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Biogeographic comparison of the laurel forests of Izu Peninsula and Tenerife Island

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Introduction

Laurisilva is distributed in both the northern and southern hemispheres, including Brazil and South Africa. This indicates that the beginning of Gondwana was 200 million years ago and fossils of Lauraceae are found from 120 million years ago in the Cretaceous period.

It is considered that the tropical and subtropical laurel forest was established in the regions of the Tethys Sea in the Oligocene, and was distributed around 40°N (TAKHTAJAN 1981). After that, during the Pleistocene, the laurisilva disappeared from southern Europe, where a Mediterranean climate replaced the warm climate. Former laurisilva is isolated in the Canary, Madeira, and Azores Islands and occurs on the cloud belt of so-called “Monte Werde” on mountain slopes. Tenerife is one of the Canary Islands, and has laurisilva at an elevation of 400–1200 m asl on the north-west face (BRAMWELL 1972).

Japan is located in the northeastern limit of laurisilva distribution in eastern Asia (TAGAWA 1995). Subtropical/warm temperate laurisilva was similar to Paleogene temperate because of similar floral aspect (TANAI 1991).

Biogeographic study uses comparisons of different regions (OHSAWA 1999). Comparison of the two far distant regions of laurisilva, based on phytosociological methods, shows how the synmorphological differences were formed.

Study area

Izu Peninsula is located on the Pacific Ocean side of central Honshu, Japan, at 34°97 - 34°68 N and 138°94 -139°9 W, which is farther north than Tenerife (Fig. 1). The climate is Asian Monsoon Warm Temperate, annual mean temperature is 15.5 °C (Fig. 2), and annual

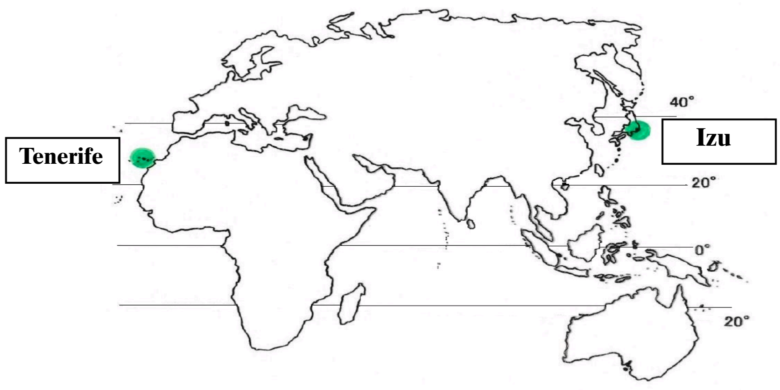

Fig. 1: Location map

precipitation exceeds 2000 mm. Typhoons strongly influence the climate, with several occurring every summer. Humidity is very high due to the oceanic climate. Climatic natural vegetation is Maeso-Castanopsion sieboldii of Camellietea japonicae, with a vertical distribution of 0-400 m asl; above this the vegetation changes to Quercion acutae which is not a subject of this research.

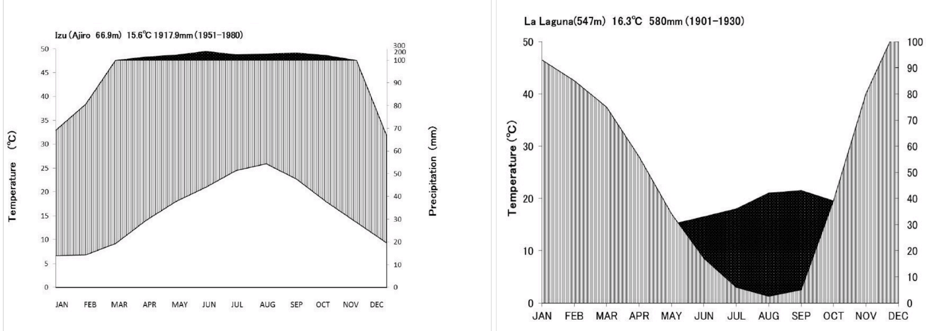

Fig. 2: Climate Diagram in Izu & La Laguna in Tenerife.

Tenerife is located in the Atlantic Ocean at 28°19 -28°31 N and 16°34 -16°56 W. Annual temperature is 21.1 °C, and in the Anaga cloud belt at 900 m asl is 15.7 °C almost the same as for Izu. The termicity index (RIVAS-MARTÍNEZ 1995) is 280-350. Annual precipitation is 233.3 mm; however, this increases in the cloud belt to 600-800 mm due to fog.

Results

1. Taxonomical comparison

Environmental adaptation exists in combination with changing species and structure of communities. Different phytosociological systems such as Camellietea japonicae in Japan and Pruno-Lauretea azoricae in the Canary, Madeira, and Azores Islands were established after long geological events. The laurisilva that developed around the Tethys Sea during the Paleogene period and along the continental drift of the Neogene local cold climatic conditions is established. Along with that the laurisilva divided and isolated in different regions during 30 million years.

However, taxonomical combinations of laurisilva at the family level did not change. Main tree taxa such as the Lauraceae, Theaceae, Pentaphylacaceae, Myrsinaceae, and Aquifoliaceae are almost the same (Tab. 1).

Characteristic families of Tenerife are Hypericaceae, Leguminoceae, and Cistaceae, which are not forest but forest edge species. Izu is characterized by Fagaceae, Pentaphylacaceae, and Elaeagnaceae in forest and has forest edge species of Araliaceae and Moraceae. Fagaceae, so-called nut tree species, disappeared from Tenerife because of the phenomenon of difficult seed dispersal in islands.

Evolutionary processes at the genus level were progressive, with only *Persea* in the Lauraceae and *Ilex* in Aquifoliaceae being common taxa. However, Japanese *Persea thunbergii* was changed to *Machilus thunbergii*, making *Ilex* the only common taxon (Tab. 2).

Ilex occurs worldwide, with 400-600 species in subtropical to temperate regions. Of Myrsinaceae, *Heberdenia* and *Pleiomeris* are endemic to Macaronesia islands. *Myrsine* and *Ardisia* are found around the tropic/subtropics of the Pacific Ocean including the southern

Tab. 1. Total species number in family.

Location	Tenerife	Izu
Number of community	65	29
Hypericaceae	4	-
Leguminoceae	4	1
Cistaceae	2	-
Fagaceae	-	6
Elaeagnaceae	-	5
Araliaceae	-	4
Pentaphylacaceae	-	3
Moraceae	-	3
Lauraceae	3	6
Aqufoliaceae	2	3
Pentaphylacaceae	1	3
Myrsinaceae	1	3
Theaceae	1	2
Myricaceae	1	1

hemisphere. Of Rauraceae, *Ocotea*, *Laurus*, and *Apollonias* are found in Southern Europe, the Indian sub-continent, and the southern hemisphere. *Neolitsea*, *Actinodaphne*, and *Cinnamomum* are also found around the tropic/subtropics of the Pacific Ocean including the southern hemisphere.

Of Pentaphylacaceae, *Visnea* is endemic in the Macaronesia islands and was found in Denmark in the middle Miocene. *Eurya* is found as macrofossils in Italy and Denmark from the Miocene. *Cleyera* is found also in Mexico. Of vicarious Theaceae species, *Camellia* is found in Asia and as fossils from the Oligocene in Washington USA and in Bulgaria.

The flora of Tenerife is Macaronesian and vicarious to Africa and South America. That of Izu belongs to the Sino-Japanese region.

2. Syntaxonomical comparison

Laurisilva of Tenerife belongs to Pruno-Lauretea azoricae Oberdorfer ex Rivas-Martínez et al. 1977 and Izu to Camellietea japonicae Miyawaki et Ohba 1963 (Tab. 3,4).

Phytosociological hierarchy

Tenerife

Pruno-Lauretea azoricae Oberdorfer ex Rivas-Martínez et al. 1977
  Pruno-Lauretalia azoricae Oberdorfer ex Rivas-Martínez et al. 1977
    Ixantho-Laurion azoricae Oberdorfer ex Santos 1977
      Lauro-Perseetum indicae Oberdorfer ex Rivas-Martínez et al. 1977
      Diplazino caudati-Ocoteetum foetentis Rivas-Martínez et al. 1993
      Ilici canariensis-Ericetum platycodonis Rivas-Martínez et al. 1993
      Visneo mocanerae-Arbutetum canariensis Rivas-Martínez et al. 1993
  Andryalo-Ericetalia Oberdorfer 1965
    Fayo-Ericion arboreae Oberdorfer 1965
      Fayo-Ericetum arboreae Oberdorfer 1965

Izu

Camellietea japonicae Miyawaki et Ohba 1963
  Myrsino-Castanopsietalia sieboldii K. Fujiwara 1981
      Maeso japonicae-Castanopsion sieboldii K. Fujiwara 1981

Table 2. Representative species of Laurus forests by taxonomical hierarchy in Tenerife & Izu.

Family	Species	Location
AQUFOLIACEAE	*Ilex canariensis*	Tenerife
	Ilex platyphylla	Tenerife
	Ilex rotunda	Izu
	Ilex integra	Izu
	Ilex crenata	Izu
ERICACEAE	*Arbutus canariensis*	Tenerife
	Erica platycodon	Tenerife
	Erica arborea	Tenerife
	Vaccinium bracteatum	Izu
	Rhododendron kaempferi	Izu
LAURACEAE	*Ocotea foetens*	Tenerife
	Laurus azorica	Tenerife
	Persea indica	Tenerife
	Actinodaphne lancifolia	Izu
	Machilus thunbergii	Izu
	Cinnamomum japonicum	Izu
	Neolitsea sericea	Izu
	Neolitsea aciculata	Izu
LEGUMINOSAE	*Adenocarpus foliolosus*	Tenerife
	Vicia cirrhosa	Tenerife
	Psoralea bituminosa	Tenerife
	Teline canariensis	Tenerife
	Lespedeza bicolor var. *acutifolia*	Izu
MYRICACEAE	*Myrica faya*	Tenerife
	Myrica rubra	Izu
MYRSINACEAE	*Heberdenia excelsa*	Tenerife
	Myrsine seguinii	Izu
	Ardisia japonica	Izu
	Ardisia crenata	Izu
PENTAPHYLACACEAE	*Visnea mocanera*	Tenerife
	Eurya japonica	Izu
	Ternstroemia gymnanthera	Izu
	Cleyera japonica	Izu
THEACEAE	*Cammelia japonica*	Izu
	Thea sinensis	Izu

Arachniodo-Castanopsietum sieboldii Miyawaki et al. 1971
Polysticho-Perseetum thunbergii Suz.-Tok. et Wada 1949
Pittosporion tobira Nakanishi et H. Suzuki 1974
Pittosporo-Quercetum phillyraeoidis Suz.-Tok. et Hatiya 1951
Euonymo-Pittosporetum tobira Miyawaki et al. 1971

This is a schematic of vegetation profiles under the effects of wind exposure and soil depth. It shows zonation between communities and the environmental gradient of Peninsula Izu (Fig. 3).

In the Canary Islands, evergreen Fagaceae are absent. In general, Fagaceae species occupy an important position in the laurisilva. *Castanopsis sieboldii* and *Quercus phillyraeoides* comprise the dominant canopy. Arachniodo-Castanopsietum sieboldii is climatic climax forest. Pittosporo-Quercetum phillyraeoidis is edaphic climax forest that occurs on wind-

Table 3. Evergreen broad-leaved laurel forest in Tenerife (Pruno-Lauretea azoricae).

a: Fayo-Ericetum arboreae d: Ilici canariensis-Ericetum platycodonis f: Diplazino caudati-Ocoteetum foetentis

b: Visneo mocanerae-Arbutetum canarie i: telinetosum, ii: heberdenietosum.

c: Telinetum canariensis e: Lauro-Perseetum indicae

Community type:	a		b		c	d		e	f
						i	ii		
Running nr.:	1	2	3	4	5	6	7	8	9
Number of releves:	3	16	16	4	9	3	3	10	10
Altitude (m):	620-842	370-1350	430-1150	855-1210	350-810	945-967	820-933	789-937	720-93(
Differential species of Ass.:									
Origanum virens	1(+)	III(+-2)	·	1(+)	·	·	·	·	·
Character species of Ass.:									
Visnea mocanera	·	·	IV(+-3)	2(1-2)	·	·	·	·	·
Arbutus canariensis	·	I(+-1)	V(+-3)	2(2-3)	·	·	·	·	·
Cistus monspeliensis	·	II(+-2)	II(+-3)	4(+-1)	·	·	·	·	·
Daphne gnidium	·	III(1-2)	III(+-2)	2(1)	II(1-2)	·	·	·	·
Cistus symphytifolius	·	III(+-4)	IV(+-3)	1(1)	·	·	·	·	·
Teline canariensis	·	·	·	·	V(+-4)	3(1-2)	1(+)	+(+)	·
Teline pallida	·	·	·	·	II(2)	·	·	·	·
Polycarpaea divaricata	·	·	·	·	II(1-2)	·	·	·	·
Sonchus acaulis	·	·	·	·	II(1)	·	·	·	·
Erica platycodon	2(2-3)	+(+)	·	·	II(1-2)	3(5)	3(4-5)	II(+-2)	I(+-1)
Heberdenia excelsa	·	·	·	·	·	·	2(1)	IV(+-2)	III(+-3)
Fissidens taxifolius	·	·	·	·	·	·	·	II(1-2)	·
Saccogyna viticulosa	·	·	·	·	·	1(+)	1(1)	II(+-2)	·
Rhamnus glandulosa	·	+(1)	+(+)	·	·	·	·	IV(+)	II(+-1)
Luzula canariensis	1(+)	+(1)	·	·	·	·	1(+)	III(+)	+(1)
Ocotea foetens	·	·	·	·	·	·	·	+(+)	V(+-4)
Diplazium caudatum	·	·	·	·	·	·	·	+(+)	V(+-4)
Polystichum setiferum	·	·	·	·	·	·	·	III(+)	IV(+-2)
Vandenboschia speciosa	·	·	·	·	·	·	·	·	III(+-1)
Dryopteris guanchica	·	·	·	·	·	·	·	·	II(1-2)
Main tree species:					·				
Erica arborea	3(4-5)	V(2-5)	V(1-3)	2(4)	V(1-4)	·	·	+(2)	II(1)
Myrica faya	3(1)	V(+-3)	V(+-3)	2(2-3)	II(+-2)	1(1)	3(1-3)	V(1-4)	II(+-2)
Ilex canariensis	3(1)	IV(1-4)	V(+-3)	2(1-3)	II(+-1)	2(1-2)	3(+-1)	II(+-2)	II(1)
Laurus azorica	1(2)	II(+-2)	II(+-1)	2(+-1)	II(+)	2(+-1)	3(2)	V(2-4)	V(+-4)
Prunus lusitanica ssp. *hixa*	1(1)	+(+)	·	·	·	2(1)	2(+)	V(+-2)	III(+-3)
Viburnum rigidum	2(+)	III(+-2)	IV(+-4)	2(+-1)	·	·	2(+)	V(+-2)	IV(1-3)
Hedera canariensis	·	·	·	·	·	1(+)	2(+)	+(+)	II(+-1)
Picconia excelsa	·	·	III(1-3)	1(2)	·	·	·	I(+)	+(1)
Persea indica	·	·	·	·	·	·	1(+)	+(2)	II(+-2)
Companions:									
Asplenium onopteris	1(+)	II(+-2)	I(+-1)	1(+)	II(+-2)	·	1(+)	V(+-2)	II(1-2)
Galium scabrum	1(+)	I(+-1)	I(+-3)	1(+)	·	·	1(+)	IV(+-1)	+(+)
Davallia canariensis	2(+)	II(+-2)	II(+-2)	2(+)	·	·	1(1)	IV(+-1)	I(+-1)
Pteridium aquilinum	·	II(+-1)	+(+)	1(1)	II(1-2)	3(+-2)	2(+-1)	II(+)	·
Ilex platyphylla	·	+(+)	·	·	·	·	3(+-1)	III(+-1)	IV(1-3)
Ixanthus viscosus	1(+)	·	·	·	·	·	1(+)	IV(+)	III(+-1)
Adenocarpus foliolosus	1(+)	I(1)	+(2)	2(+-1)	I(2)	2(+)	·	·	·
Phyllis nobla	·	I(+-1)	I(1-2)	·	·	·	·	III(+)	+(2)
Isoplexis canariensis	·	+(+)	II(+-2)	1(+)	·	·	·	·	+(+)
Rubus ulmifolius	·	II(1-2)	II(+-3)	·	III(1-3)	·	·	I(+-1)	+(1)
Ranunculus cortusifolius	·	I(+)	I(+-1)	·	I(1)	·	·	+(+)	I(+-1)
Smilax canariensis	1(+)	·	·	1(+)	·	·	·	I(+-1)	·
Brachypodium sylvaticum	·	II(+-2)	+(2)	1(+)	III(+-4)	·	·	·	·
Ageratina adenophora	·	+(+)	+(+)	1(+)	·	·	·	·	·
Hypericum canariensis	·	I(1-2)	III(+-3)	·	II(+)	·	·	+(+)	·

omitted

Table 4. Japanese evergreen broad-leaved forest (Camellietea japonicae).
a: Euonymo-Pittospotretum tobira
b: Pittosporo-Quercetum phillyraeoidis
c: Polysticho-Perseetum thunbergii
d: Arachniodo-Castanopusietum sieboldii

Community type:	a	b	c	d
Number of releves:	2	13	7	7
Height of Treelayer T1(m):	-	-	10-20	12-20
Coverage of Treelayer T1(%):	-	-	60-90	70-85
Height of Treelayer T2(m):	-	5-10	7-11	8-11
Coverage of Treelayer T2(%):	-	60-90	20-50	20-50
Height of Shrublayer S(m):	1.8-3.5	1.3-3	2.5-3	3-4
Coverage of Shrublayer S(%):	90	20-95	30-70	30-60
Height of Herblayer H(m):	0.5	0.3-0.8	0.3-0.7	0.6-0.8
Coverage of Herblayer H(%):	5-20	10-80	40-80	25-95
Altitude (m):	5-10	5-80	20-90	35-190
Average species number:	17	19	38	37
Character species of Ass.:				
Quercus phillyraeoides	·	Ⅴ(2-5)	·	·
Carex oahuensis var. *robusta*	·	Ⅲ(+-1)	·	·
Rhaphiolepis umbellata var. *integerrima*	1(+)	Ⅲ(+-2)	·	·
Elaeagnus umbellata	·	Ⅱ(+-1)	·	·
Reineckea carnea	·	·	Ⅳ(+-4)	·
Aphananthe aspera	·	·	Ⅲ(+-2)	·
Cyclosorus acuminatus	1(1)	·	Ⅲ(+-1)	·
Celtis sinensis var. *japonicus*	·	Ⅰ(+)	Ⅲ(+-2)	·
Ilex rotunda	·	·	Ⅲ(+-2)	Ⅰ(+)
Rohdea japonica	·	·	Ⅲ(+)	Ⅰ(+)
Podocarpus nagi	·	·	Ⅱ(+-1)	·
Actinodaphne lancifolia	·	·	Ⅱ(+-2)	·
Liriope platyphylla	·	·	Ⅱ(+-1)	·
Prunus zippeliana	·	·	Ⅱ(+)	·
Dryopteris pacifica	·	·	Ⅱ(+)	·
Cyrtomium falcatum	·	·	Ⅱ(+)	·
Microlepia marginata	·	·	Ⅱ(+)	·
Dryopteris lacera	·	·	Ⅱ(+)	·
Arachniodes aristata	·	·	Ⅰ(1)	Ⅴ(+-5)
Maesa japonica	·	·	Ⅱ(+-2)	Ⅴ(+-2)
Ficus nipponica	·	Ⅰ(+)	Ⅰ(+)	Ⅴ(+-1)
Hydrangea macrophylla var. *normalis*	·	Ⅰ(+)	Ⅰ(+)	Ⅳ(+-1)
Callicarpa japonica	·	Ⅰ(+)	Ⅰ(+)	Ⅳ(+)
Deutzia scabra	·	Ⅰ(+)	Ⅱ(+)	Ⅳ(+)
Myrsine seguinii	·	Ⅱ(+-2)	Ⅰ(1)	Ⅳ(+-3)
Myrica rubra	·	·	·	Ⅲ(2-4)
Osmanthus heterophyllus	·	·	Ⅰ(+)	Ⅲ(+)
Quercus salicina	·	·	Ⅰ(+)	Ⅲ(+-3)
Anodendron affine	·	Ⅰ(+)	Ⅰ(1)	Ⅲ(+-1)
Species of Cammelietea japonicae:				
Pittosporum tobira	2(2-4)	Ⅴ(+-3)	Ⅴ(+-1)	Ⅴ(+-1)
Daphniphyllum teijsmanii	2(+)	Ⅳ(+-2)	Ⅴ(+-1)	Ⅳ(+-2)
Persea thunbergii	1(2)	Ⅰ(+)	Ⅴ(1-4)	Ⅴ(+-2)
Ardisia japonica	1(+)	Ⅲ(+)	Ⅳ(+)	Ⅲ(+-1)
Cinnamomum japonicum	1(2)	Ⅲ(+-1)	Ⅴ(+-3)	Ⅴ(+-1)
Neolitsea sericea	1(3)	Ⅱ(+-2)	Ⅴ(+-2)	Ⅴ(+-1)
Eurya japonica	2(+-2)	Ⅱ(1)	Ⅲ(+)	Ⅴ(+-1)
Ilex integra	2(+)	Ⅱ(+-2)	Ⅱ(+-2)	Ⅲ(+-1)
Fatsia japonica	1(1)	Ⅱ(+-2)	Ⅴ(+)	Ⅲ(+)
Cammelia japonica	1(1)	Ⅱ(+)	Ⅳ(+-2)	Ⅲ(+)

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exposed faces on shallow soil and with structure of besom heather form similar to Ilici canariensis-Ericetum platicodonis. *Quercus phillyraeoides* belongs to the Subgen. *Quercus* Sect. *Ilex* but all other evergreen oaks are Subgen. *Cyclobalanopsis*.

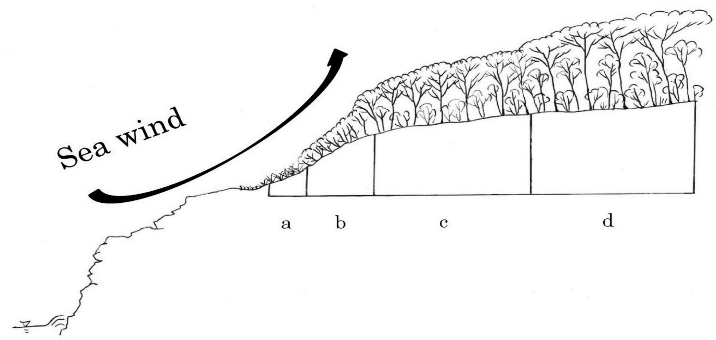

Fig. 3: Zonation along the environmental gradient in Peninsula Izu.
a: Chrisanthemo-Miscanthetum condensati; b: Euonymo-Pittosporetum tobira; c: Pittosporo-Quercetum phillyraeoidis; d: Arachniodo-Castanopsietum sieboldii.

Lauro-Perseetum indicae is climatic climax forest in Tenerife. However Japanese Polysticho-Perseetum thunbergii occurs on humid concave site like Diplazino caudati-Ocoteetum foetentis.

Fayo-Ericetum arboreae makes tree heather on the shallow soil of convex sites. In comparison with Ilici canariensis-Ericetum platicodonis, fog dominates this community and site conditions are wet mainly on ridges.

A similar ecological niche to that of Fayo-Ericetum arboreae is occupied by Euonymo-Pittosporetum tobira and Pittosporo-Quercetum phillyraeoidis. According to wind-exposure gradient, Euonymo-Pittosporetum tobira occurs in front as shorter bushes.

In front of Euonymo-Pittosporetum tobira is perennial grassland where Chrisanthemo-Miscanthetum condensati develops; however, in Tenerife succulent communities such as Umbilico horizontalis-Aeonietum urbici are common.

Laurisilva in Tenerife with moderate to humid habitats is occupied by Lauro-Perseetum indicae and Diplazino caudati-Ocoteetum foetensis, which include the principal species of laurisilva. However, on dry habitat the dominant species of *Telinetum canariensis*, Fayo-Ericetum arboreae, and Ilici canariensis-Ericetum platicodonis are African elements such as *Erica* and *Teline*. The Japanese laurisilva has typical communities such as Arachniodo-Castanopsietum sieboldii and Polysticho-Perseetum thunbergii with the principal species of laurisilva. Characteristic species of edaphic communities like Euonymo-Pittosporetum tobira are conifers such as *Pinus thunbergii*, *Juniperus chinensis*, and *Podocarpus macrophyllus*.

3. Synmorphological comparison

The climatic condition of Izu is similar to that of the Paleogene because of similar floral aspect (TANAI 1991). The Mediterranean climate appeared in the Pleistocene, when mainly the west side of continents became dry in summer. The limiting factor of Mediterranean laurisilva is summer drought. Fig. 4 shows monthly relative humidity in Tenerife and Japan. Santa Cruz has a typical Mediterranean climate with low humidity, particularly during summer. However, Anaga sometimes has high humidity because of cloud belt (EGUCHI et al.

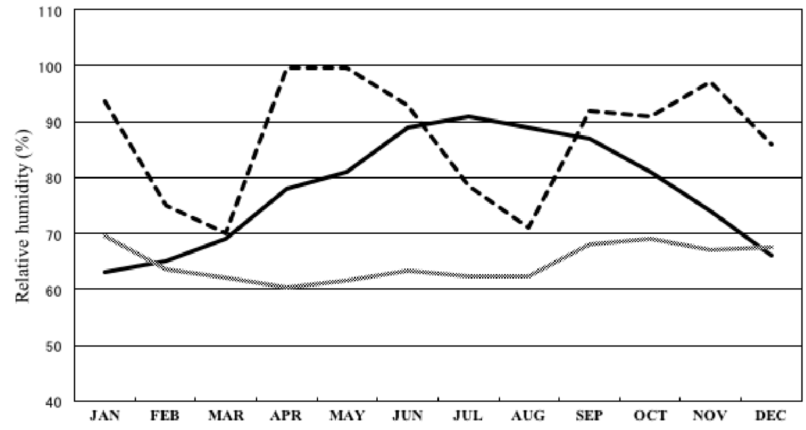

Fig. 4. Monthly relative humidity in Anaga, Tenerife and Izu (EGUCHI et al. 1999).

Izu(1951-1980); Anaga(1997-98, Eguchi et al. 1999);

Santa Cruz(1997-98, Eguchi et al. 1999).

1999). There has been discussion of how laurisilva adapted to the Mediterranean climate (IZQUIERDO, de las HERAS & MARQUEZ 2011).

Here are the species numbers for different layers. In each interior layer, the Japanese laurel forest has more species (Fig. 5). Comparing the climax forests shows that Arachniiodo-Castanopsietum sieboldii has three times more species than Lauro-Persetum indicae. So in Anaga

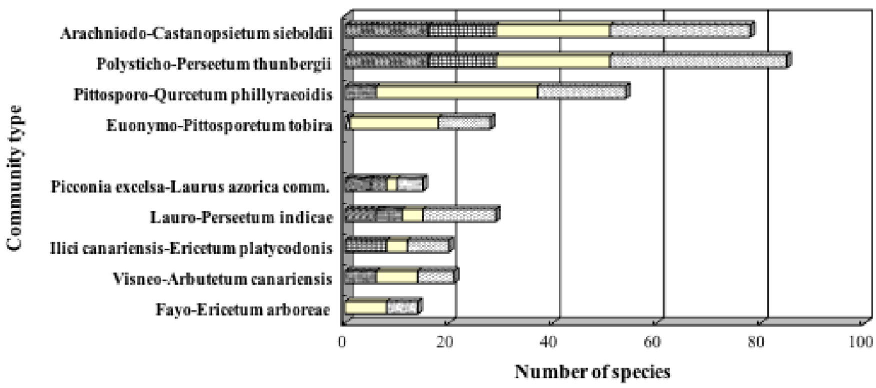

Fig. 5 Species number at the different layers of forest-interior.

Treelayer, Subtreelayer, Shrublayer, Herblayer

canopy species appear in shrub- and subtree-layers too, and make forest structure completely.

The canopy species of Ilici canariensis-Ericetum platicodonis make the besom heather form (Fig. 6). And many-branched limbs can extract moisture from the fog and resist strong winds also in Pittosporo-Quercetum phillyraeoidis.

Fig. 6: Wind exposed convex site characterized by the besom heather form.

4. Community circles of Arachniodo-Castanopsietum sieboldii and Lauro-Perseetum indicae

Through regeneration processes, dynamic stages are composed of several community types such as shrub and pioneer forest communities. In Izu they are (fast growing) pioneer summer-green broad-leaved species such as *Mallotus* Euphorbiaceae, *Fagara* Lutaceae, *Clerodendrum* Verbenaceae, *Idesia* Flacourtiaceae, *Rhus* Anacardiaceae, and *Melia* Meliaceae – so-called gap makers that belong to Clerodendro-Mallotion japonici. There is no gap maker that comprises a dynamic stage in Lauro-Perseetum indicae because young branches or stems of basal shoots close the gap immediately. *Persea indica*, *Laurus azorica*, *Ilex canariensis*, and

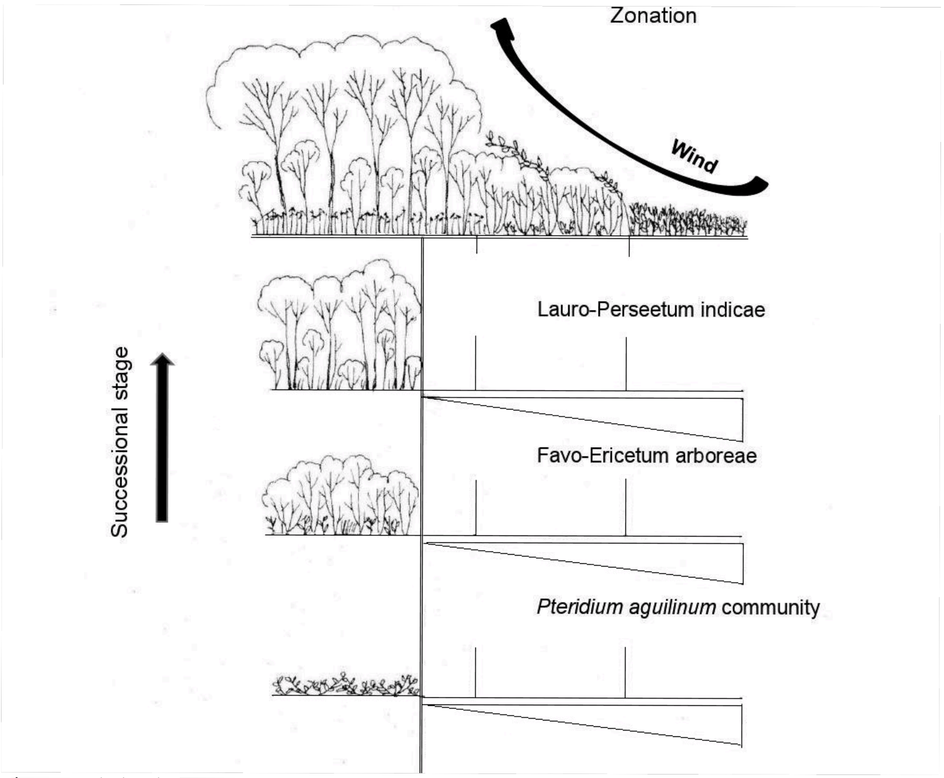

Fig. 7.: Relation between succession and zonation in Anaga, Tenerife.

Prunus lusitanica vegetatively propagate by shoots and deploy in shrub and subtree layers. Therefore, the species number is lower in Tenerife than Izu.

However, when the collapse area is wide, Fayo-Ericetum arboreae occurs on the stand and makes secondary forest of Lauro-Perseetum indicae (Fig. 7; NAKAMURA et al. 2000).

5. Adaptation to climate change and evolution of vegetation

Comparison of the two far distant, regions of laurisilva, based on phytosociological methods, showed how synmorphological differences were formed. Tenerife and Izu have common families that originated around the Tethys Sea: Lauraceae, Myrsinaceae, and Theaceae. However, they differ at genus level. They have different floral regions: Macaronesia and Sino-Japanese in the Paleoarctic region.

Synmorphologically, Canarian laurisilva is adapted to the Mediterranean climate.

1. Edaphically xerophytic site of laurisilva composed of *Erica* and *Teline* which originated in Paleo tropical kingdom.
2. Species diversity of laurisilva in Anaga is one-third of that in Izu. However, Pruno-Lauretea species form a dense canopy and promptly close forest gaps mostly by sprouting regeneration.
3. Fayo-Ericetum arboreae is an edaphic climax community on wind-exposed faces; however, it also occurs as a pioneer stage of Lauro-Perseetum indicae.
4. Climatic climax Aracniodo-Castanopsietum sieboldii has its own pioneer plant community of Crerodendro-Mallotion japonici in the secondary stage.
5. The besom heather form and many-branched limbs can extract moisture from the fog and resist strong winds in Ilici canariensis-Ericetum platicodonis and Pittosporo-Quercetum phillyraeoidis.

Zusammenfassung

In diesem Aufsatz werden vergleichende pflanzengeographische Untersuchungen von Lorbeerwäldern des Anaga-Gebirges der Kanarischen Insel Teneriffa und der Halbinsel Izu auf Honshu in Japan vorgestellt.

Auffällig ist das Auftreten gemeinsamer Pflanzenfamilien in den Lorbeerwäldern der Pruno-Lauretea azoricae auf Teneriffa sowie der Camellietea japonicae in Honshu: Das sind die Vertreter der Lauraceae, Theaceae, Pentaphylacaceae, Myrsinaceae, und Aquifoliaceae.

Erklärbar ist dieses durch allopatrische Artbildungsprozesse vom Oligozän bis zum Pleistozän, wobei hinsichtlich der Pflanzengattungen besonders die Gattung *Persea* aus der Familie der Lauraceae und die Gattung *Ilex* aus der Familie der Aquifoliaceae die floristischen Beziehungen zwischen Makkaronesien und den Sino-Japanischen Florenbezirken innerhalb der Paläoarktis auffallen.

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