia Mounts and Giammarusa Mt., located at about 7 km distance from the sea, are of great importance not only from the ecologic point of view but also from the chorologic one, pointing out a distributive continuity of the species in the north-western portion of the Isle (Fig. 1). While all the other biotopes with hollies are subject to the humid ombro-type, only the two recorded localities are exposed to the upper meso-Mediterranean termo-type with sub-humid ombro-type (Table 1).

Morphology, as already mentioned, can strongly affect the growth of holly which, under favourable microclimatic and edaphic conditions, in the watershed and small valleys, may have tree habit reaching about 10 m altitude. Under these conditions, this plant can rise to monumental size or can be found in monospecific formations (surely favoured by the

forestry management) extending in hundred square metres or even more. The most noteworthy example is the already mentioned locality of Piano Pomo (Madonie Mts) but there are also recent records on the Peloritani Mountains (Crisafulli & al. 2002) and Nebrodi Mountains (Schicchi 2003) and also new localities are on the Nebrodi Mountains at Pizzo di Luminaria at 1200 m a.s.l. and on the Madonie Mountains at P.no Di Farina - V.ne Canna, about 1350 m a.s.l., and at Gorgo Nero between 1200 and 1400 m.

Under the edaphic aspect, this species occurs on humid substrata and its being more subject to acid substrata in Sicily may depend on the edaphic humidity (generally higher in substrata evolved on flysch than on carbonaceous lithology) rather than on the pH. In the calcicolous beech-wood at Canna countryside (Madonie Mts), holly, scattered on the more or less steep slope, becomes abundant in the lower small valleys. As for pH, there are no strong differences within the holm-oak woods and the acidophilous deciduous oak-woods surveyed. As regards distribution, the map in Figure 1 shows that it is almost consistent and, apart from small gaps depending on orography, stretches from the Madonie to the Peloritani Mountains. *Ilex aquifolium* is more or less localised on the Palermo Mounts, Trabia Mounts, Rocca Busambra, Giammarusa Mt., and Etna Mt. where, depending on geological and edaphic reasons (Pignatti 1978), the species occurs scattered. It is reported exclusively on the eastern slope by Nicotra (1893), in the Vallone S. Giacomo by Poli & al. (1978) who generically consider it as rare in the Etna area.

Although holly is often evaluated as a specie typical of beech-woods, the greatest phytocoenosis aspects in the Isle are included – on the northern slopes and mostly under acidophilous conditions – between the lower horizon in the vegetation belt characterised by beech and in some formations with mesophilous deciduous species (*Quercus petraea* s.l. and *Q. cerris*). In such formations, to be considered “zonal”, *I. aquifolium* is occasionally found in large shrubby cover (Fig. 2) and can be part of the wood marginal vegetation dynamically linked to them. In Great Britain the sessile-oak formations are reported as the ones to whom the species mostly expresses costancy and is particularly abundant (Peterken & Lloyd 1967).

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Appendix A - Related dates of Table 2 (annex in the volume).

Locality and date of relevés:

- rel. 1, 2, 3, 4, 6, Bosco countryside (Madonie), 12-6-2001.
 rel. 5, Bosco countryside (Madonie), 30-3-2001.
 rel. 8, 12, 13, Fossa del Lupo Mt. (Nebrodi), 27-5-2001.
 rel. 9, 10, Fossa del Lupo Mt. (Nebrodi), 11-5-2001.
 rel. 11, Fossa del Lupo Mt. (Nebrodi), 29-4-2001.
 rel. 14, 15, 16, P. Acqua Bianca (Peloritani), 23-6-2001.

Accidental taxa:

Aristolochia sicula Tineo + (11, 15); *Cardamine hirsuta* L. + (4, 6); *Dactylis glomerata* L. + (5, 7); *Geranium lucidum* L. + (11, 14); *Helianthemum nummularium* (L.) Miller + (5, 13); *Paeonia mascula* (L.) Miller + (7, 12); *Prunella vulgaris* L. + (3, 5); *Prunus spinosa* L. + (3, 4); *Scutellaria rubicunda* Hornem. + (1, 5); *Sedum tenuifolium* (S. et S.) Strobl + (5, 12); *Stellaria* gr. *media* (L.) Vill. + (8, 14); *Acinos alpinus* (L.) Moench + (5); *Agrostis stolonifera* L. + (7); *Anthemis arvensis* L. subsp. *incrassata* (Loisel) Nyman + (8); *Anthemis triumfetti* All. + (7); *Arabis collina* Ten. + (10); *Aristolochia clusii* Lojac. + (15); *Asplenium trichomanes* L. + (15); *Catabrosa aquatica* (L.) Beauv. + (9); *Cistus salvifolius* L. + (2); *Crataegus* cfr. *laciniata* Ucria + (6); *Cymbalaria muralis* Gaertn. Mey et Sch. + (7); *Daucus carota* L. s.l. + (8); *Festuca arundinacea* Schreber + (7); *Festuca pratensis* Hudson + (2); *Galium aparine* L. + (15); *Genista cupani* Guss. + (5); *Lolium perenne* L. + (14); *Origanum heracleoticum* L. + (2); *Ornithogalum gussonei* Ten. + (10); *Picris hieracioides* L. + (7); *Polypodium cambricum* L. + (3); *Ranunculus velutinus* Ten. + (7); *Romulea bulbocodium* (L.) Seb. et Mauri + (5); *Silene latifolia* Poiret + (7); *Silene vulgaris* (Moench) Garcke + (7); *Trifolium bivonae* Guss. + (13); *Vicia villosa* Roth subsp. *varia* (Host) Corb. + (3); *Viola hirta* L. + (7).

Appendix B - Syntaxonomical scheme of Sicilian woods including holly.

- Quercus robur-Fagetum sylvaticae*** Br.-Bl. & Vlieger in Vlieger 1937
- ***Fagetalia sylvaticae*** Pawlowski in Pawlowski, Sokolowski & Wallisch 1928
 - ***Geranio versicoloris-Fagion sylvaticae*** Gentile 1969
 - Anemone apenninae-Fagetum* Brullo 1984
 - Anemone apenninae-Fagetum melittetosum albidae* (Ualdi 1995) Brullo, Guarino, Minissale, Siracusa & Spampinato 2001
 - Ilici-Taxetum baccatae* Brullo, Minissale, Signorello & Spampinato 1996
 - Ilici-Taxetum baccatae rusetosum aculeati* Gianguzzi & La Mantia 1999
 - Ilici-Quercetum petraeae* Brullo & Marcenò in Brullo 1984
 - Arrhenathero nebrodensis-Quercetum cerridis* Brullo, Minissale, Signorello & Spampinato 1996
 - Luzulo siculae-Fagetum* Brullo, Guarino, Minissale, Siracusa & Spampinato 2001
 - Rubus aetnisi-Fagetum* Brullo, Guarino, Minissale, Siracusa & Spampinato 2001
 - Epipactido meridionalis-Fagetum* Brullo, Guarino, Minissale, Siracusa & Spampinato 2001
 - ***Populetalia albae*** Br.-Bl. ex Tchou 1948
 - ***Populion albae*** Br.-Bl. ex Tchou 1948
 - Agropyro panormitani-Salicetum pedicellatae* Brullo & Spampinato 1990
 - ***Osmundo-Alnion glutinosae*** (Br.-Bl., P. Silva & Rozeira 1956) Dierschke & Rivas-Martinez 1975
 - Osmundo-Salicetum pedicellatae* Brullo & Spampinato 1990
 - ***Quercetalia pubescentis*** Klika 1933
 - ***Pino-Quercion congestae*** Brullo, Scelsi, Siracusa & Spampinato 1999
 - Geranio versicoloris-Quercetum ilicis* ass. nov.
 - community with *Quercus congesta* and *Ilex aquifolium* (mesophilous and acidophilous formations facing the Tyrrhenian sea)
 - community with *Castanea sativa* and *Ilex aquifolium* (mesophilous formations on the eastern slope of Etna Mt.)
- Quercetea ilicis*** Br.-Bl. ex A. & O. Bolòs 1950
- ***Quercetalia ilicis*** Br.-Bl. 1936 em. Rivas-Martinez 1975
 - ***Quercion ilicis*** Br.-Bl. 1936 em. Brullo, Di Martino & Marcenò 1977
 - Aceri campestris-Quercetum ilicis* Brullo 1984
 - Aceri campestris-Quercetum ilicis helleboretosum siculi* Marcenò & Ottonello 1991
 - ***Erico-Quercion ilicis*** Brullo, Di Martino & Marcenò 1977
 - ***Quercenion dalechampii*** Brullo 1984
 - Teucrio siculi-Quercetum ilicis* Gentile 1969 em. Brullo & Marcenò 1985 *polystichetosum aculeati* Bartolo, Brullo, Minissale & Spampinato 1990
 - community with *Quercus congesta* and *Ilex aquifolium* (termophilous and acidophilous formations on the Trabia Mounts)
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Annex: Table 2. *Geranio versicoloris-Quercetum ilicis* ass. nov.