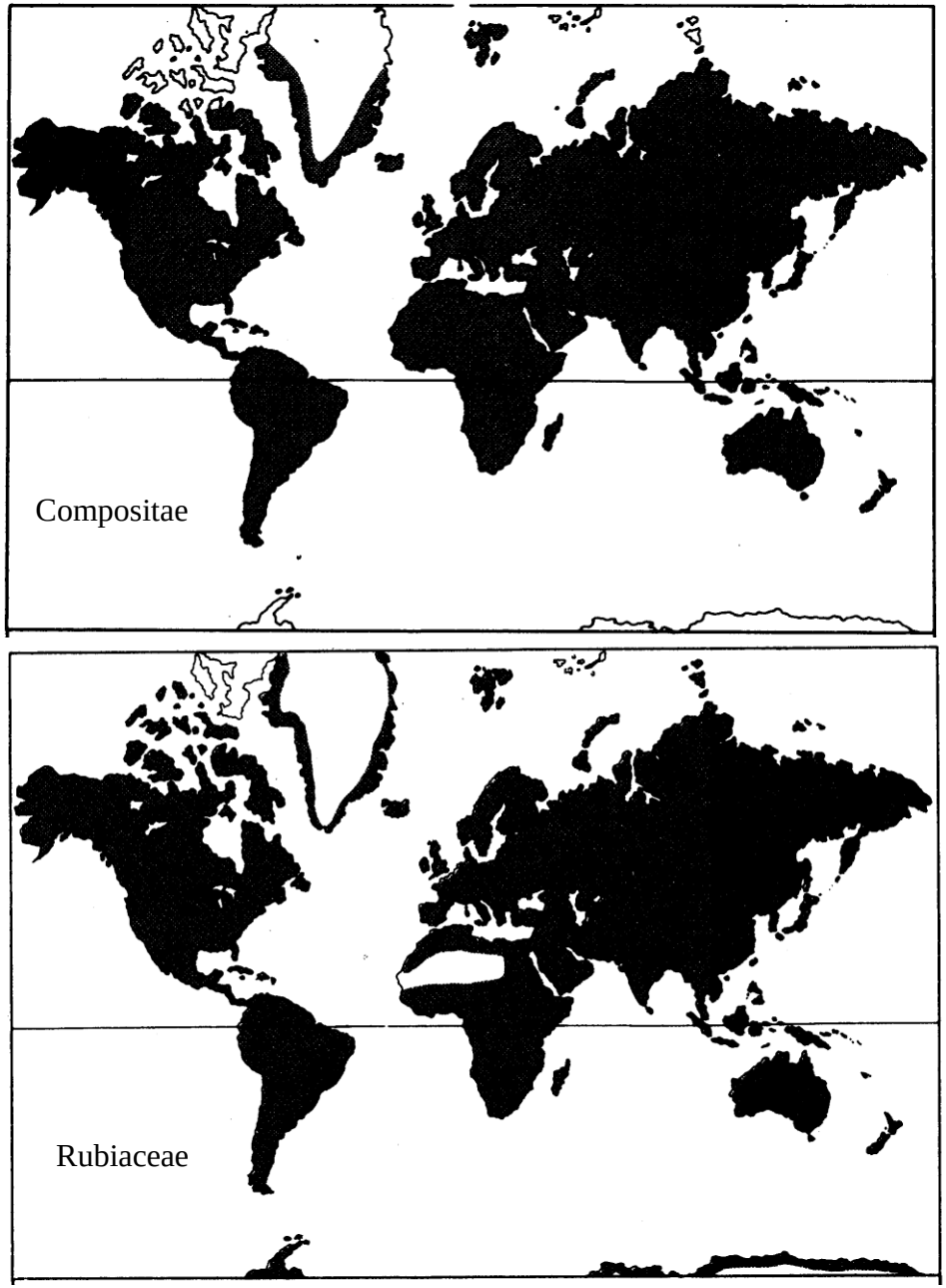
TIPOS FUNDAMENTAIS DE DISTRIBUIÇÃO

Cosmopolitanismo

Endemismo

Disjunção

Provincialismo



Heywood 1976

Distribution of a *Myomorpha* - a cosmopolitan genus of a mouse-like rodents (from Alderton, D., 1996, *Rodents of the World*, Blandford).

Spellerberg & Saywer 1999

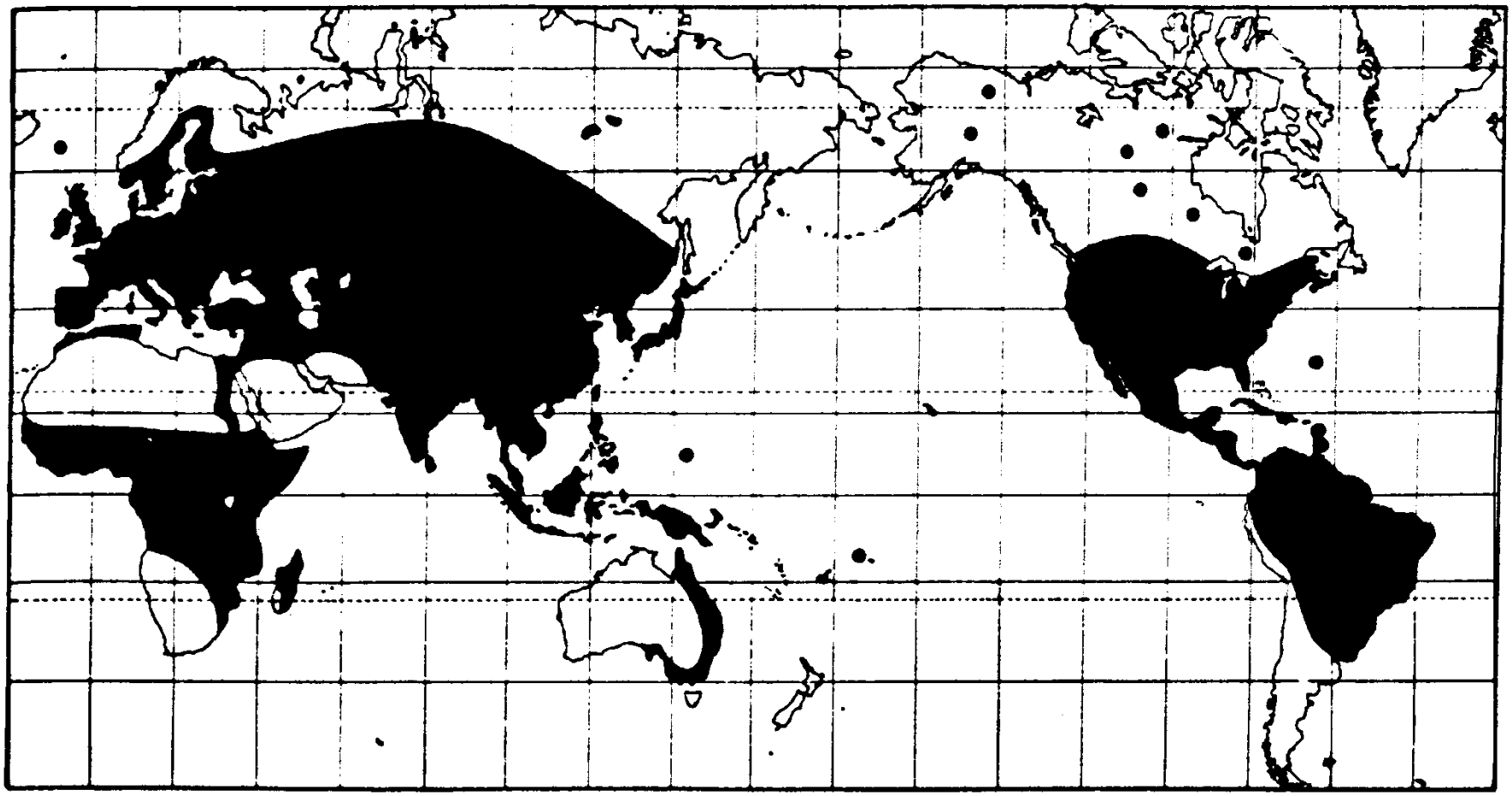
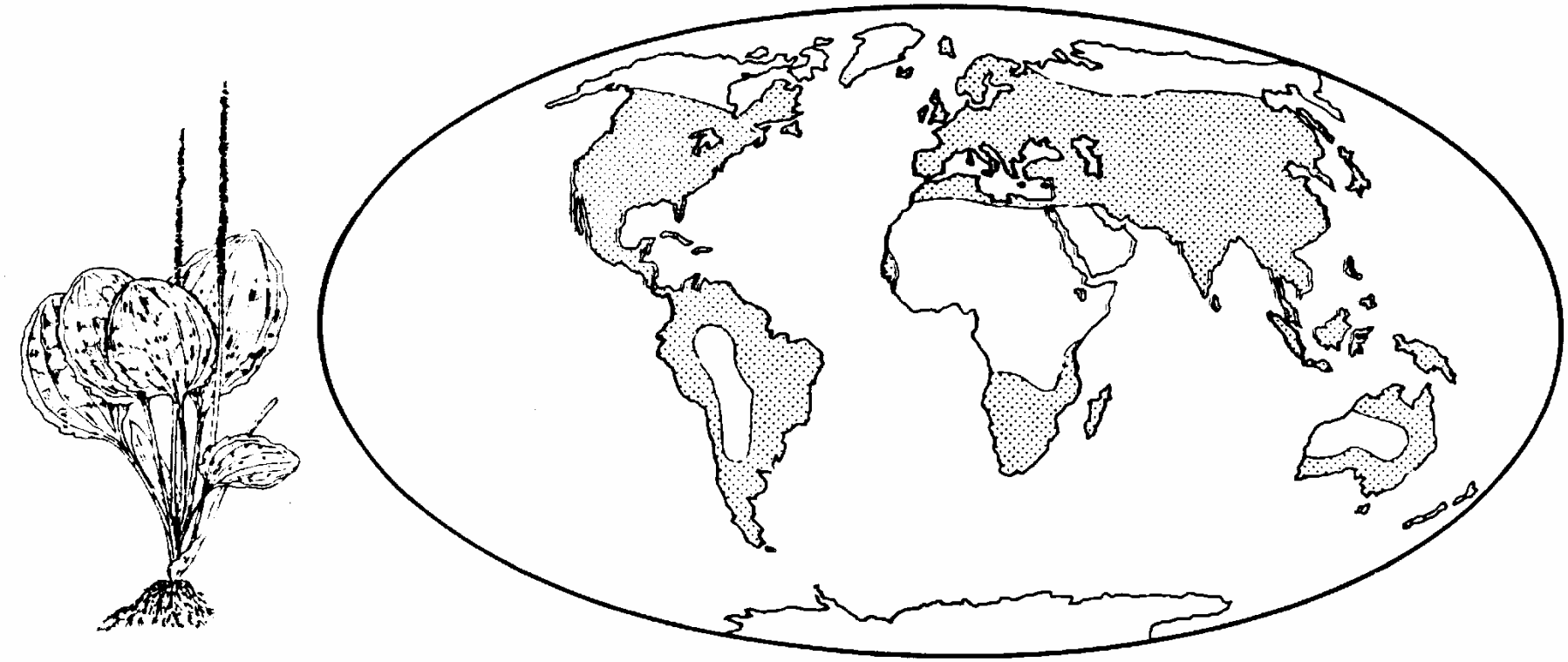


Fig. 1.2. Distribution of *Ceratophyllum demersum* (Ceratophyllaceae). (After Thorne, 1972, Fig. 43, p. 397.)



The world distribution of a cosmopolitan species, ***Plantago major***, the broad-leaved plantain. (Plantaginaceae)

Cox & Moore 1993

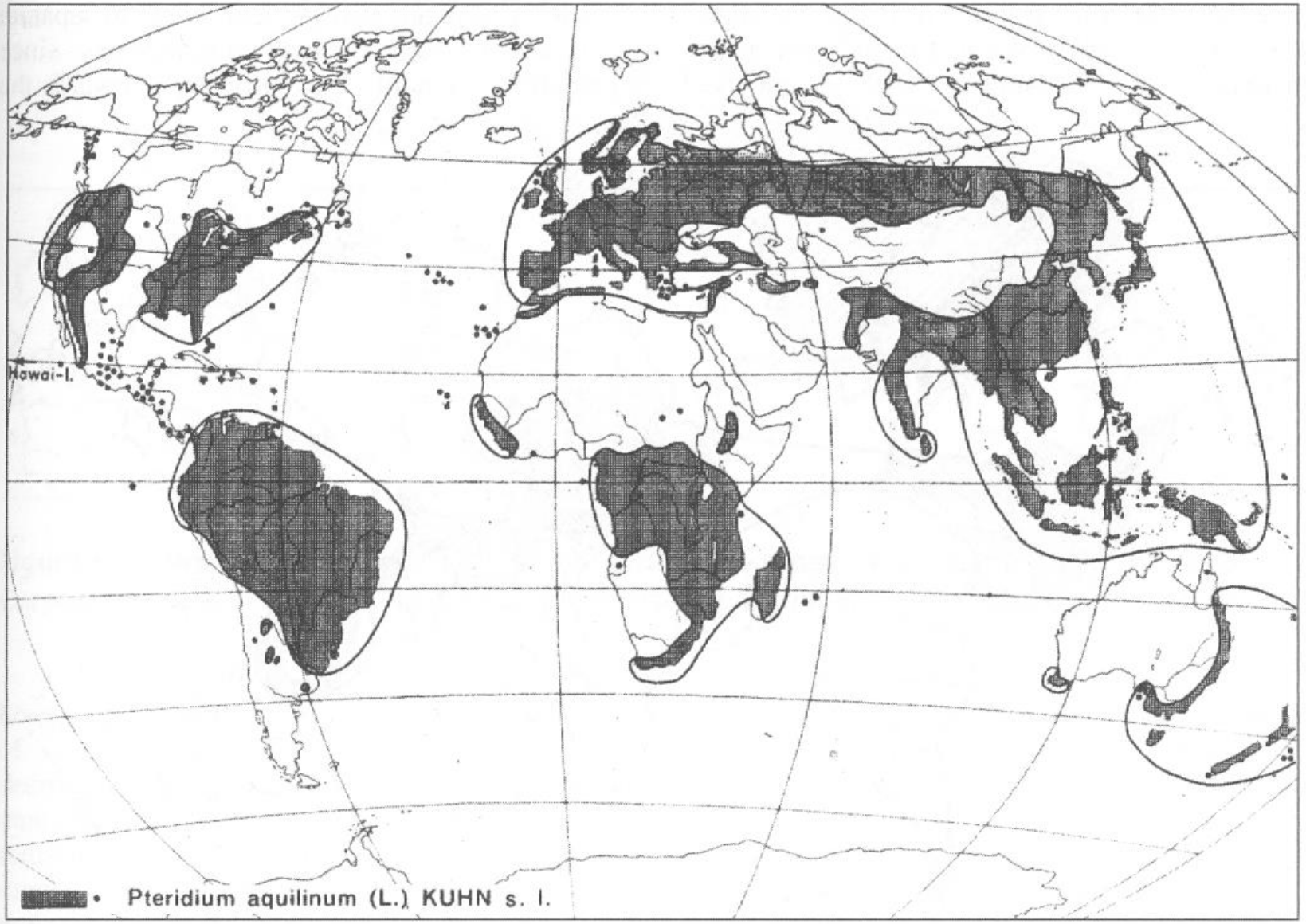
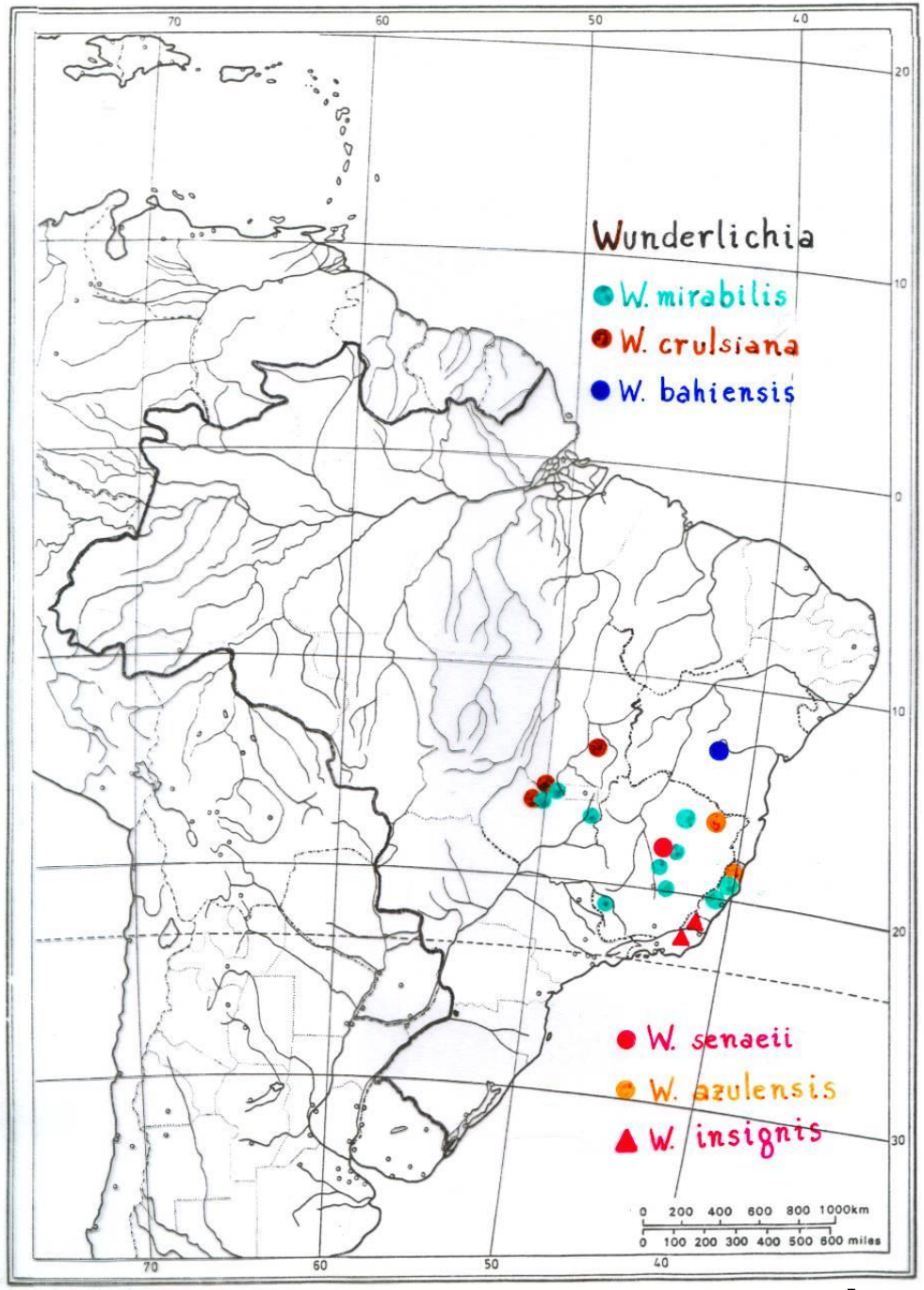


Figure 8.2 The world distribution of bracken (Pteridium aquilinum), a cosmopolitan species (after Meusel et al., 1965)

Millington et al. 2011



baseado em dados de Barroso & Maguire 1973

Endemismo

A.P. de Candolle (1820)
Táxon é endêmico de uma área se ele vive ali e em nenhuma outra área.

X

Cosmopolitanismo

TERMOS podem ser definidos em escala restrita ou ampla
(e.g. Parenti & Ebach 2009)

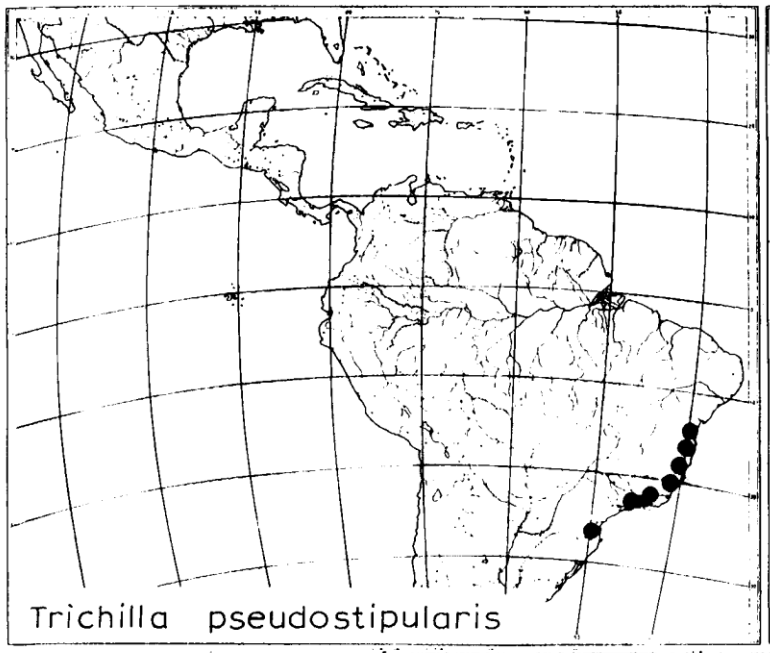
Famílias endêmicas do Reino Neotropical

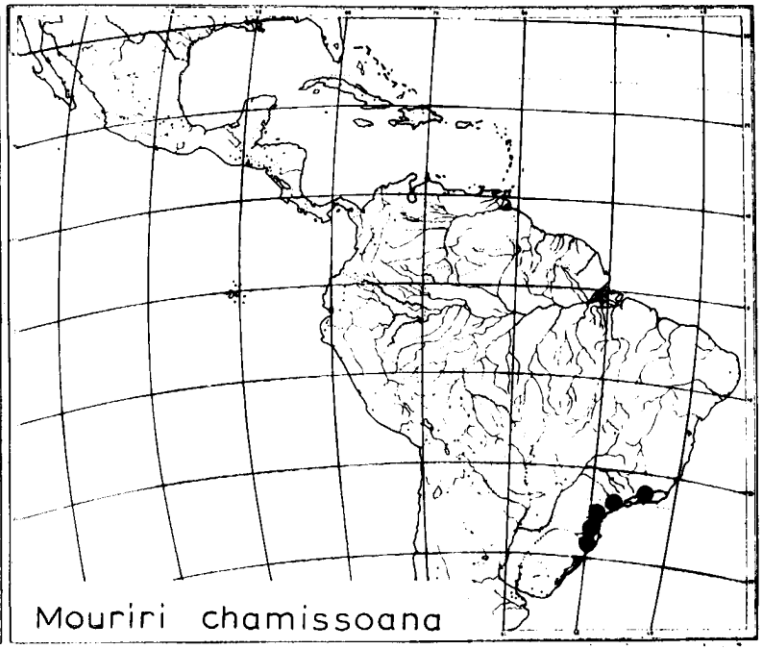
Table ordered from the family with the largest number of genera to the smallest number of genera.

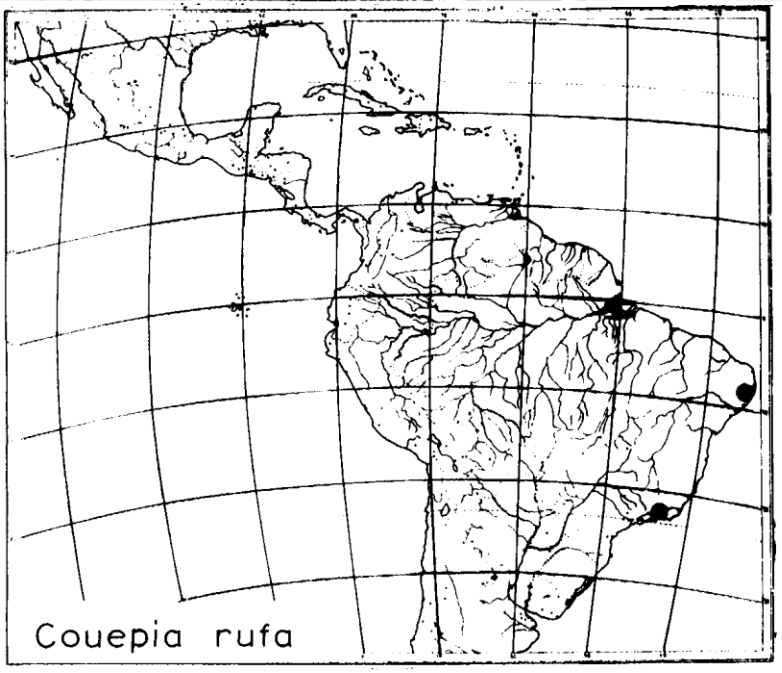
Smith *et al.* 2004

Family	*Approximate # of genera*	*Approximate # of species*	*Family*	*Approximate # of genera*	*Approximate # of species*
CYCLANTHACEAE	12	180	EUPHRONIACEAE	1	3
MARCGRAVIACEAE	7	130	LISSOCARPACEAE	1	5
THEOPHRASTACEAE	6	95	PELLICIERACEAEE	1	1
QUIINACEAE	4	51	PHYLLONOMACEAE	1	4
EREMOLEPIDACEAE	3	12	PLOCOSPERMATACEAE	1	1
MUNTINGIACEAE	2–3	3	PTEROSTEMONACEAE	1	2
CARYOCARACEAE	2	25	RHABDODENDRACEAE	1	3
PERIDISCACEAE	2	2	TEPUIANTHACEAE	1	6
PICRAMNIACEAE	2	46	TICODENDRACEAE	1	1
ALZATEACEAE	1	1	TOVARIACEAE	1	2
BRUNELLIACEAE	1	65	CANNACEAE	1	10
COLUMELLIACEAE	1	4	THURNIACEAE	1	3
DUCKEODENDRACEAE	1	1			

Caryocar brasiliense


Trichilla pseudostipularis


Mouriri chamissoana


Couepia rufa

Prance 1989

TABLE 4. Distributional patterns of naturally occurring plant species in local florulas.

Gentry 1986

Distributional pattern	Barro Colorado[a] Panama		Jauneche[b] Ecuador		Rio Palenque[c] Ecuador	
	No. spp.	%	No. spp.	%	No. spp.	%
Locally endemic (may have ranges up to 75,000 km^2)	92[d]	7	85[e]	14	172[e]	20
Wide endemic (distributional area ca. 100,000–200,000 km^2)	122[f]	9	8[g]	1	51[g]	6
Regional	180[h]	14	63[i]	11	154[i]	18
Widespread on continent (Central America to Amazonia but not West Indies)	473[j]	36	111	19	167	19
Pan-American (Central America and West Indies to Amazonia)	436	33	279	47	271	31
Trans-Andean disjuncts (Western Ecuador and Amazonia but not reaching Panama)	—	—	16	3	35	4
Central America and West Indies to coastal Ecuador (but not in Amazonia)	—	—	10	2	20	2
More or less widespread in South America and/or West Indies but not reaching Central America	—	—	5[k]	1	—	—
Disjunct between northern Colombia/ Venezuela and coastal Ecuador	—	—	7	1	—	—
Other	—	—	4[l]	1	—	—
Total species analyzed	1316		589		870	

TABLE 1. Endemism on some islands.

Gentry 1986

Island	Area (km^2)	Genera	Endemic genera	Species	Endemic species	Percentage endemism
Cuba[a]	114,914	1308	62	5900[b]	2700	46
Hispaniola[a]	77,914	1281	35	5000[b]	1800	36
Jamaica[a]	10,991	1150	4	3247[b]	735	23
Puerto Rico[a]	8,897	885	2	2809[b]	332	12
Galapagos[c]	7,900	250	7	701	175	25
Hawaii[d]	16,600	253	31	970[e]	883	91
New Zealand[c]	268,000	393	39	1996	1618	81
New Caledonia[f]	17,000	787	108	3256	2474	76

[a] From Liogier, 1981.
[b] Includes adventives.
[c] From Raven and Axelrod, 1978.
[d] W. Wagner, personal communication; Wagner and Gagné, in press.
[e] Note that this value is significantly lower than older estimates of the number of species in Hawaii.
[f] From Morat et al., 1984.

Conservation Biology

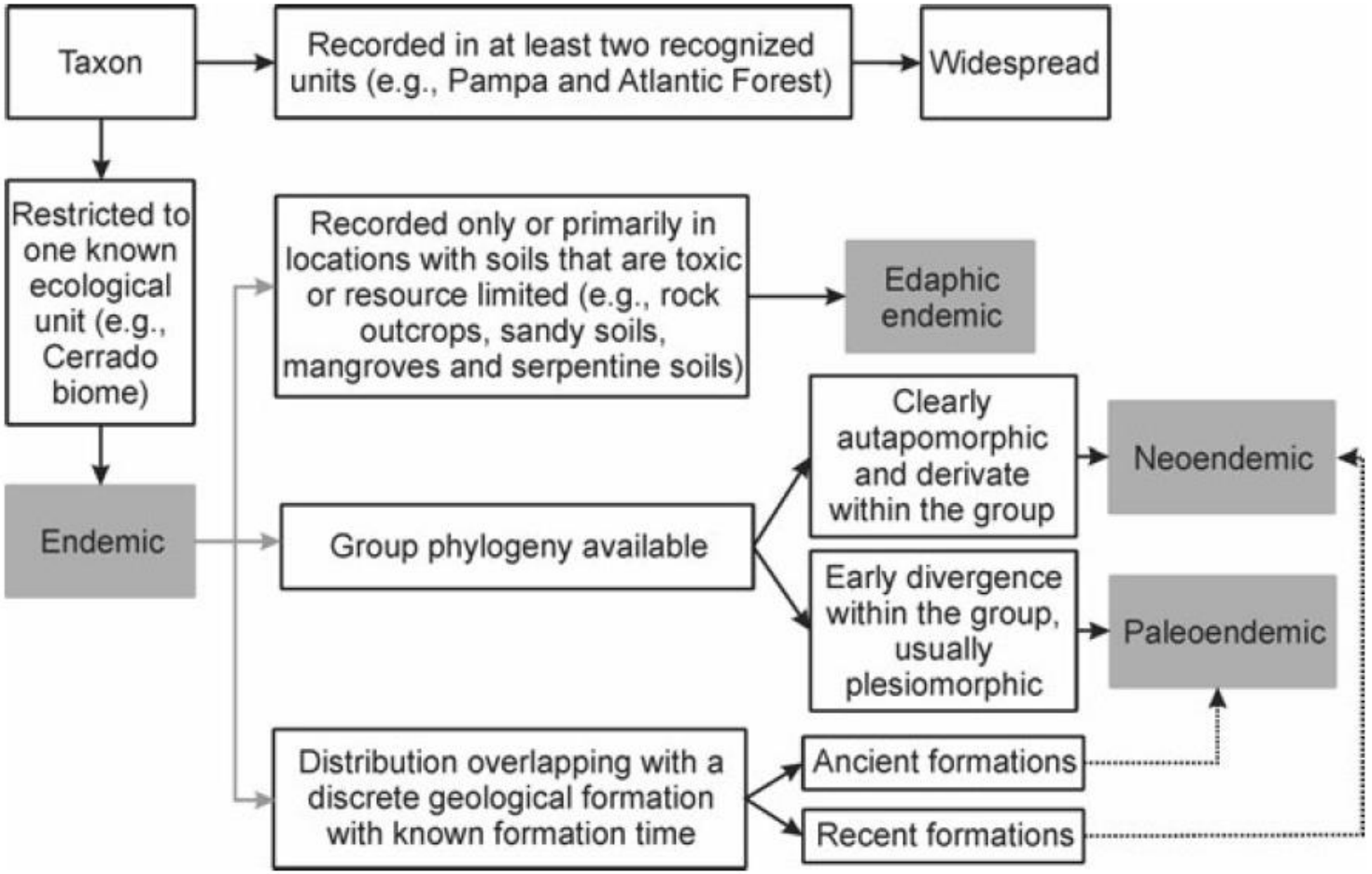
Ferreira & Boldrini 2011

Definição estrita de endemismo

Review

Potential Reflection of Distinct Ecological Units in Plant Endemism Categories

PEDRO M. A. FERREIRA* AND ILSI I. BOLDRINI



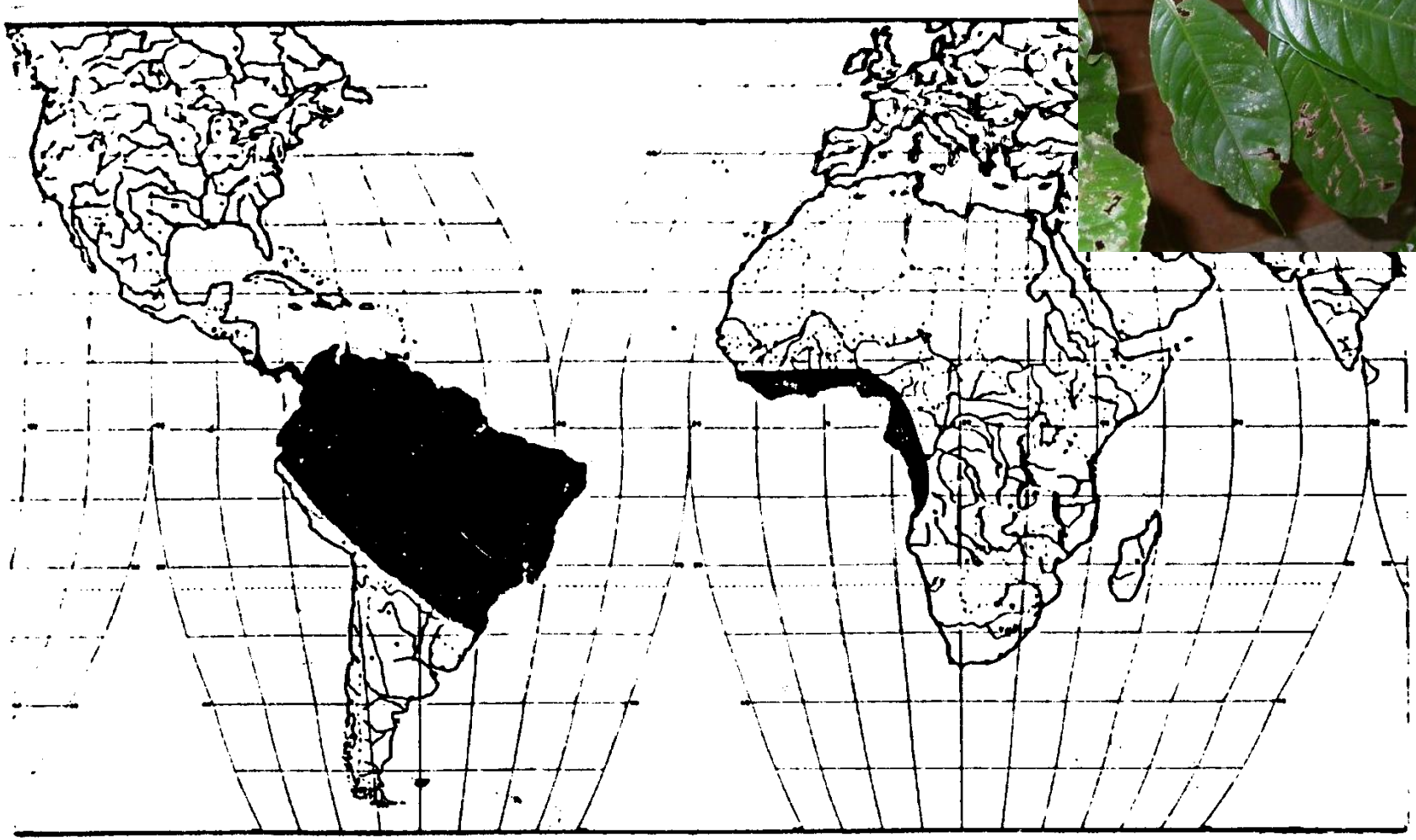
Decision tree for categorization of taxa into endemism categories.

DISJUNÇÃO

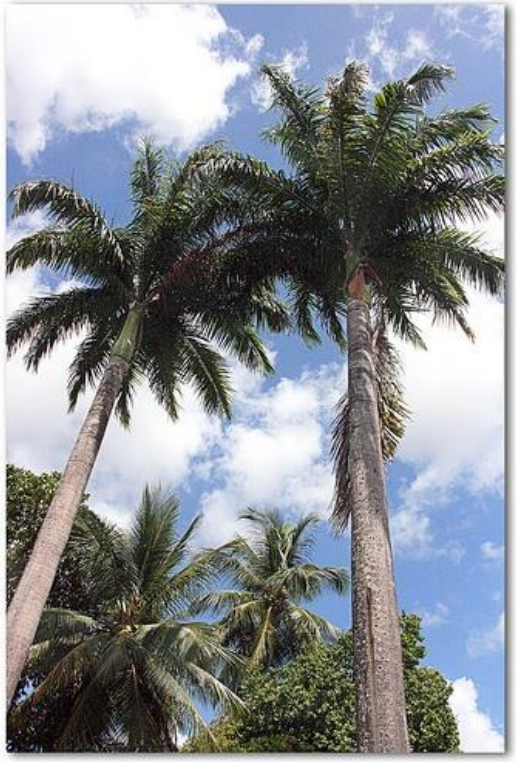
Definição?

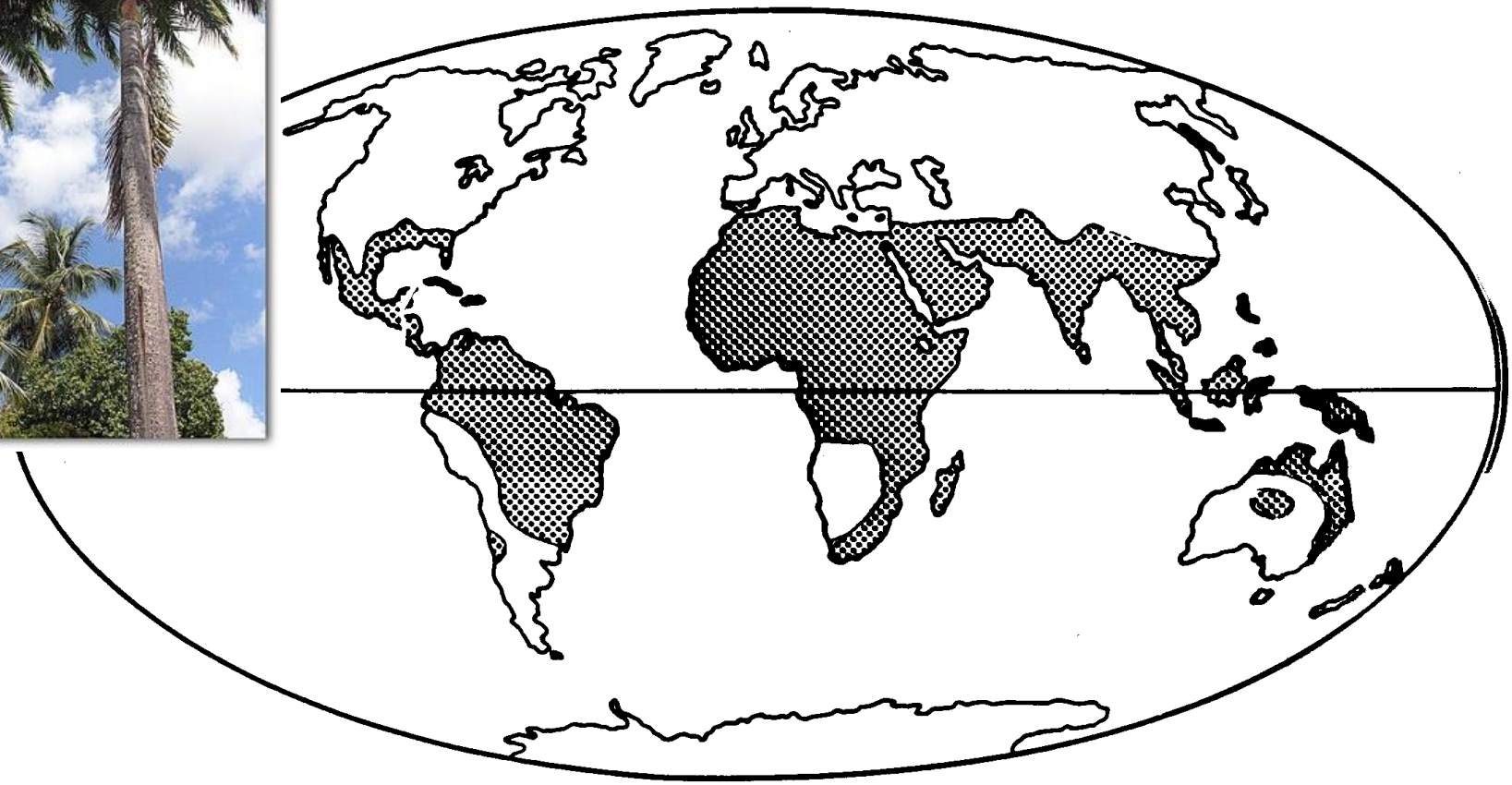
Padrão?
Causas? (processos)

Afro-American disjunctions. Distribution of **Bromeliaceae** (white area) and of **Rapateaceae** (black area). The only African members of these families are ***Pitcaimia feliciana*** and ***Maschalocephalus dinklagei*** respectively. (Mter Hepper, 1965.)



Distribution of the Humiriaceae, with just one species, *Sacoglottis gabonensis*, in the tropical West Africa. **Cuatrecasas 1961**





Cox & Moore 1993

World distribution map of the palm family (Palmae), a pantropical family of plants

I Eurasian-North American
- 1 Arctic
  - 1a Circum-Arctic
  - 1b Beringian-Arctic
  - 1c Amphi-Atlantic-Arctic
- 2 Boreal
  - 2a Circum-boreal
  - 2b Beringian-boreal
  - 2c Amphi-Atlantic-boreal
- 3 Temperate
  - 3a Circum-north temperate
  - 3b North-south temperate
  - 3c Fragmentary-north temperate

II Amphi-Pacific tropical

III Pantropical

IV African-Eurasian (-Pacific)
- 1 African-Mediterranean
- 2 African-Eurasian
- 3 African-Eurasian-Malesian
- 4 African-Eurasian-Pacific
- 5 African-Eurasian-Australasian
- 6 Indian Ocean-Eurasian

V Amphi-Indian Ocean

VI Asian-Pacific
- 1 Asian-Papuan
- 2 Asian-Papuan-Melanesian
- 3 Asian-Papuan-Pacific Basin
- 4 Asian-Papuan-Australasian

VII Pacific Ocean

VIII Pacific-Indian-Atlantic Ocean

IX American-African

X North American-South American

XI South American-Australasian

XII Temperate South American-Asian

XIII Circum-south temperate

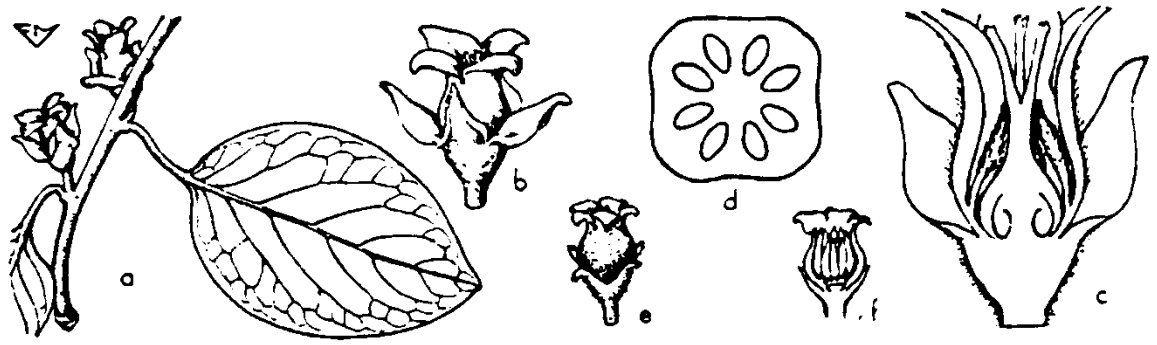
XIV Circum-Antarctic

A broad classification of major distribution patterns of seed plants (after Thorne 1972; Scott 1982)

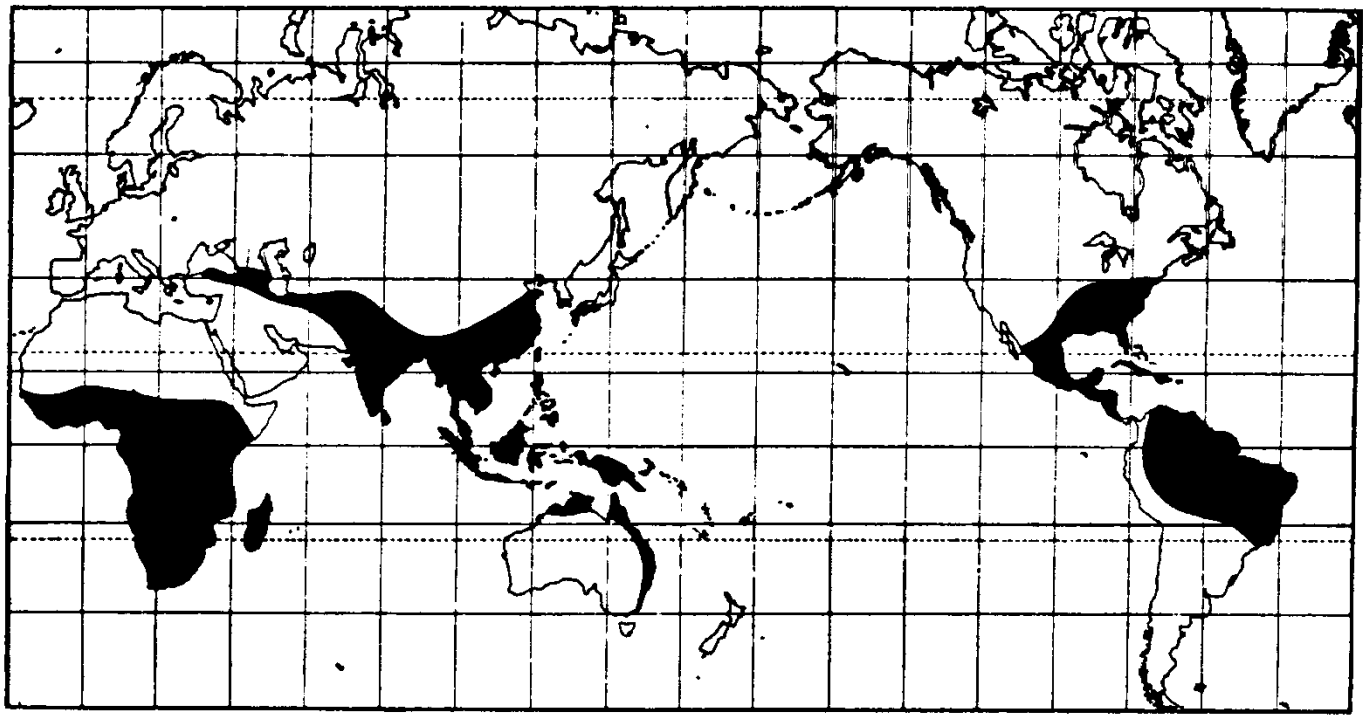
Humphries & Parenti 1986

Total range of *Rhododendron,* illustrating the basically Laurasian range with rapid extension (and subsequent speciation) west of Wallace's line (dotted arrows), especially in upland New Guinea, after the uplift (in the last 1-3 million years) of the last island. Only isolated taxa reach Australia and the Solomon Islands. (Range showing late Tertiary and Pleistocene contraction: R. *pont/cum,* now in southern Europe, was in Tertiary times in Britain.)

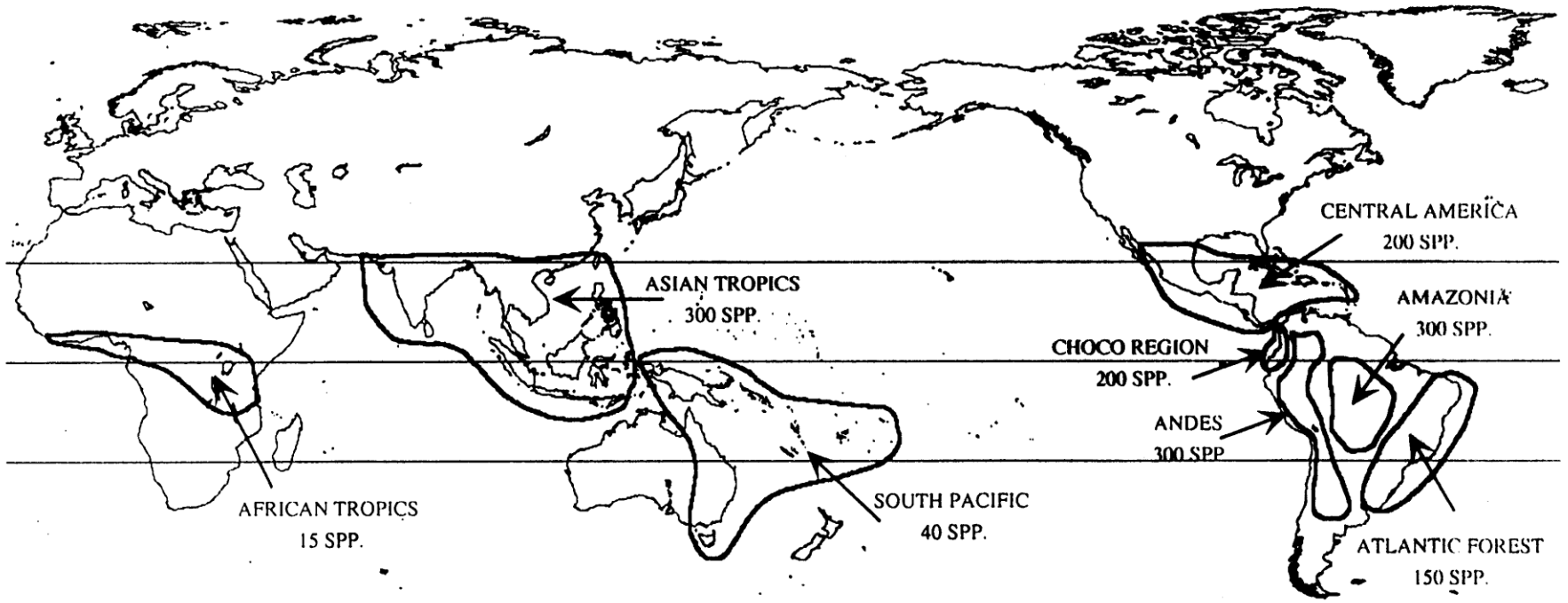
Schuster in Beck (1976)



EBENACEAE. *Diospyros virginiana*



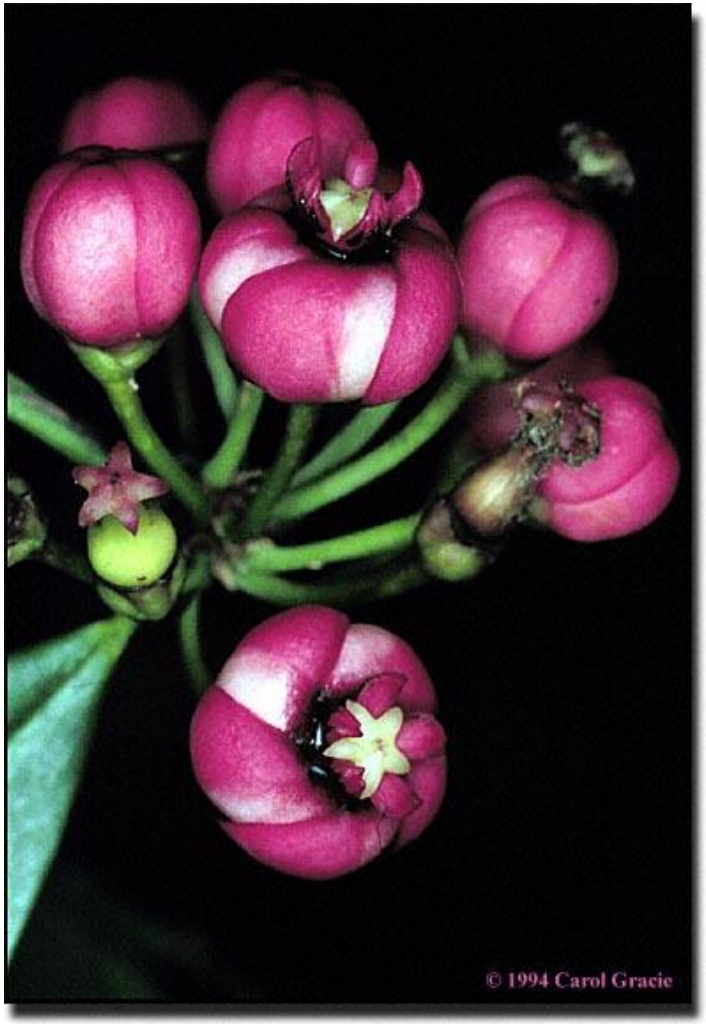
Distribution limits of the pantropical ebonies *Diospyros* (s.l). (Thorne 1972)



Geographic distribution of the genus *Piper.*

Species numbers are estimates for each of the centers of diversity of the group, thus regionally widespread taxa may be represented more than once.

Jaramillo & Manos 2001



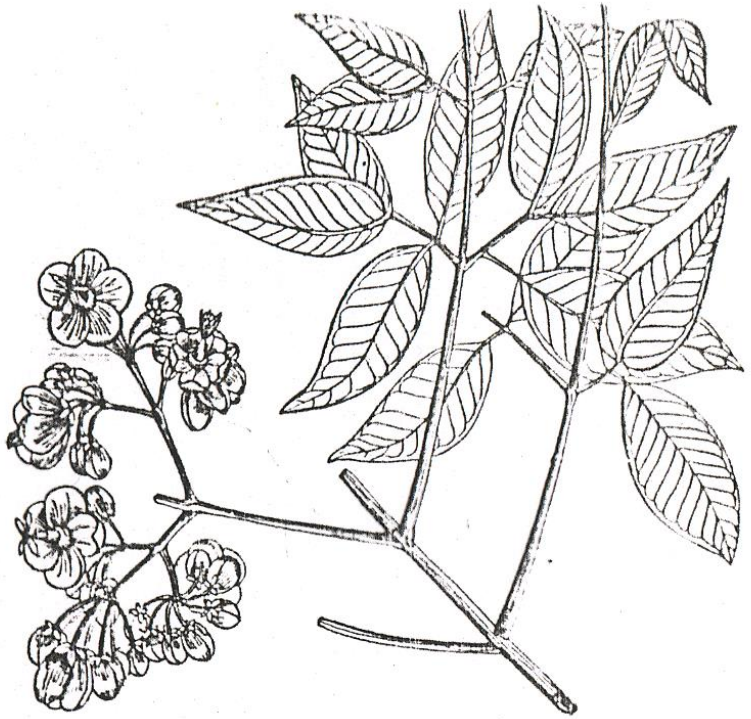
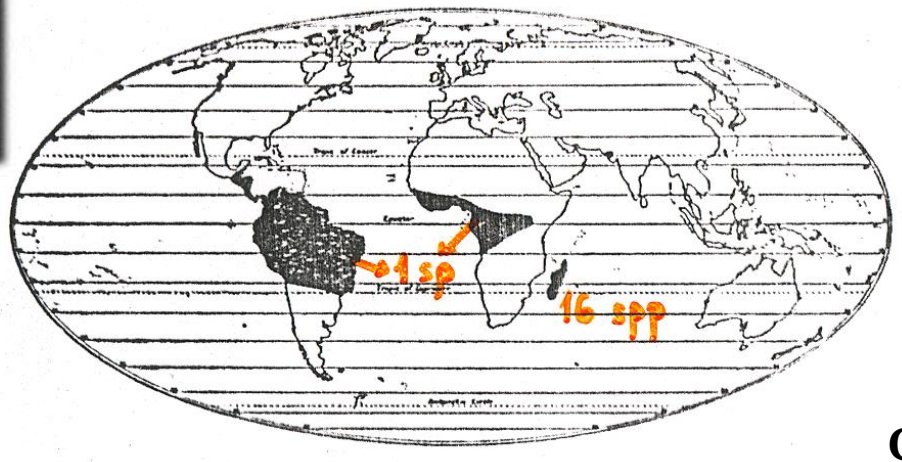
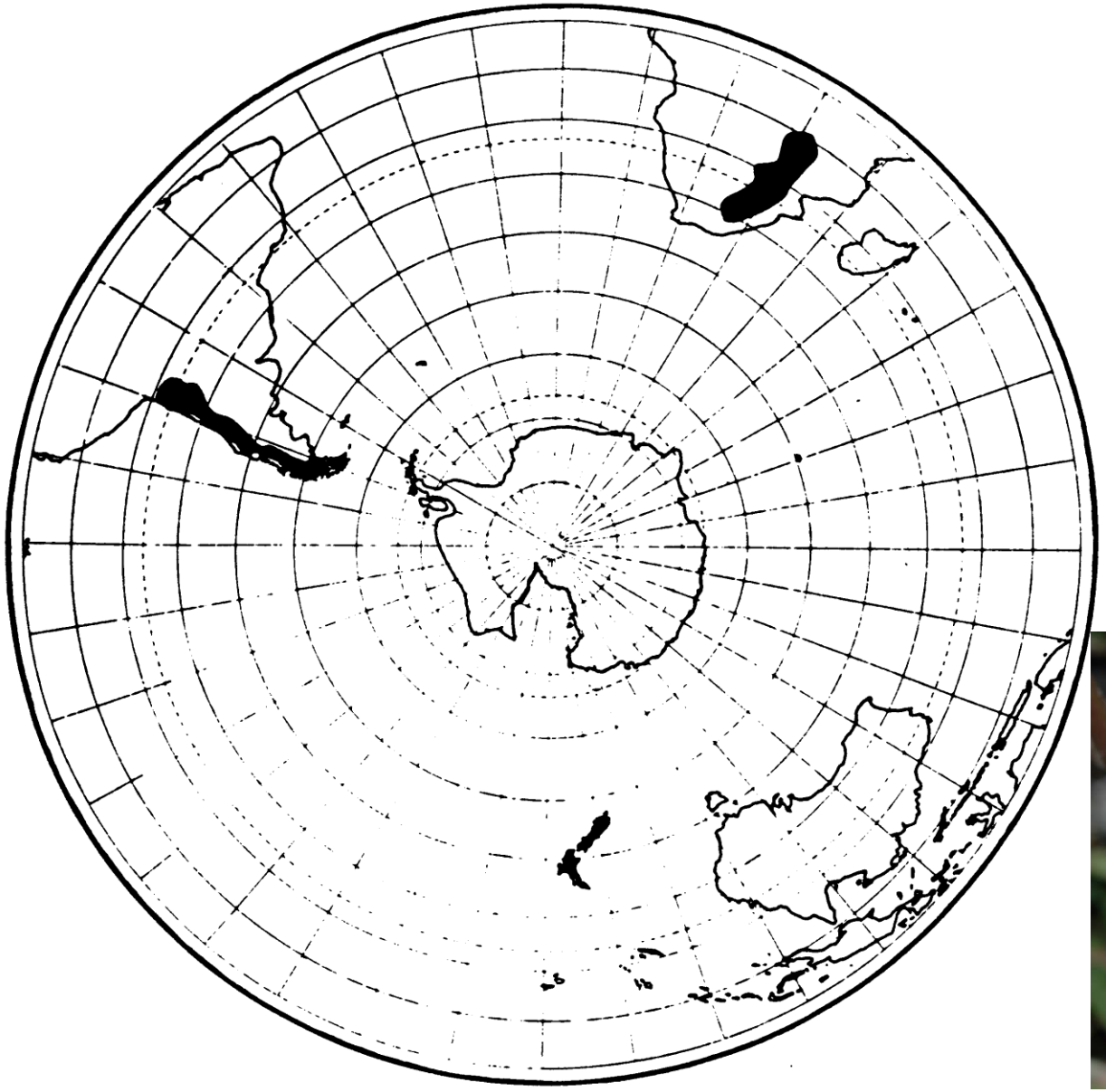


FIG. 28.—*Symphonia globulifera*, about half natural size, after Engler.



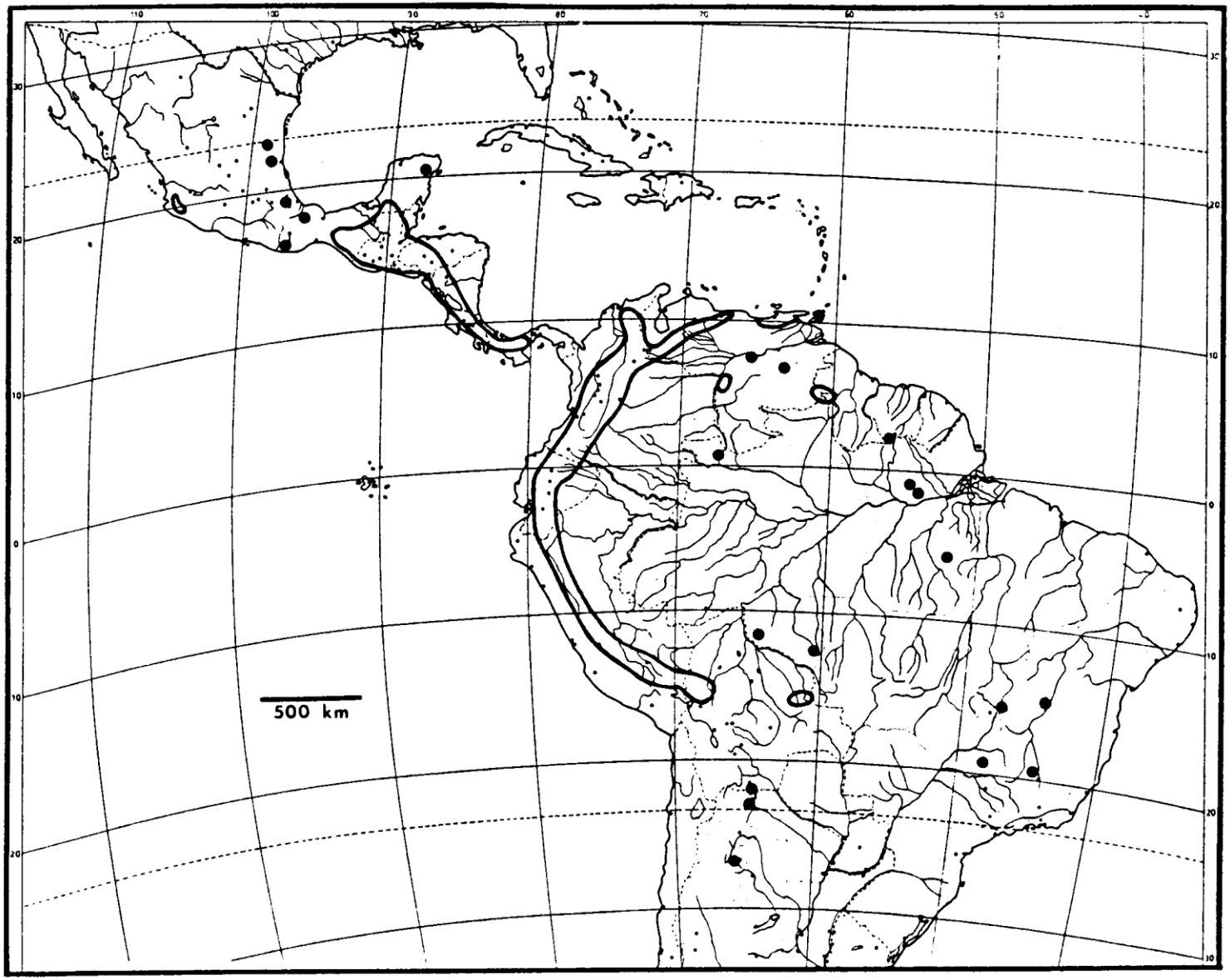
Good 1974

FIG. 29.—Map showing (black) the distribution of the genus *Symphonia*, after Hutchinson.



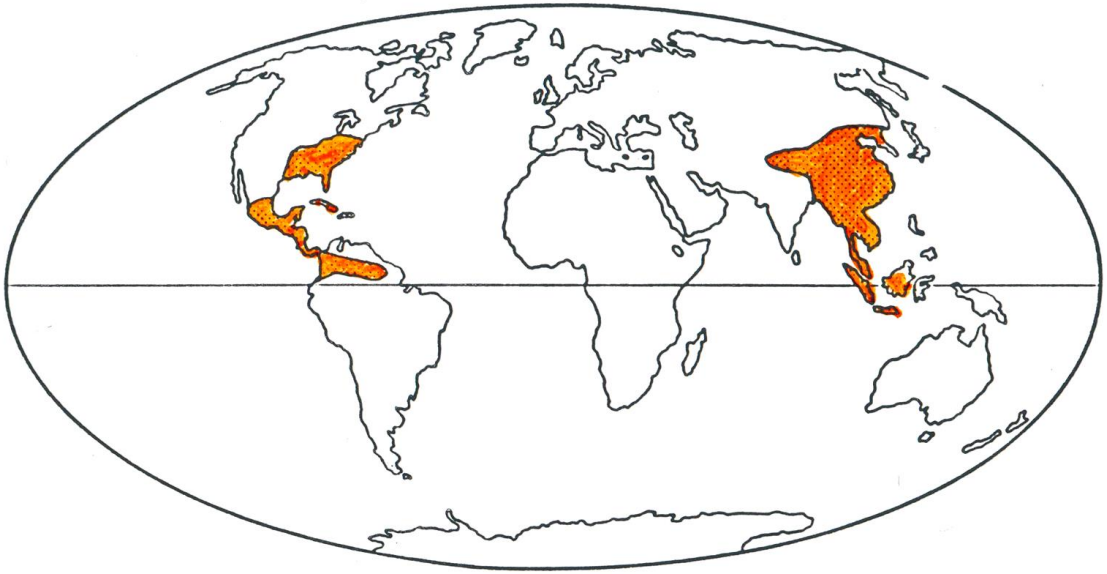
Distribuição de *Taraxacum magellanicum* (Compositae) - Croizat 1952

Padrão *Circum-Sul Temperado* de Thorne 1972.



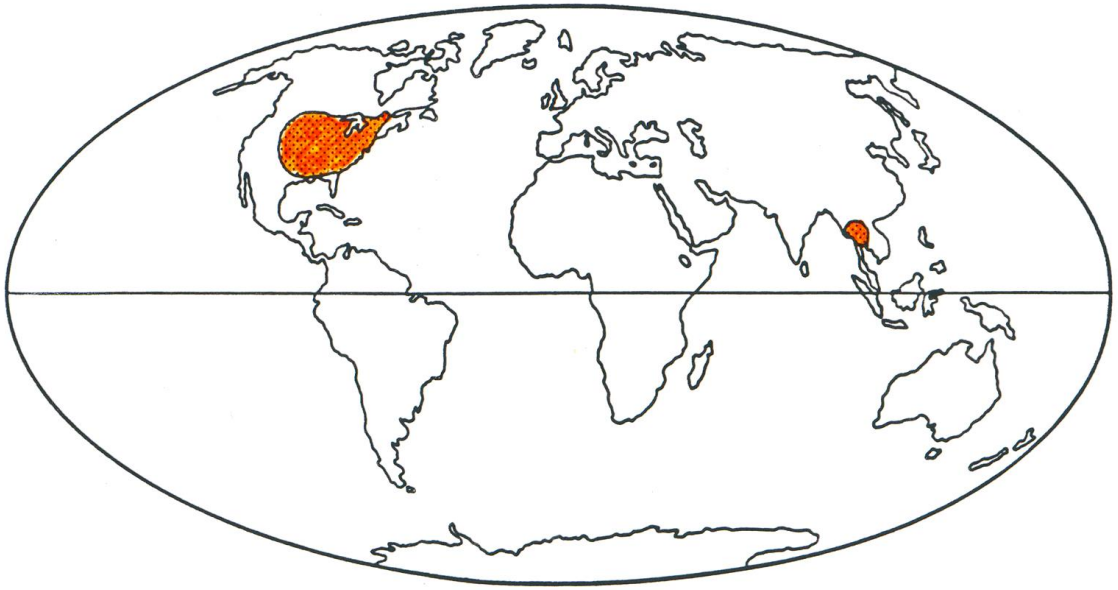
Distribution of *Rhipidocladum* - Gramineae - Bambusoideae

Clarke 1995

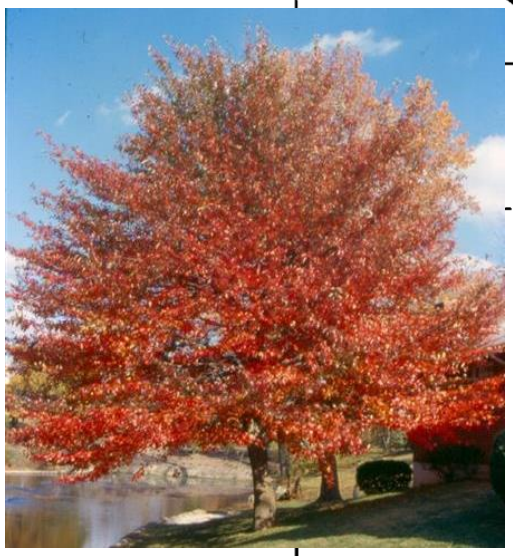


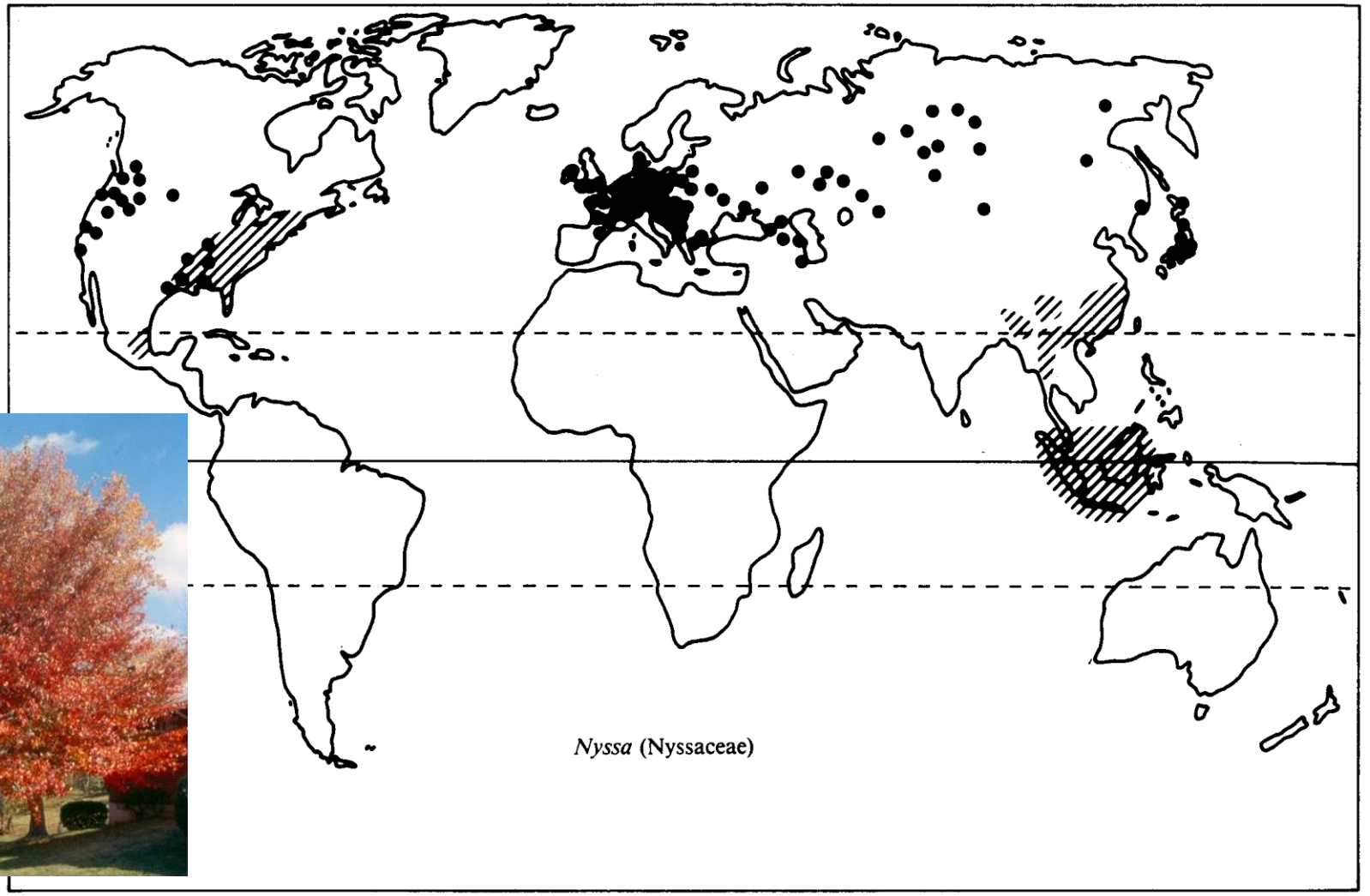
World distribution map of the magnolias illustrating a disjunct distribution.

Cox & Moore 1993



World distribution of the tulip trees (Liriodendron species). Only two species now survive, in widely separated localities, though it was once a widespread genus.

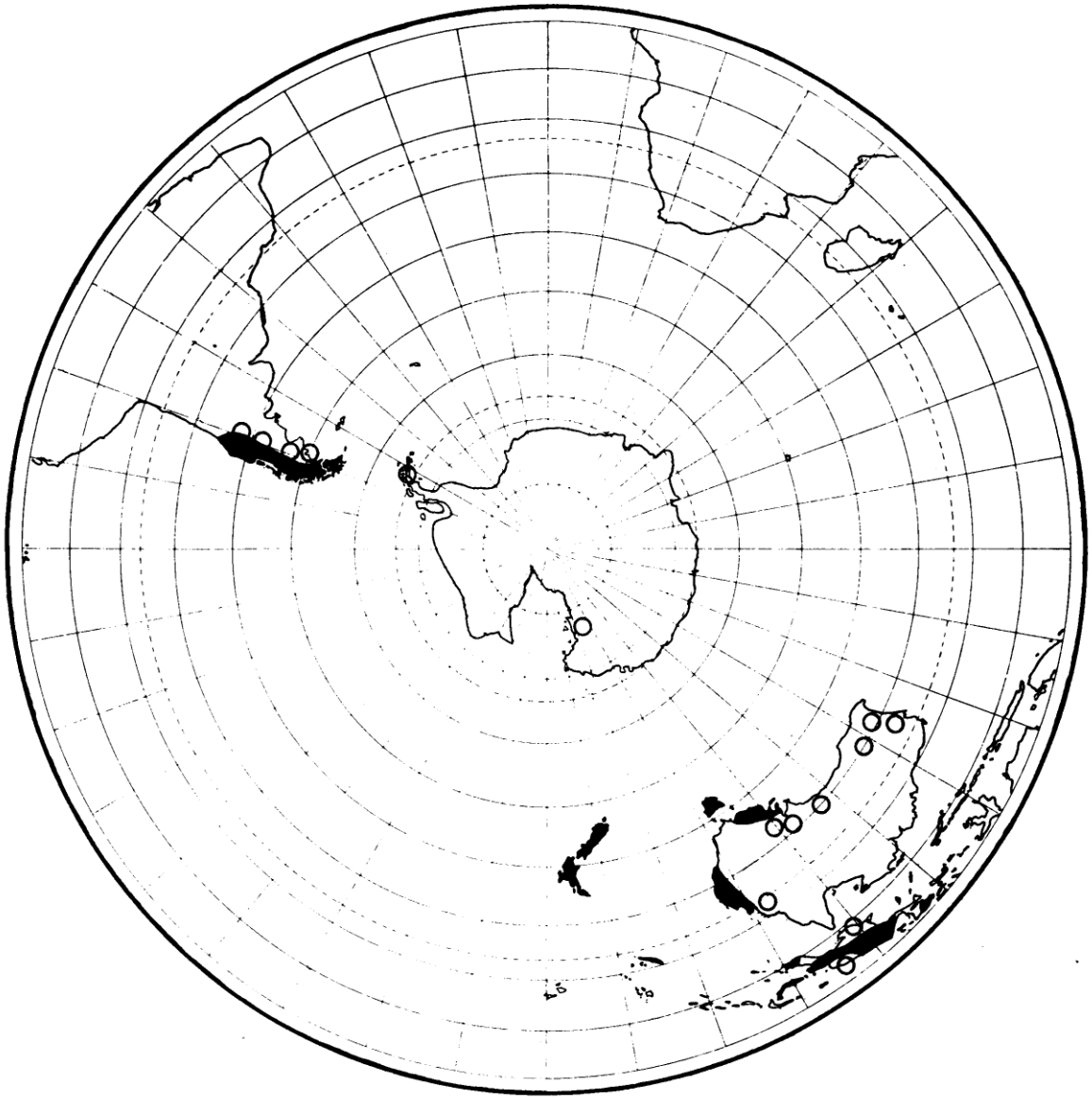


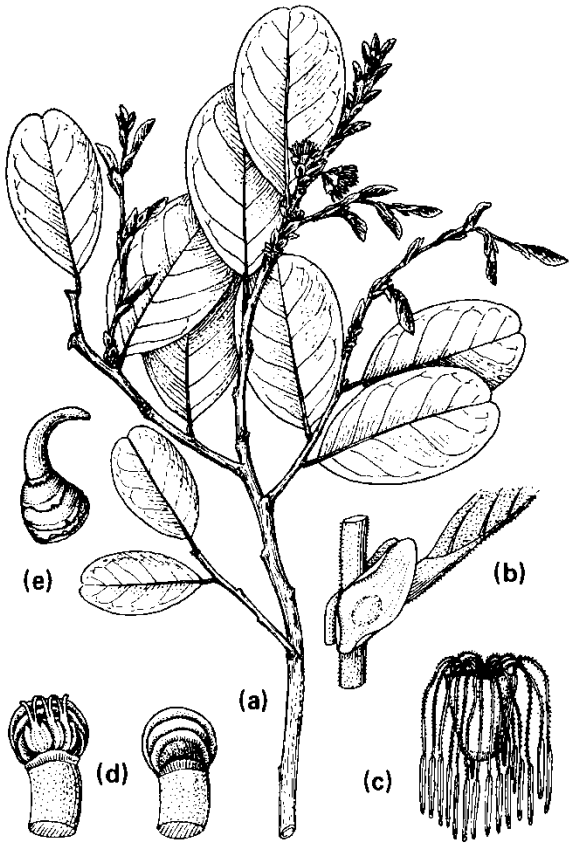


Distribution of extant *(shaded)* and extinct *(dots)* populations of the sourgums or blackgums, the tree genus *Nyssa* (Nyssaceae). Fossils show that this taxon was widely distributed across Europe, Asia, and North America during the Tertiary, but it is now confined to eastern North America (including Mexico and Guatemala) and southeast Asia (including the islands of the East Indies out to Wallace's Line). (Wood 1972)

Fig. 25. *Podocarpus*: total present distribution — □; distribution in the past — ?early Jurassic ◇, middle Jurassic ◆, ?late Jurassic ◈, ?early Cretaceous ⊠, late Cretaceous ■, Eocene ⊕, Oligocene (in New Zealand incl. Oligo-Miocene) ◐, Miocene ⊙, Pliocene ●, Tertiary (indeterm.) ⊘

***Podocarpus*, Podocarpaceae** - **Florin 1963**





Nothofagus recurva van Steenis from Papua New Guinea (van Steenis, 1953)

Distributional limits of the southern beech genus ***Nothofagus*** (after Humphries 1981). Areas inhabited by recent species are blackened; dots in circles represent localities of fossils.

Humphries & Parenti 1986

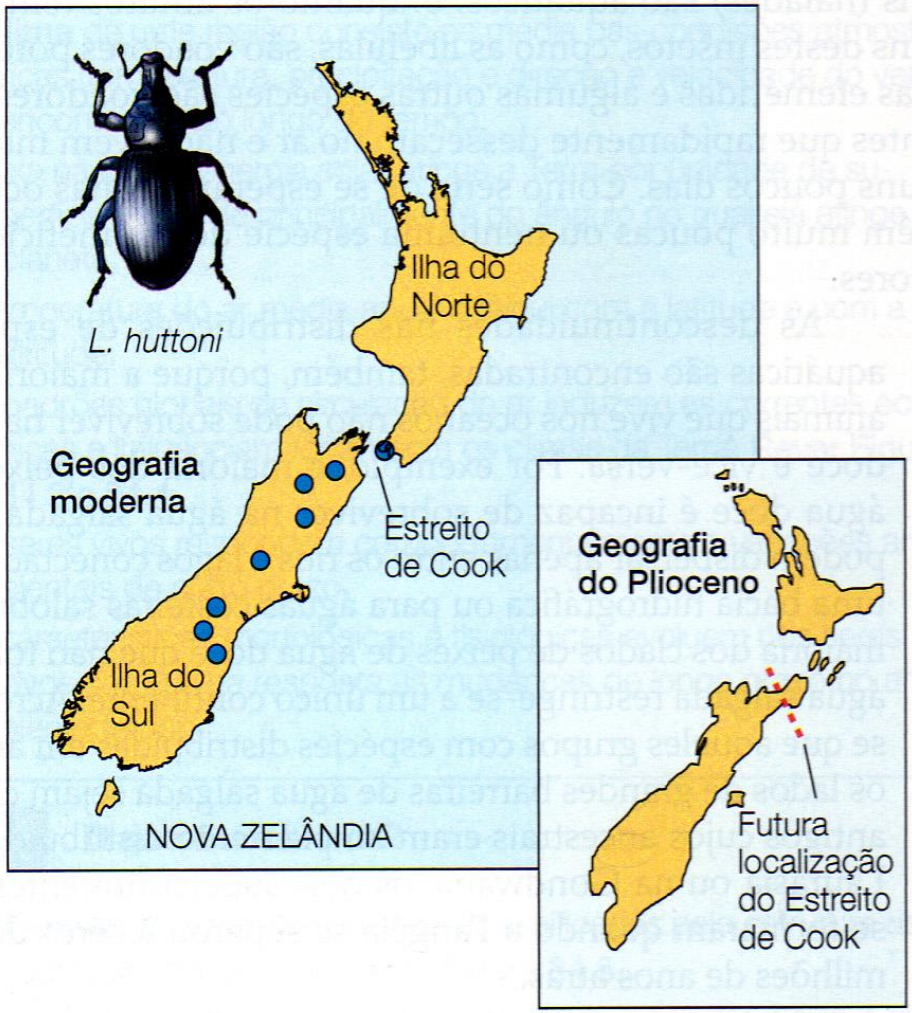
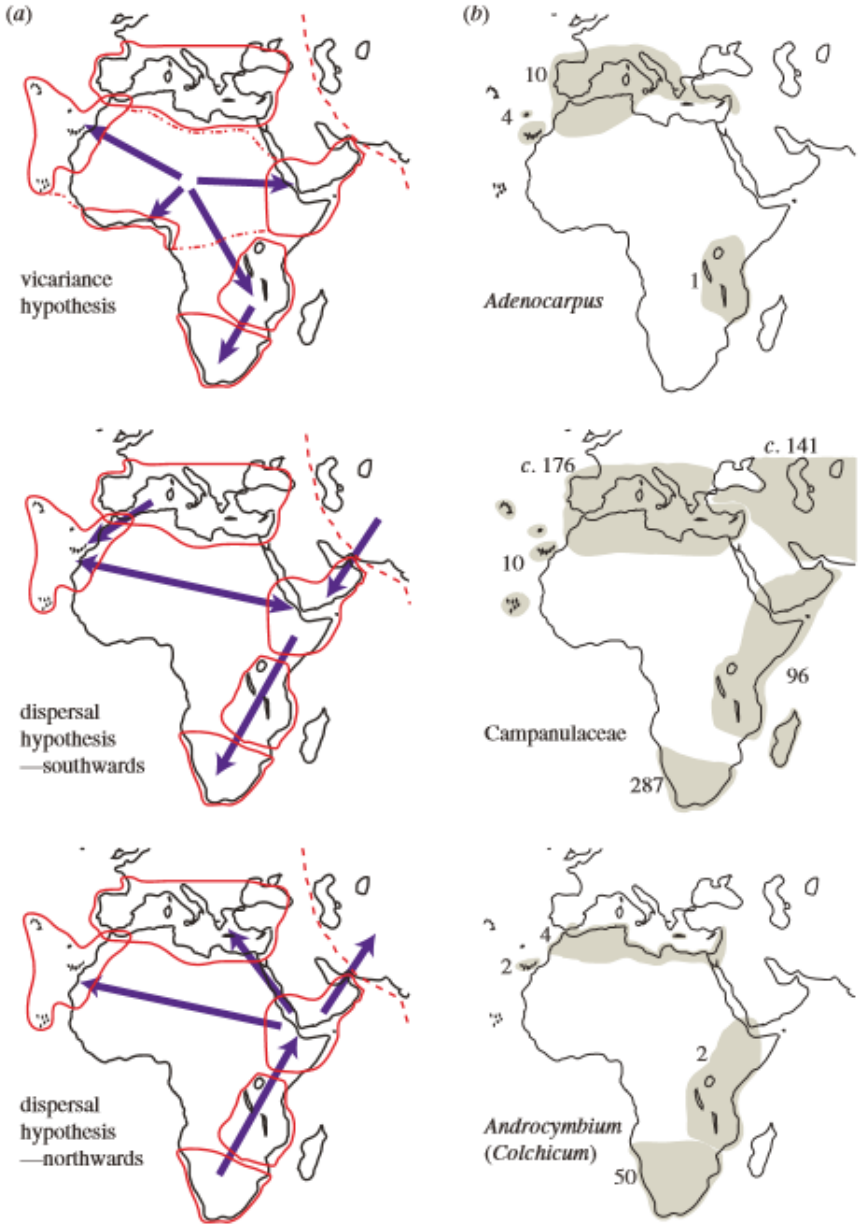


Figura 34.14 A explicação de uma distribuição vicariante Os círculos azuis indicam a atual distribuição do gorgulho *Lyperobius huttoni*. Uma comparação da atual geografia da Nova Zelândia com aquela do Plioceno, quando a parte meridional da Ilha do Norte de hoje fazia parte da Ilha do Sul, sugere que um evento vicariante – uma divisão física separando populações – explica esta distribuição.

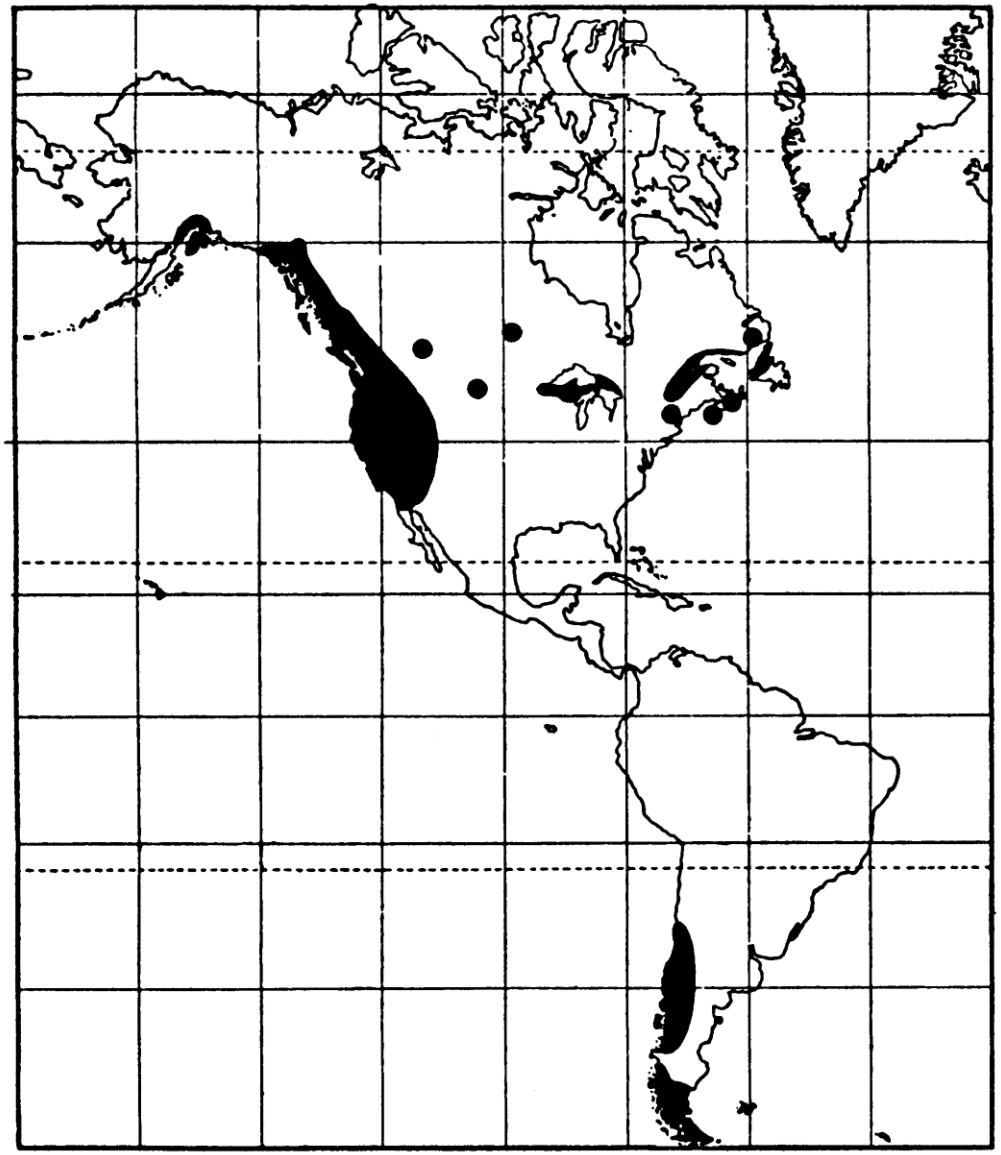
Sadava et al. 2009



AFRICA
Rand Flora

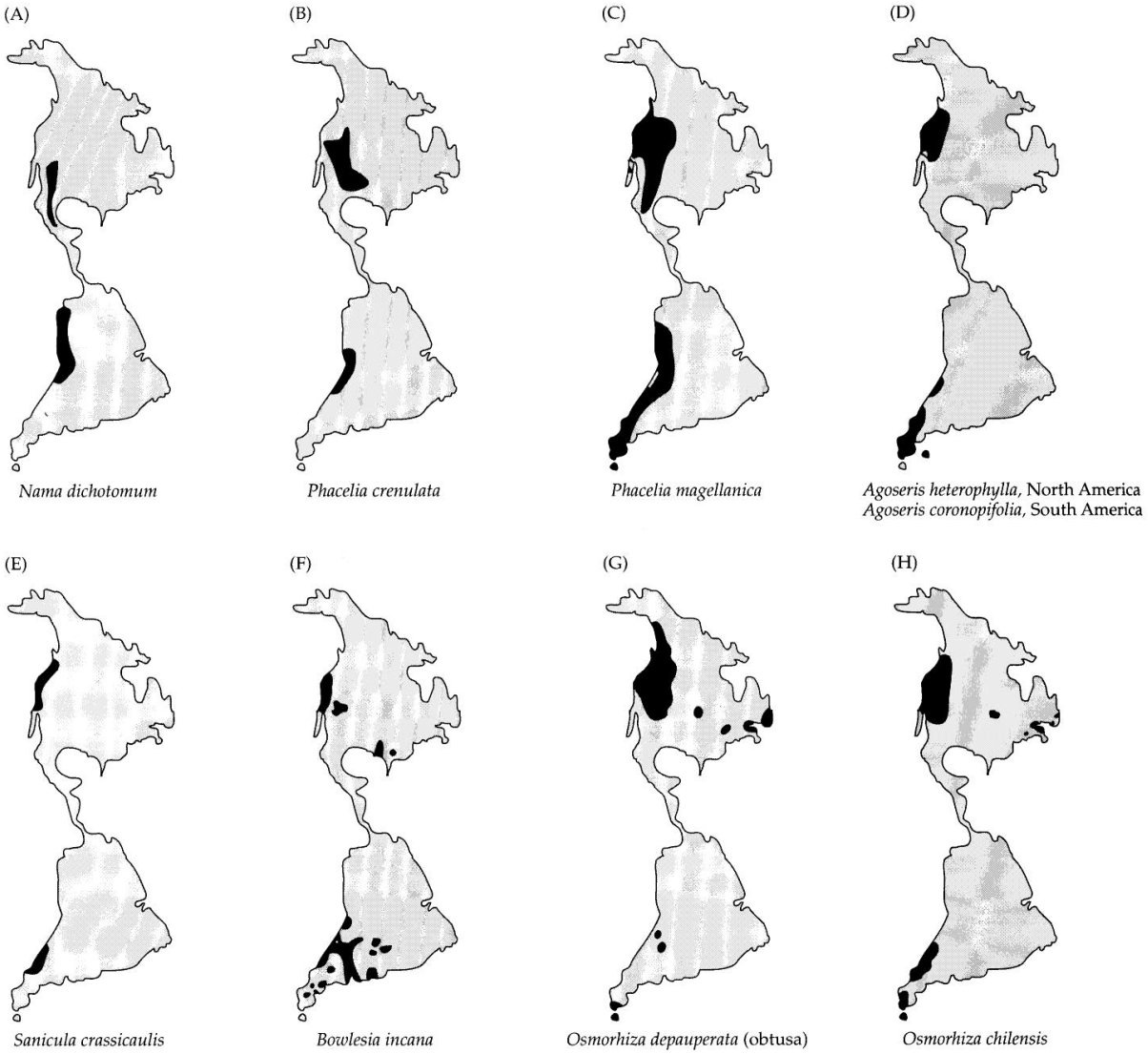
Sanmartín et al. 2010

Figure 1. (*a*) The main hypotheses to explain the origin of the 'Rand Flora' pattern and (*b*) plant groups that have been argued to exemplify these hypotheses. (1) Vicariance—climatological changes lead to vicariance of a once continuous Paleogene flora. (2a) Dispersal southwards—the pattern is a consequence of immigrants from the Mediterranean region and west spreading to south Africa via eastern Africa. (2b) Dispersal northwards—the elements of the flora dispersed from south Africa to Horn of Africa region, and from there to the west and north.

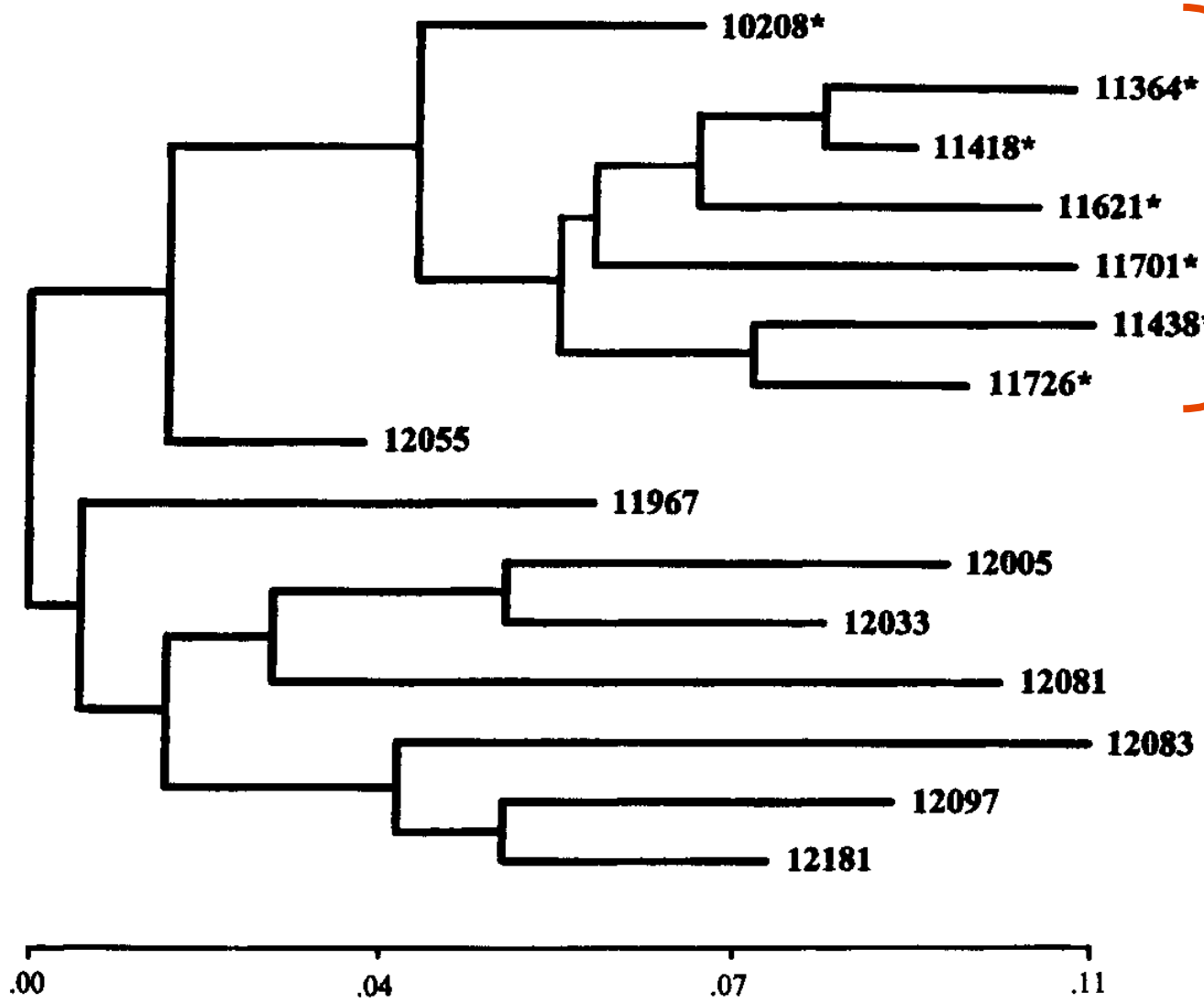


Osmorhiza chilensis (Hook & Arn). A member of the carrot family (Umbelliferae) with a bipolar distribution in North and South America (Wildeman 1905).

Distribution of *Osmorhiza chilensis* (Araliaceae).
Disjunção anfitropical Americana. **(Thorne 1972.)**



Examples of amphitropical disjunct distributions of plant species North and South America. These examples represent only a small fraction of the disjunct distributions of closely related plant species, mostly in arid regions, on the two continents. These disjunct distributions raise interesting questions about the historical geological and climatic events that have allowed these plants to disperse across the tropics.



Phenogram showing **genetic distance among populations** of ***Muhlenbergia torreyi.*** Correlation coefficient = 0.814; length = 0.728; numbers refer to population collections given in Table 1; populations from South America are marked with an asterisk; scale indicates distance from midpoint.

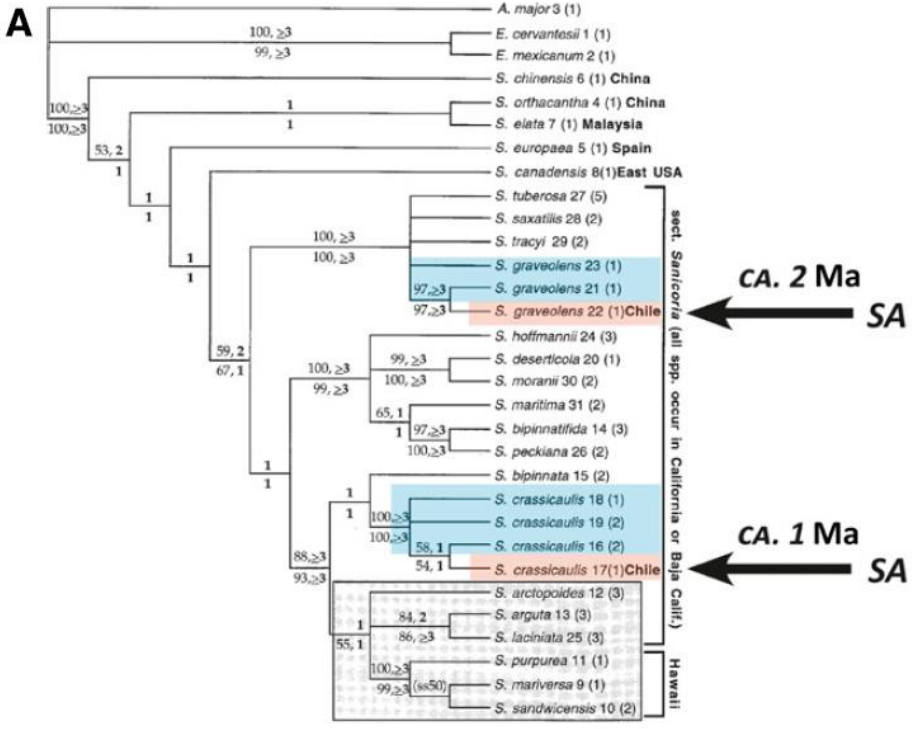
Peterson & Ortiz Dias 1998

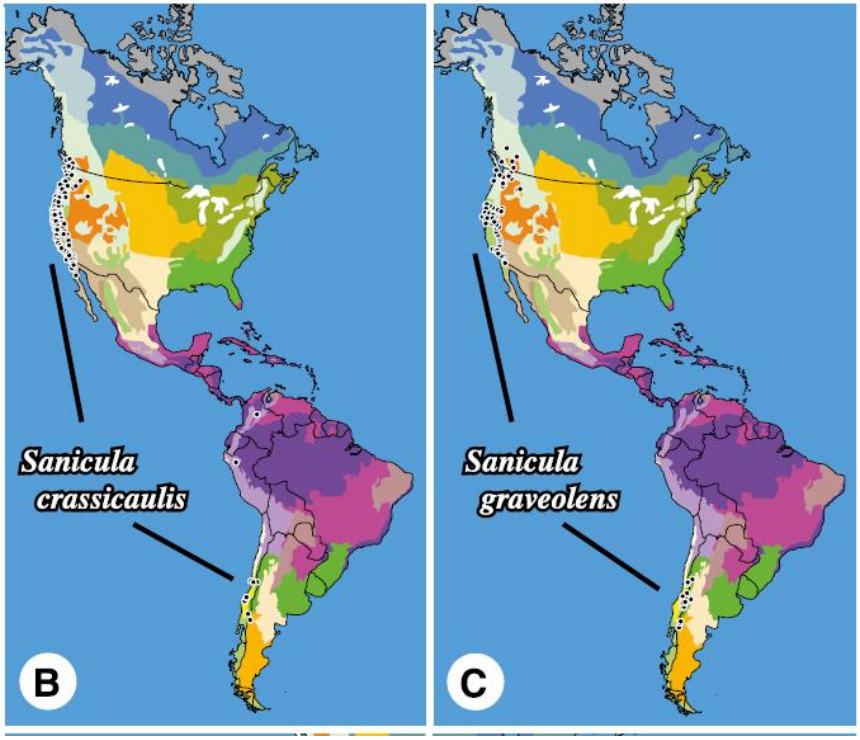
American amphitropical disjuncts: Perspectives from vascular plant analyses and prospects for future research[1]

Simpson et al. 2017

TABLE 1. Taxonomic categories of the 237 American amphitropical disjunct vascular plants, showing the total number, percentage of the total, and mean time of evolutionary divergence (including range of individual means) based on phylogenetic studies. [*N*] = number of studies from which mean divergence time was calculated. See Appendices for sources of data.

Taxonomic category	Total number	Percent of total	Mean divergence time (Range), Ma [*N*]
Conspecific (including infraspecies)	135	57.0	**0.63** (0–2.45) [27]
Conspecific (excluding infraspecies)	118	49.8	**0.62** (0–2.45) [22]
Infraspecific	17	7.2	**0.65** (0.20–2.46) [5]
Coninfraspecific	8	3.4	**0.63** (0.33–0.92) [2]
Different infraspecies	9	3.8	**0.66** (0.20–1.48) [3]
Species-species pairs	54	22.8	**3.14** (0–14.9) [21]
Species-clade, clade-species, & clade-clade	48	20.3	**6.29** (0.61–24.78) [24]
Species-clade & clade-species	21	8.9	**4.51** (0.61–14.50) [13]
Species-clade	11	4.6	**4.81** (0.61–14.50) [8]
Clade-species	10	4.2	**4.40** (1.37–5.53) [4]
Clade-clade	27	11.4	**8.40** (0.98–24.78) [11]





American amphitropical disjuncts: Perspectives from vascular plant analyses and prospects for future research[1]

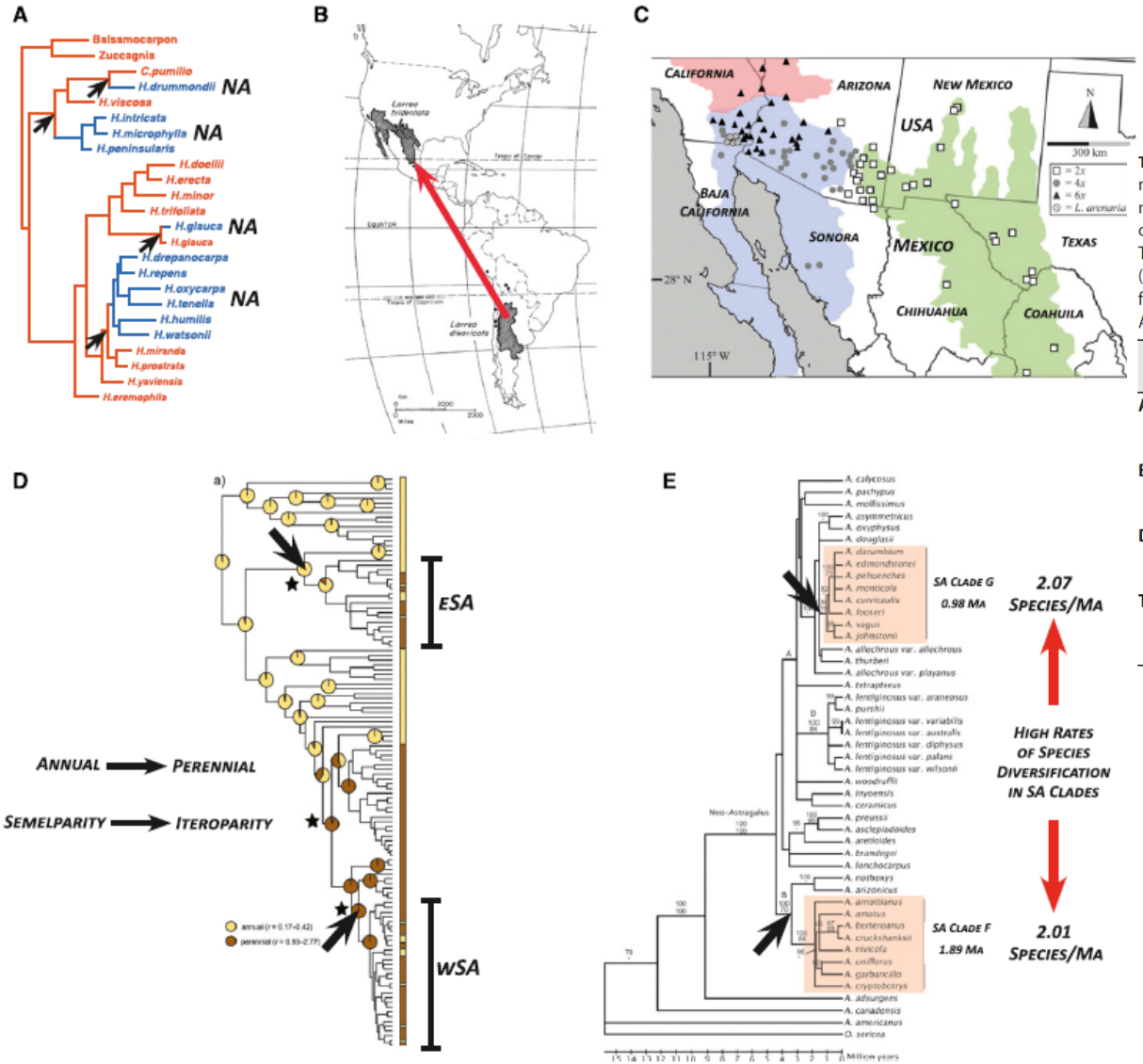
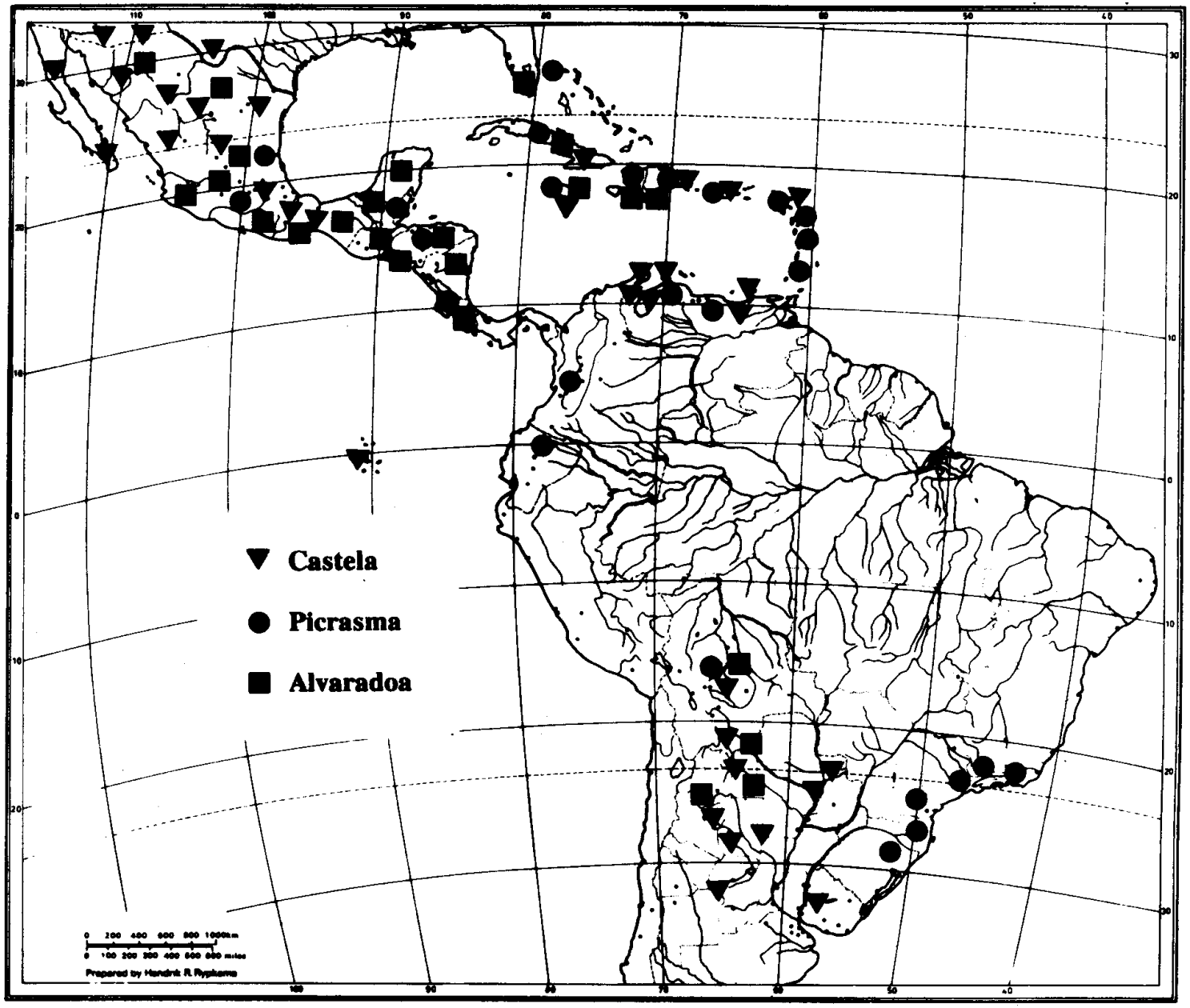


FIGURE 6 (A) Cladogram of *Hoffmannseggia* (Fabaceae), showing four dispersal events (arrows), all from South America (lineages/taxa in orange) to North America (NA; lineages/taxa in blue). Modified from Simpson et al. (2005, p. 21), with permission. (B) Distribution map of *Larrea* (Zygophyllaceae), showing hypothesized dispersal from South to North America. Modified from Hunter et al. (2001, p. 525), with permission. (C) Distribution map of *Larrea* spp., showing North American 2*n*, 4*n*, and 6*n* chromosome races. From Laport et al. (2012, p. 155), with permission. (D) Cladogram of *Lupinus* (Fabaceae), showing evolutionary shift from annual (light yellow) to perennial (dark brown) habit, associated with a similar shift from semelparity to iteroparity, and two independent dispersals from North to South America (arrows). Stars indicate increases in species diversification rates. Modified from Drummond et al. (2012, p. 452), with permission. (E) Cladogram of *Astragalus* (Fabaceae), showing shift of species diversification rate correlated with two independent dispersals from North to South America (arrows). Modified from Scherson et al. (2008, p. 1034), with permission.

TABLE 3. American amphitropical vascular disjunct plants, comparison of number, percentage, and mean divergence time (with range of individual means) of annual vs. perennial plants for all regions, bipoar plants only, desert plants only, and temperate plants only. Only nonequivocal data listed. Those taxa listed in the literature ambiguously as either annual or perennial (or a combination with biennial) were omitted. [*N*] = number of examples from which mean divergence time is calculated. — = no available data. See Appendices for source of data.

Plant duration	Total number	Percent of total	Mean divergence time, Ma (Range) [*N*]
All regions			
Annuals	82	40.6	**2.31** (0–14.9) [29]
Perennials	120	59.4	**2.77** (0–24.78) [26]
Bipolar only			
Annuals	1	4.0	—
Perennials	24	96.0	**0.25** (0–0.69) [7]
Desert only			
Annuals	8	18.2	**4.27** (0.03–14.42) [6]
Perennials	36	81.8	**6.07** (0–24.78) [7]
Temperate only			
Annuals	73	54.9	**1.81** (0.26–14.90) [23]
Perennials	60	45.1	**2.31** (0–7.69) [12]

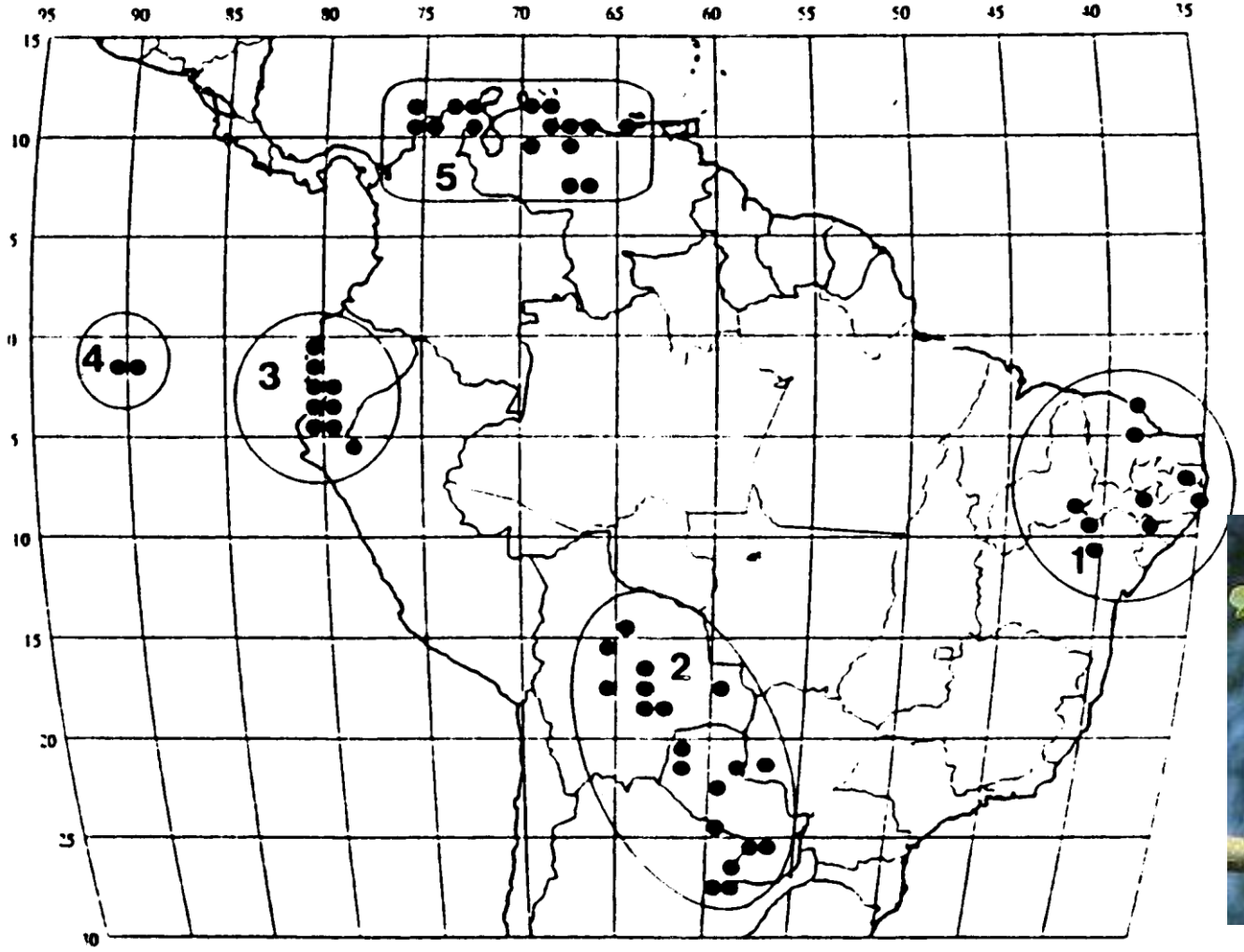
Simpson et al. 2017



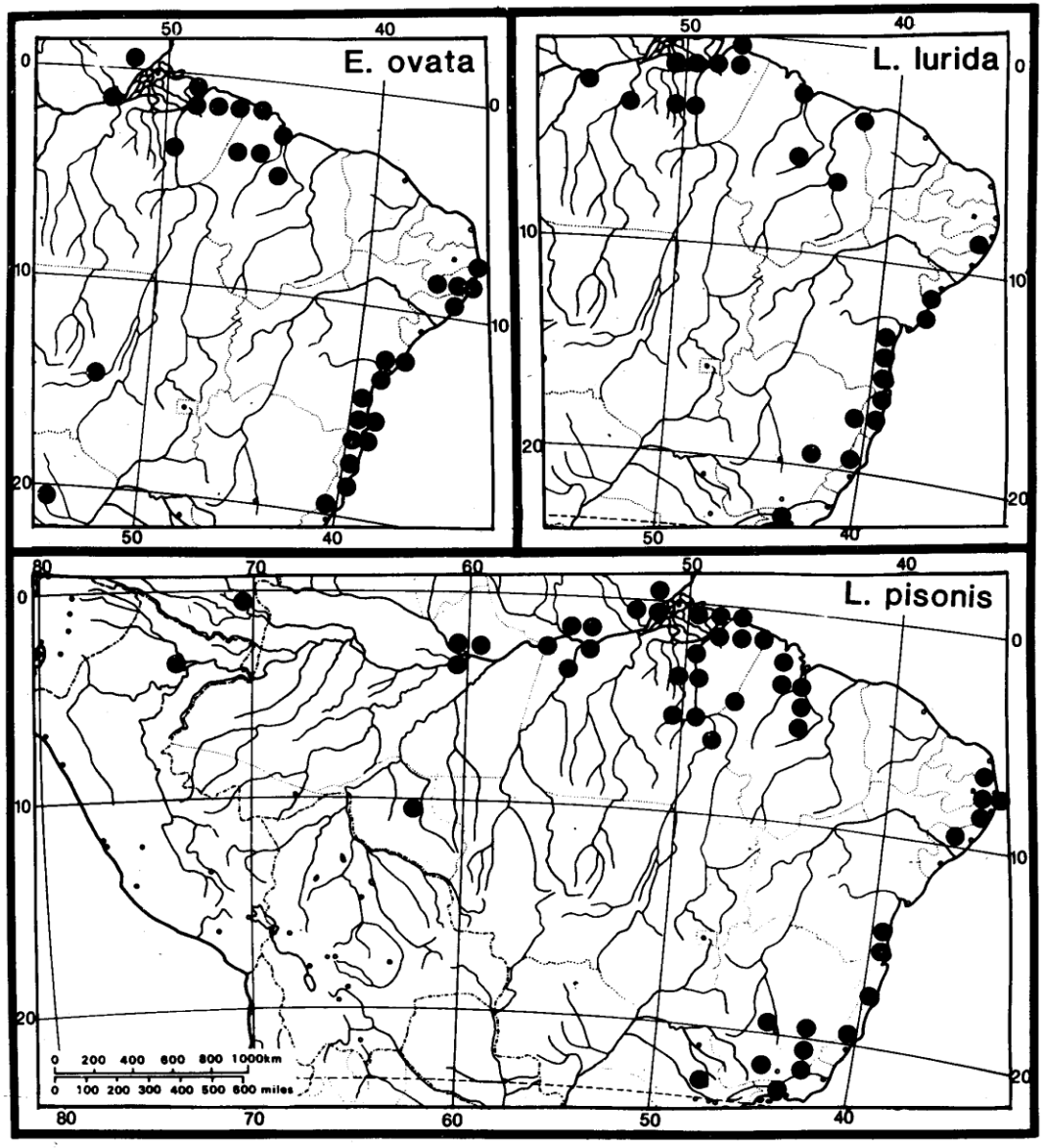
Thomas, 1990

Currently known distributions of the genera *Alvaradoa*, *Castela* and *Picrasma* (Simaroubaceae).

Distribution of *Geoffroea spinosa* (Leguminosae)

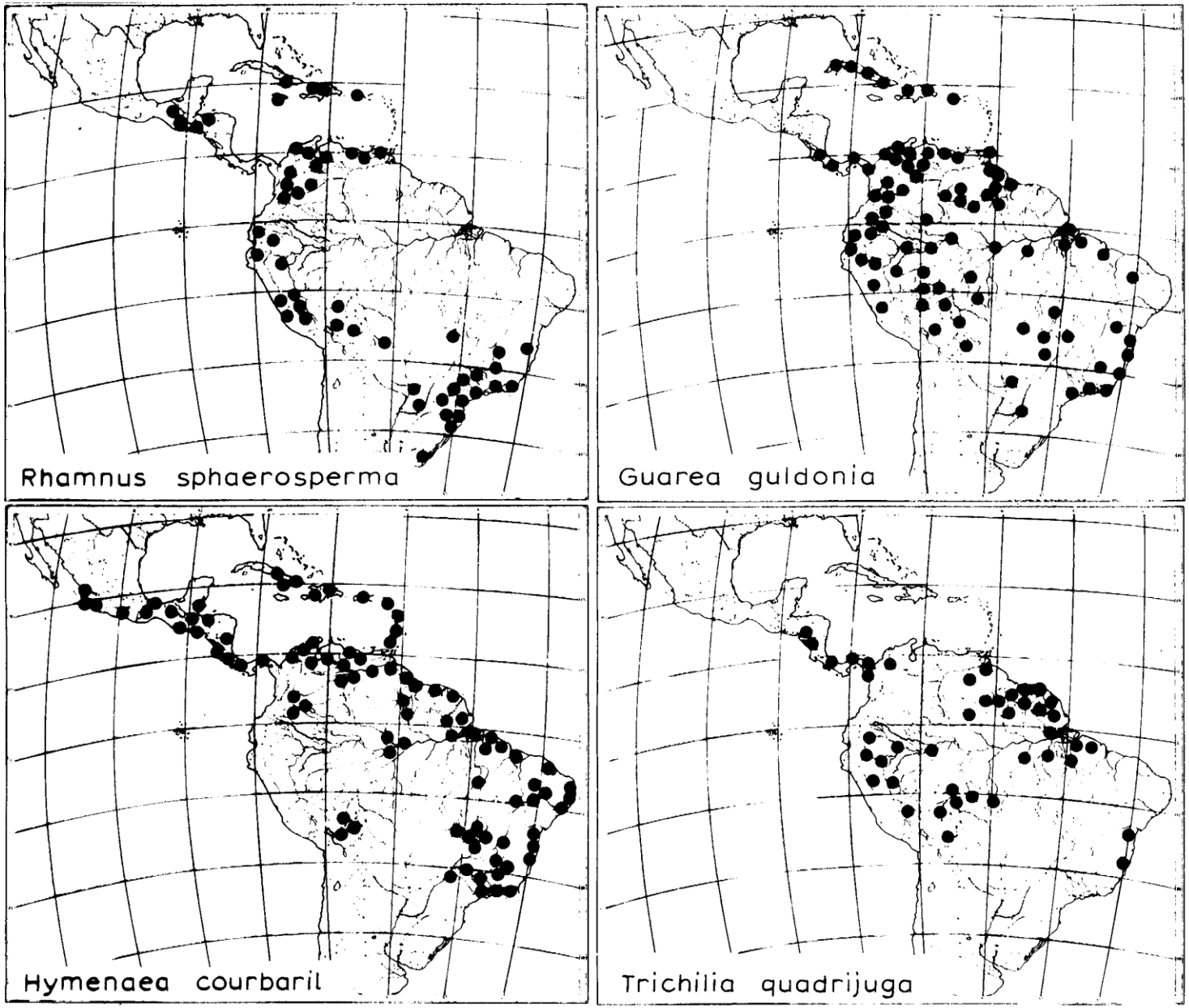


Ireland & Pennington 1999



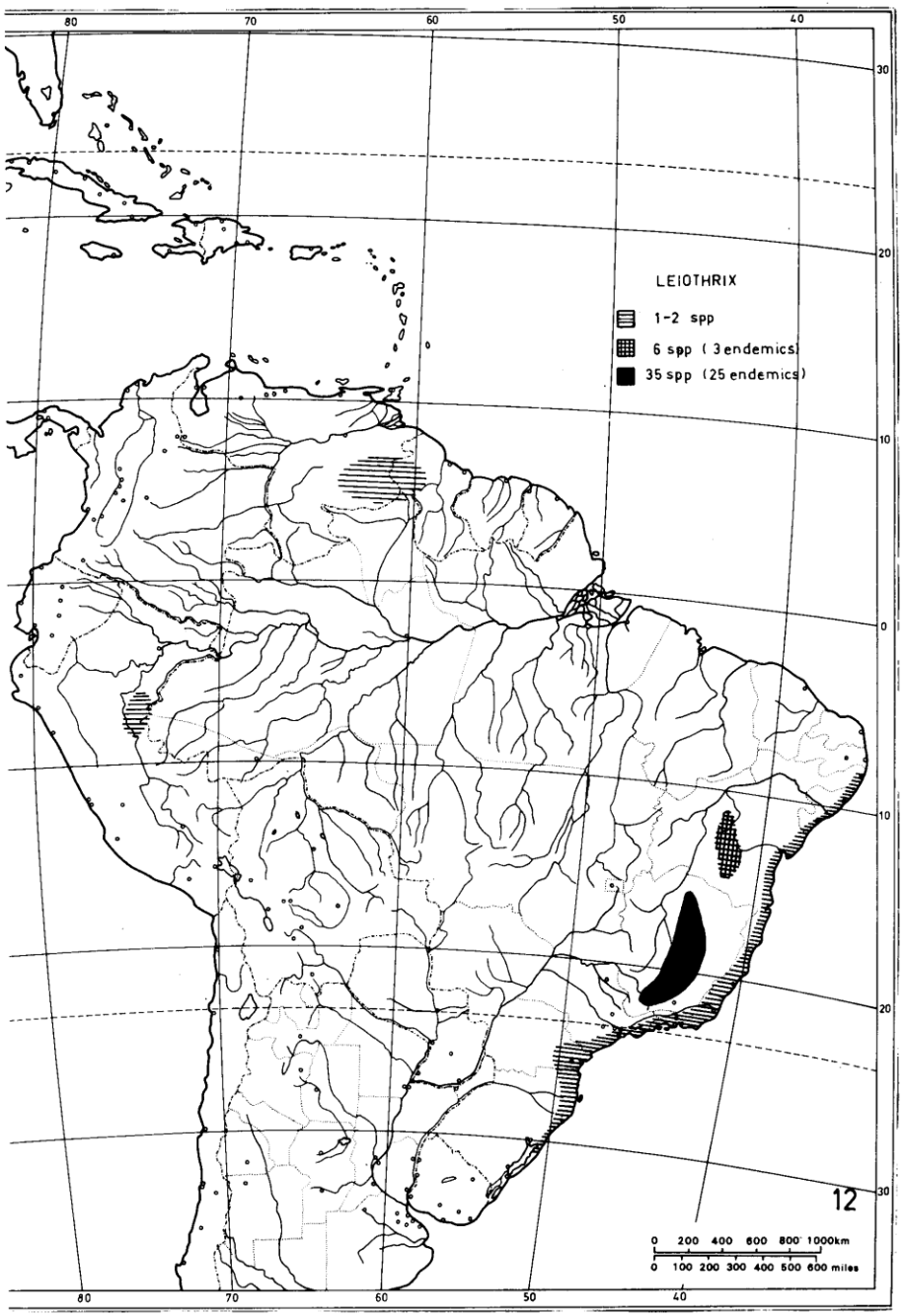
Mori, 1990

Distribuição de ***Eschweilera ovata***, ***Lecythis lurida*** e ***L. pisonis***, espécies selecionadas de Lecythidaceae com o limite de suas distribuições ao norte próximo ao rio Amazonas e com disjunções entre o leste extra-amazônico e a Amazônia brasileira.



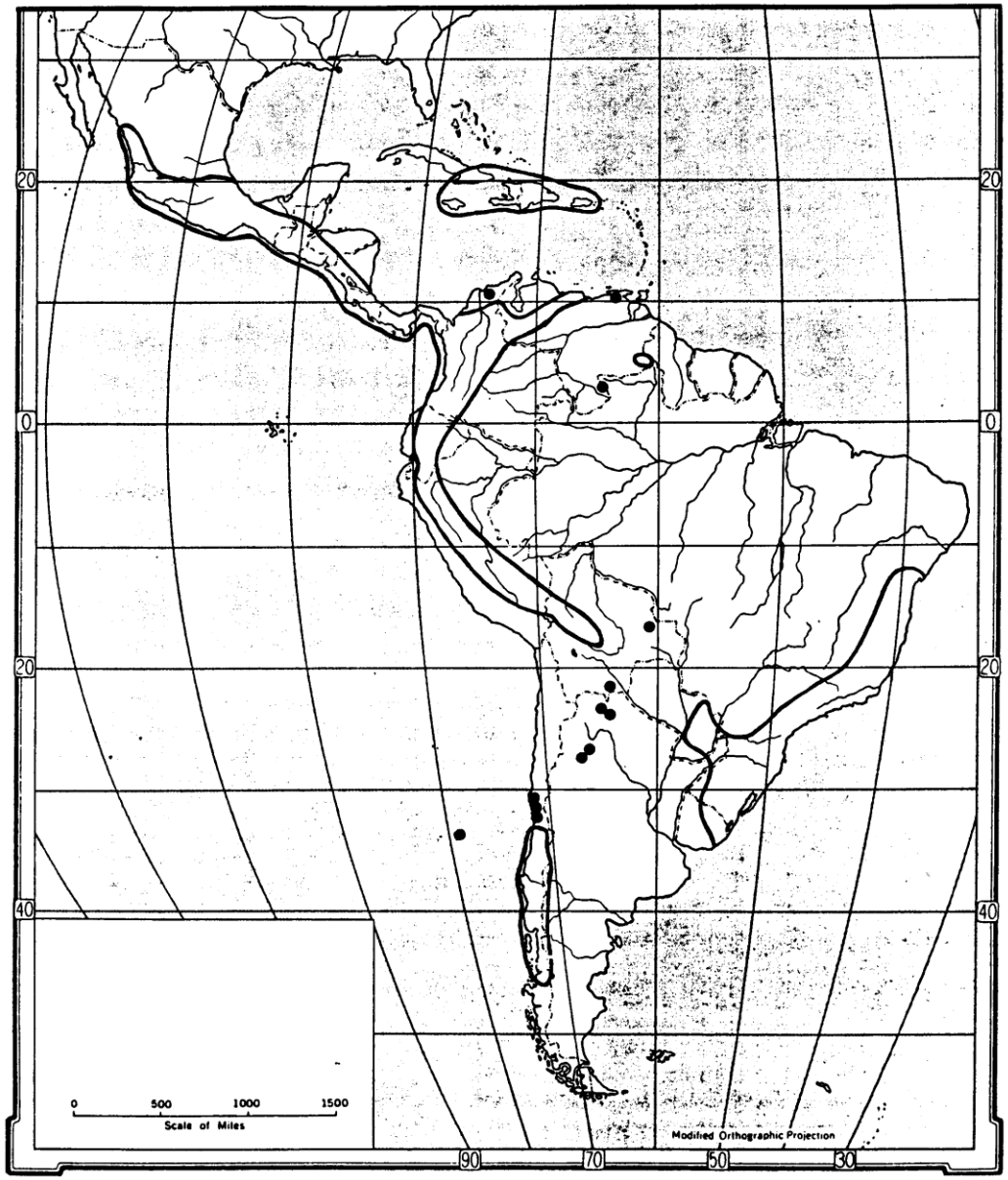
Selected tree species widespread in the neotropics. (from Mori *et al.*, 1981).

Prance 1989

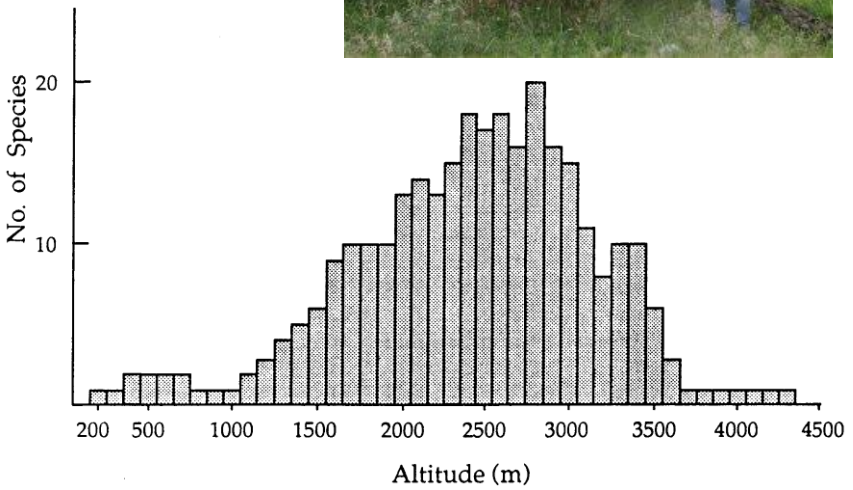


Distribution of the genus *Leiothrix* (Eriocaulaceae) and species density throughout its range; note the main center of diversity in the Espinhaço Range in Minas Gerais (based on Giulietti 1984).

Giulietti & Pirani 1988

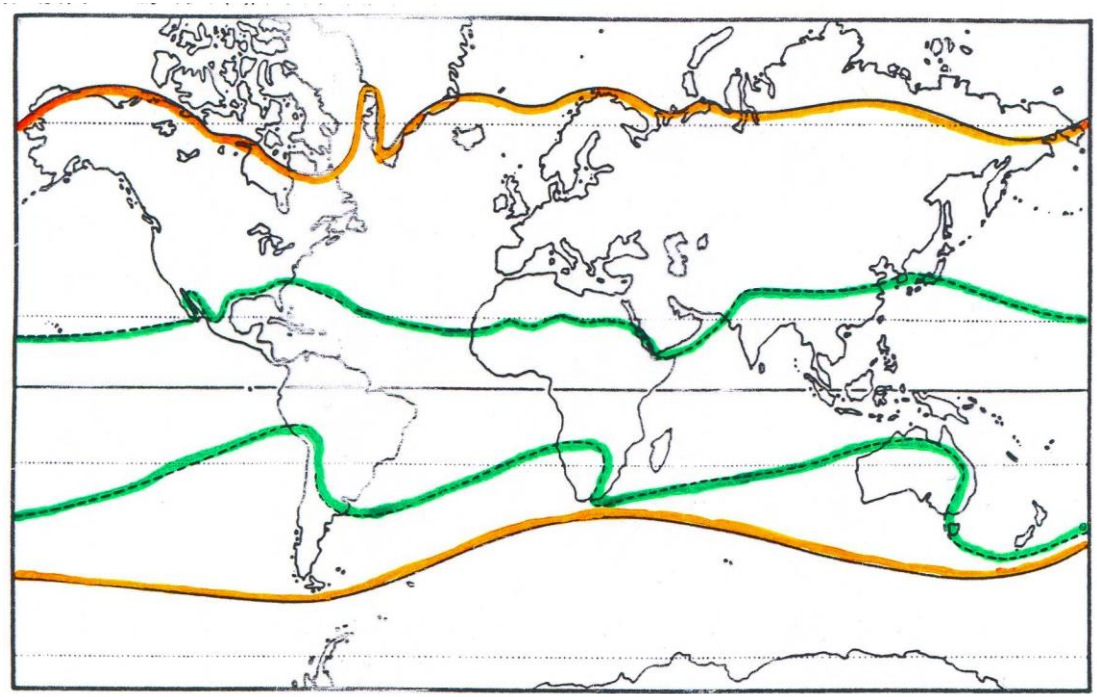


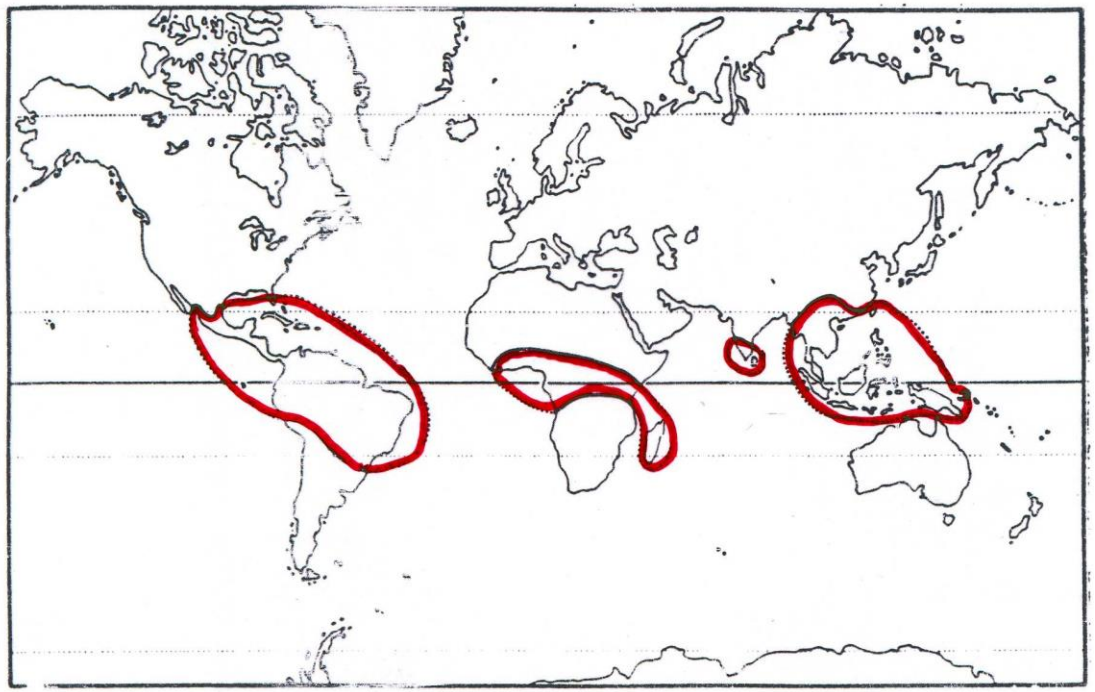
Distribution of *Chusquea* (Bambuseae)



Altitudinal distribution of 50 Neotropical Andean species of *Chusquea*

Clarke in Churchil *et al.* 1995





ORCHIDACEAE

Limites aproximados de ocorrência da família (—) e das orquídeas epífitas (—)

Distribuição geográfica do gênero *Vanilla*

Dressler 1981

DISJUNÇÕES

Casos onde um ou mais táxons proximamente relacionados vivem em regiões substancialmente separadas, estando ausentes no espaço intermediário.
(exceções drásticas ao padrão de provincialismo)

Padrões variados no mundo todo!

Causas – devem refletir eventos históricos:
- Organismos dispersaram a longa distância, transpondo a barreira.
- Organismos foram carregados por placa derivando.
- As populações disjuntas são remanescentes de táxon anteriormente amplamente distribuído.

Terms used to describe patterns in the distribution of species and other taxonomic groups

Spellerberg & Sawyer 1999

Type of distribution	Definition
Cosmopolitan	A species or taxonomic group that is distributed widely throughout the world
Primary endemic	A species or taxonomic group is a primary endemic in a particular region if it is native only to that region
Secondary endemic	A species or taxonomic group is a secondary endemic in a particular region if its distribution has contracted so that it is now native only to the region in which it is found
Rare	A species or taxonomic group that is restricted geographically or is widespread but never found in abundance
Disjunct	A species that occupies areas that are widely separated and scattered (species with a discontinuous distribution)
Indigenous or native	A species that originates in a particular place or which has arrived there entirely independently of human activity

RARIDADE X Abundância

Rabinowitz 1986

TABLE 1. Seven forms of rarity, based on three traits.

Geographic distribution		Wide		Narrow	
Habitat specificity		**Broad**	**Restricted**	**Broad**	**Restricted**
Local population size	Somewhere large	*Chenopodium album*, lamb's quarters	*Rhizophora mangle*, red mangrove	*Primula scotica*, Scottish bird's-eye primrose	*Argyroxiphium macrocephalum*, Haleakala silversword
	Everywhere small	*Setaria geniculata*, knotroot bristlegrass		*Draba muralis*, wall whitlow grass	*Lloydia serotina*, alpine lily

(Adapted from Rabinowitz, 1981)

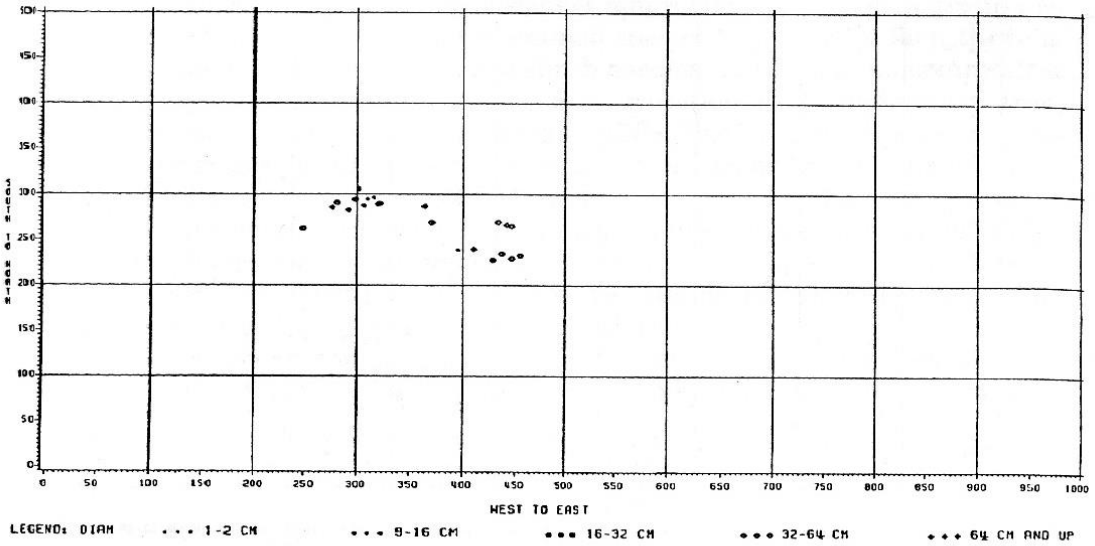


FIGURE 6. Distribution of a rare specialist, the oil palm *Eleais oleifera* (Palmae), found only in the 2 ha seasonal swamp in the center of the plot. This is a case of an extreme specialist, strictly limited to a rare habitat.

Eleais oleifera
Palmae
especialista rara

Hubbell & Foster 1986

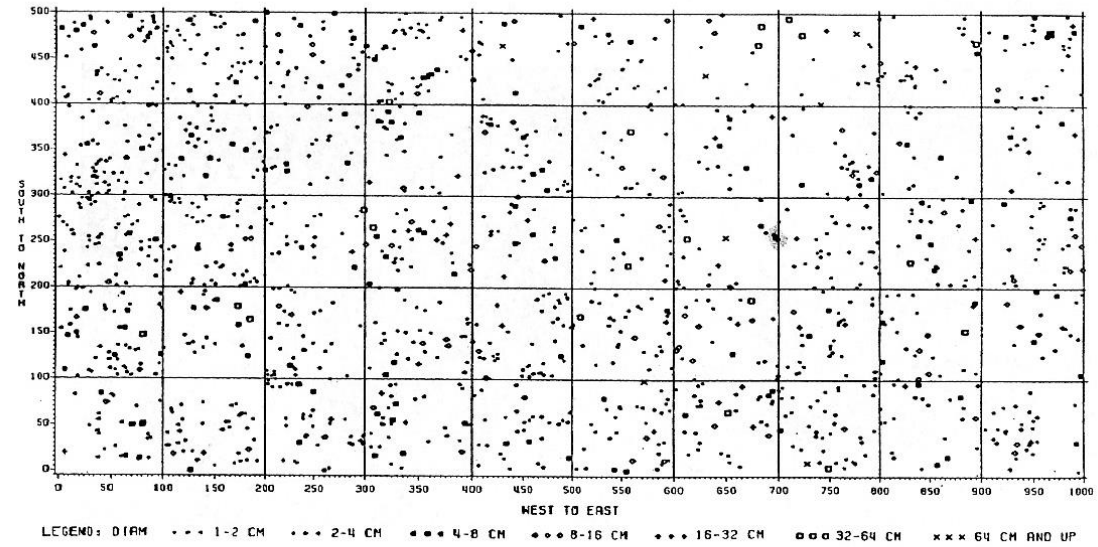


FIGURE 7. Distribution of the generalist overstory tree *Pterocarpus rohrii* (Leguminosae, Papilionoideae), which is largely indifferent to the habitat variation occurring in the plot.

Pterocarpus rohrii
Leg.Pap.
generalista abundante

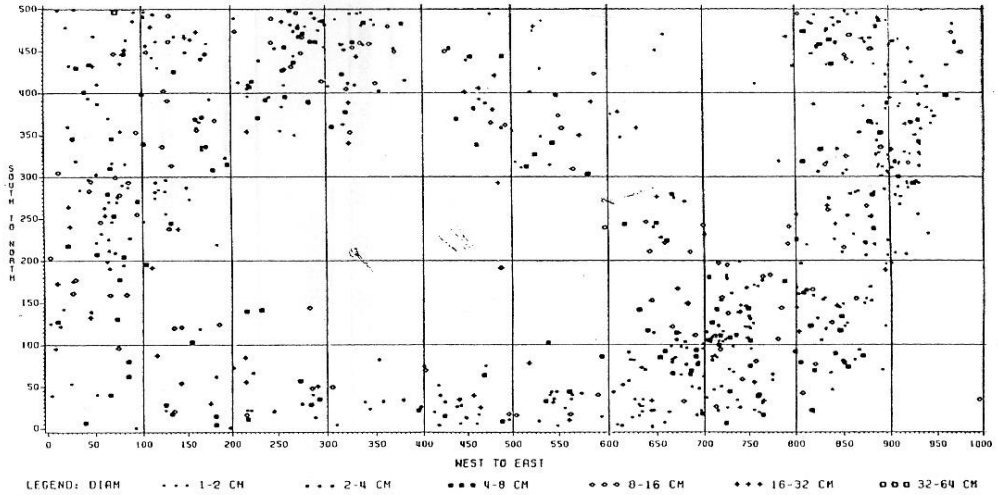


FIGURE 4. Distribution of *Unonopsis pittieri* (Annonaceae), a midcanopy tree which is a slope specialist. Grid lines mark hectare (100 m) boundaries. Map symbols refer to different diameter classes. Note that even though *U. pittieri* is more common on the steeper slopes, it occurs at low density throughout most of the rest of the plot. This is a general pattern for most of the habitat specialists.

Unonopsis pittieri
Annonaceae
especialista comum

Hubbell & Foster 1986

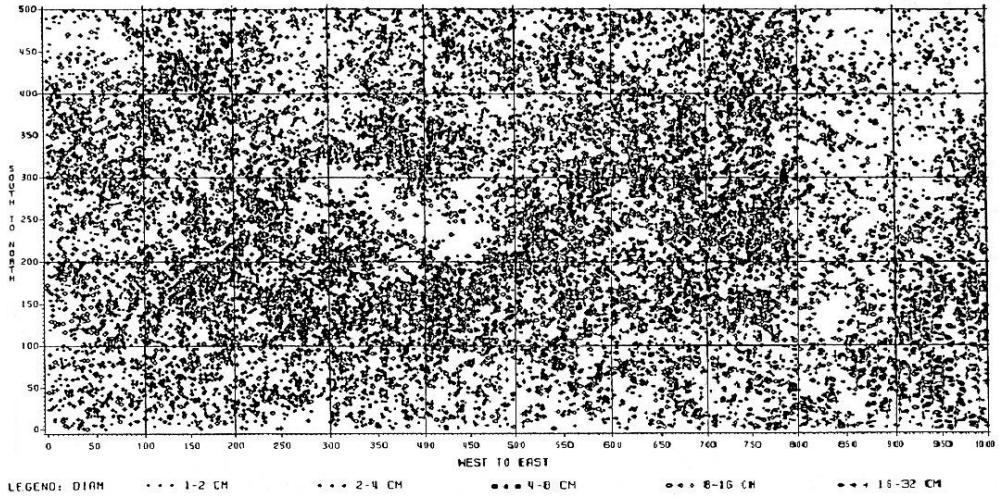


FIGURE 5. Distribution of a flat terrain specialist, *Faramea occidentalis* (Rubiaceae), an understory tree.

Faramea occidentalis
Rubiaceae
especialista abundante

Tipos de endemismos

autóctone x alóctone (relicto)

(primário x secundário seg. Spellerberg & Sawyer 1999)

paleoendemismo x neoendemismo

(Major 1993)

PROVINCIALISMO:

Endemismos não são distribuídos ao acaso; tendem a ser mais abundantes em regiões particulares.

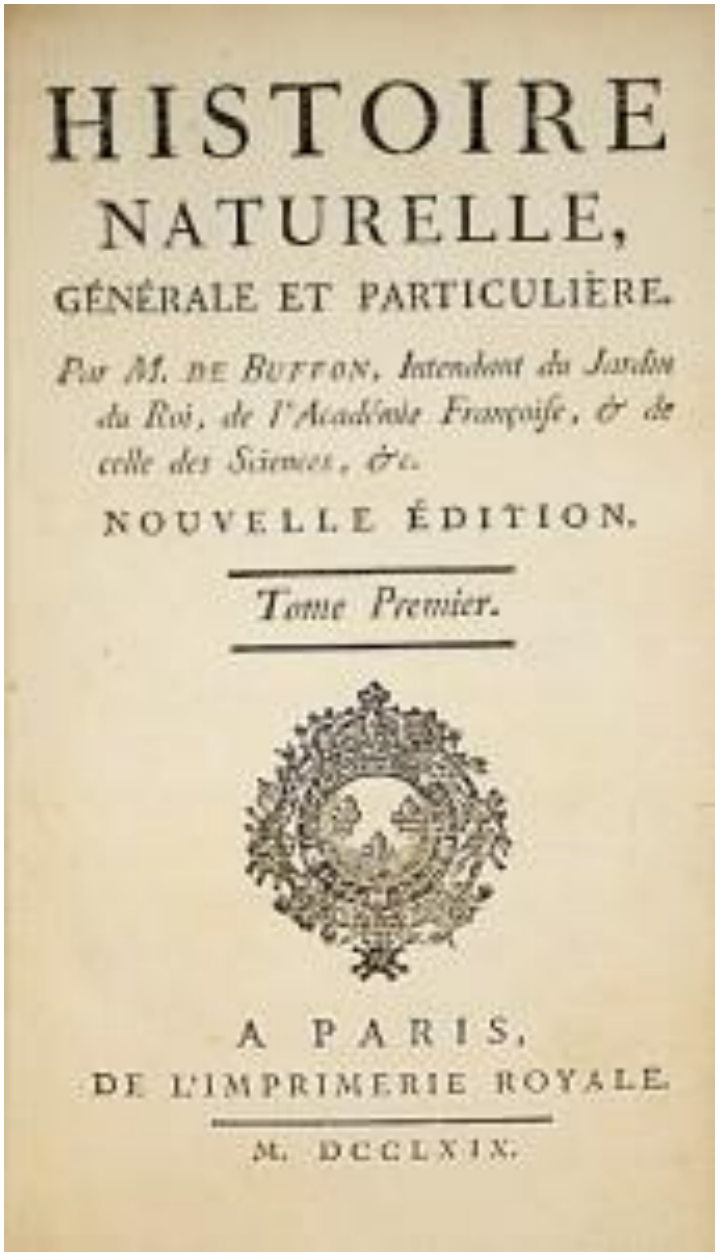
América do Sul, Austrália, África do Sul,

muitas ilhas (Madagascar, Nova Caledônia)

contêm alta % de táxons (spp. e táxons superiores) endêmicos.

Tais “províncias” ou “regiões” (unidades biogeográficas) não correspondem precisamente ao limite atual de continentes ou oceanos.

Schouw 1823, De Candolle 1855, Sclater 1858, Wallace 1876


HISTOIRE
NATURELLE,
GÉNÉRALE ET PARTICULIÈRE.
Par M. DE BUFFON, Intendant du Jardin du Roi, de l'Académie Françoise, & de celle des Sciences, &c.
NOUVELLE ÉDITION.
Tome Premier.
A PARIS,
DE L'IMPRIMERIE ROYALE.
M. DCCLXIX.

Georges-Louis Leclerc
Conde Buffon
1707-1788

“Lei de Buffon”

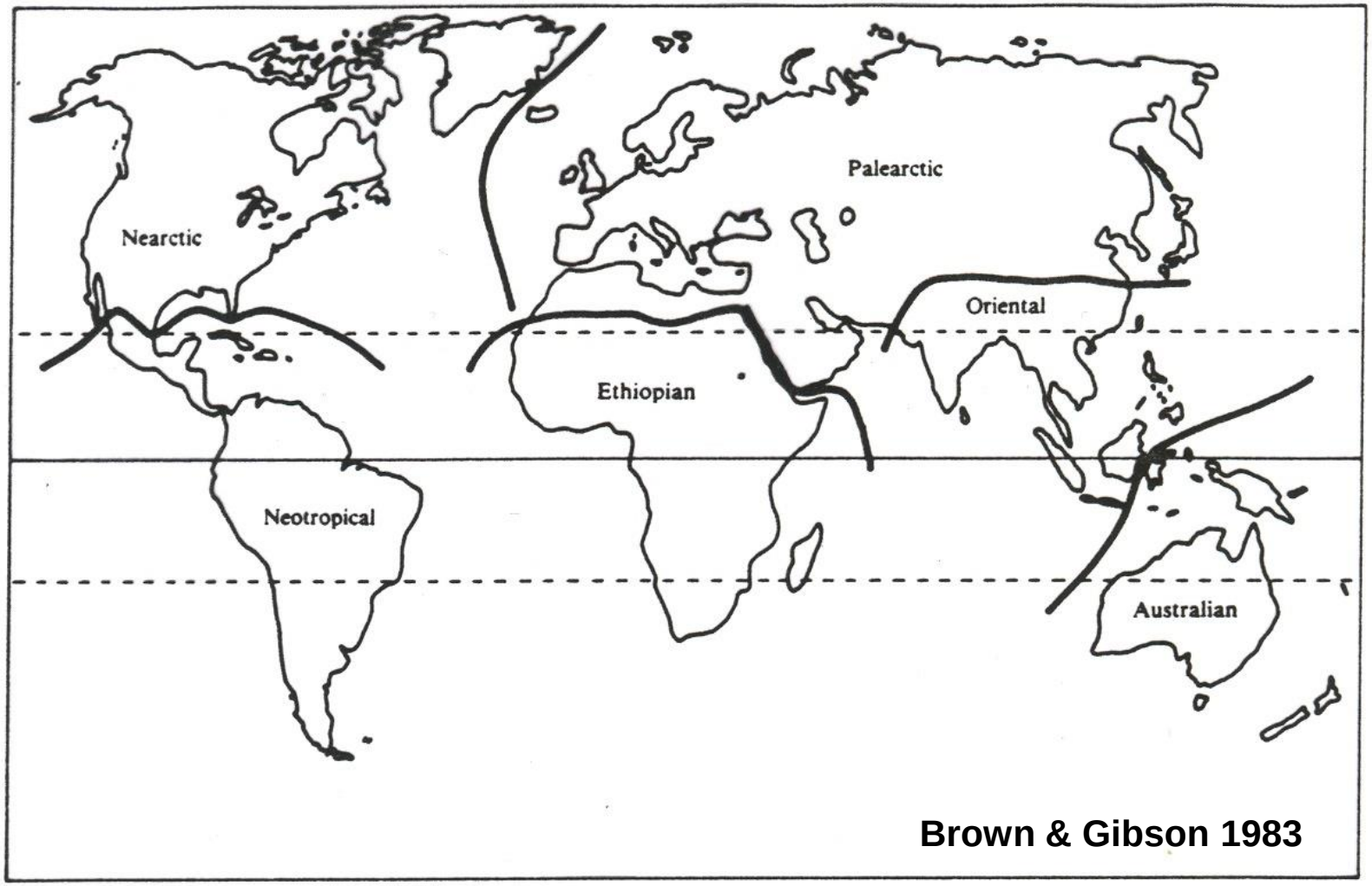
Distintas regiões do globo, embora compartilhando as mesmas condições climáticas, são habitadas por diferentes espécies de animais e plantas.

Region	Higher plants	Mammals	Reptiles	Amphibians	Swallowtail butterflies
Cape Region (South Africa)	6000[2]	15	43	23	0
Upland western Amazonia	5000[1]	—	—	c. 70	—
Atlantic coastal Brazil	5000[1]	40	92	168	7
Madagascar	4900[1]	86	234	142	11
Philippines	3700[1]	98	120	41	23
Borneo (north)	3500[1]	42	69	47	4
Eastern Himalaya	3500[1]	—	20	25	—
SW Australia	2830[2]	10	25	22	0
Western Ecuador	2500	9	—	—	2
Colombian Chocó	2500[1]	8	137	111	0
Peninsular Malaysia	2400[1]	4	25	7	0
Californian floristic province	2140[2]	15	15	16	0
Western Ghats (India)	1600[2]	7	91	84	5
Central Chile	1450[2]	—	—	—	—
New Caledonia	1400[1]	2	21	0	2
Eastern Arc Mts (Tanzania)	535[2]	20	—	49	3
SW Sri Lanka	500[2]	4	—	—	2
SW Côte d'Ivoire	200[2]	3	—	2	0
Total	49 655	363	892	c. 807	59

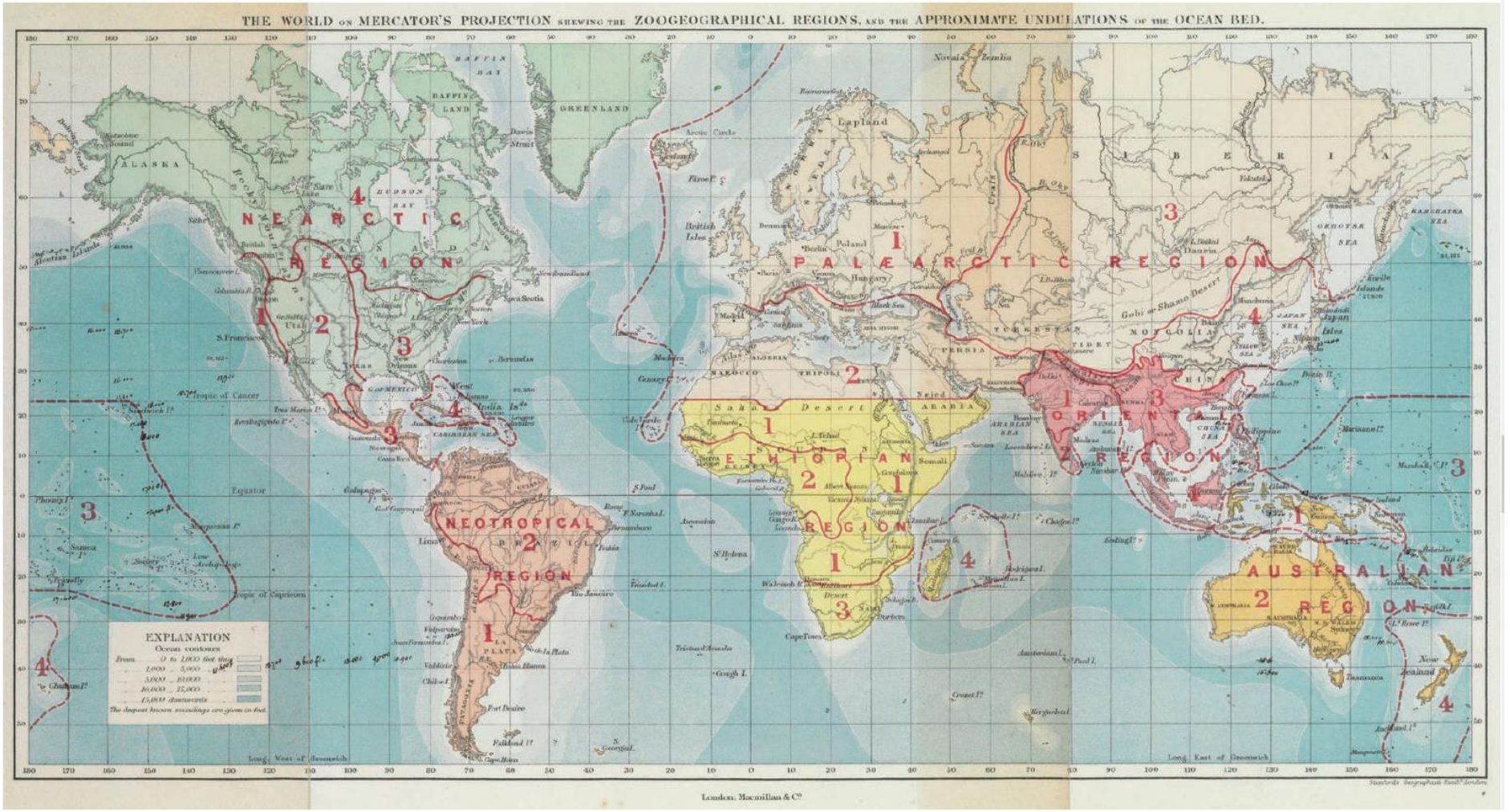
Number of endemic species in 18 "hot spots",

including some islands

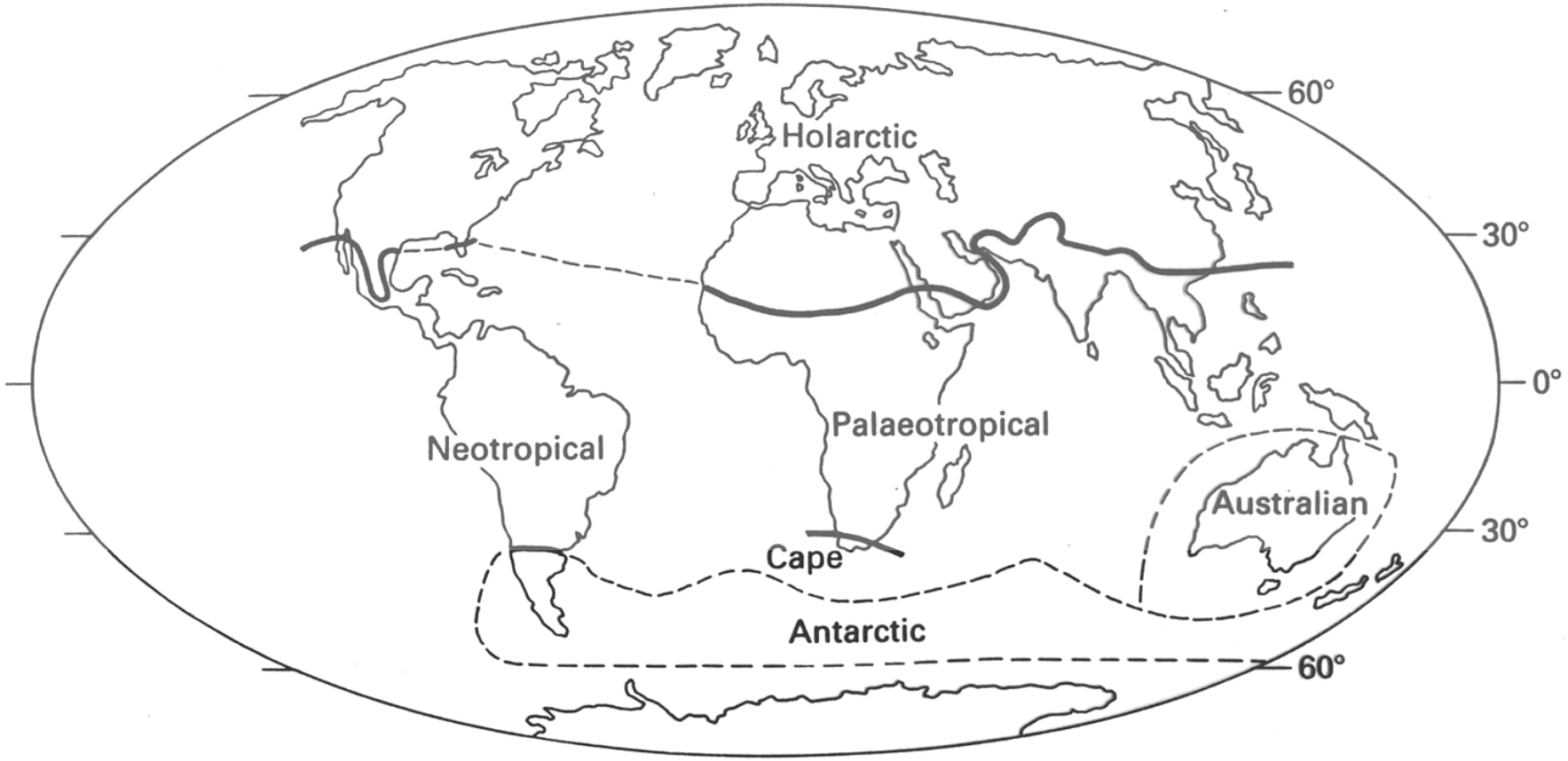
Spellerberg & Sawyer 1999



Major zoogeographic regions reflect attempts of biogeographers to divide the landmasses into a classification reflecting the affinities of the terrestrial fauna. The regions shown here are those described by A.R. Wallace in 1876 and are still widely accepted today. This classification is similar to that proposed by Sclater (1858) for birds.



Grandes regiões zoogeográficas
e suas províncias (numeradas)
A.R. Wallace (1876): *Categorias hierárquicas.*



Reinos florísticos do mundo

Takhtajan 1986

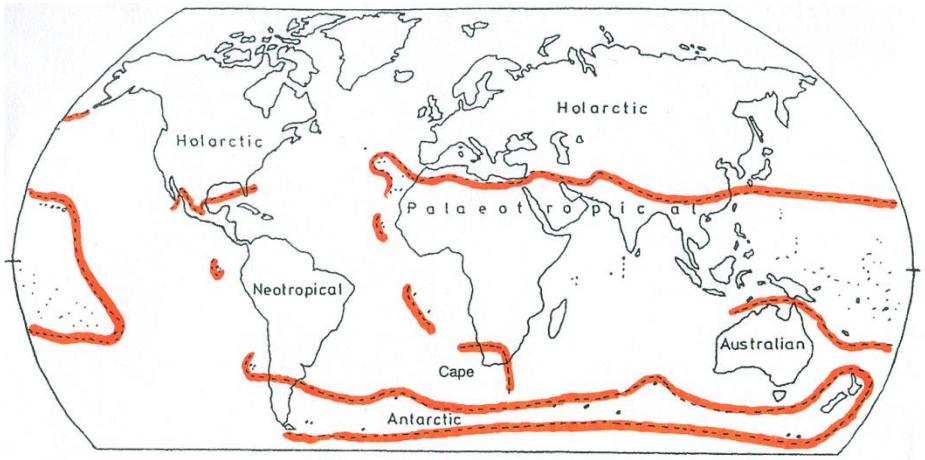
Major floristic regions - a classification reflecting the affinities of the terrestrial flora.

	Numbers of endemic taxa, from Takhtajan		Families, from Heywood		
	Fams.	Genera	Total no.	Endemics	Endemics (%)
Holarctic Kingdom	52	1280+	202	13	6.4
Palaeotropical Kingdom	25	(no estimate)	342	13	3.4
Neotropical Kingdom	25	3000–3660	223	17	7.6
Cape Kingdom	8	200	150	7	4.7*
Australian Kingdom	17	550	177	10	5.6
Antarctic Kingdom	11	34	?	?	?

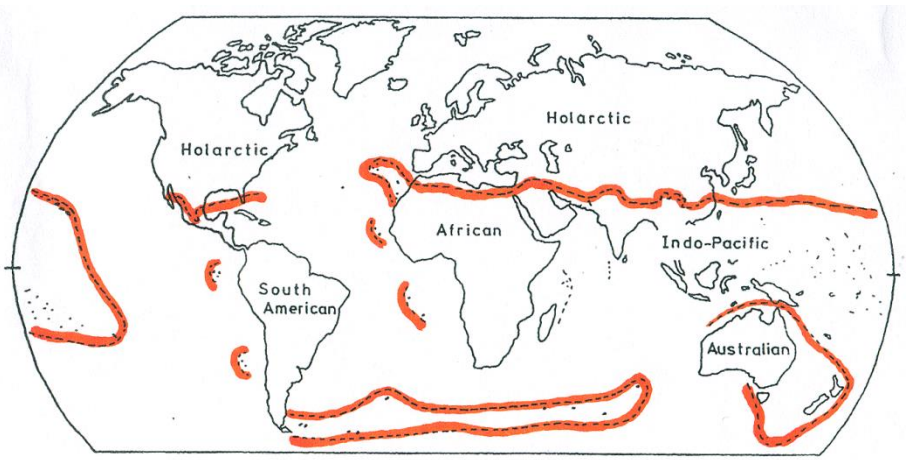
*From Bond & Goldblatt (1984).

Levels of endemism in Takhtajan's kingdoms

Cox 2001



A



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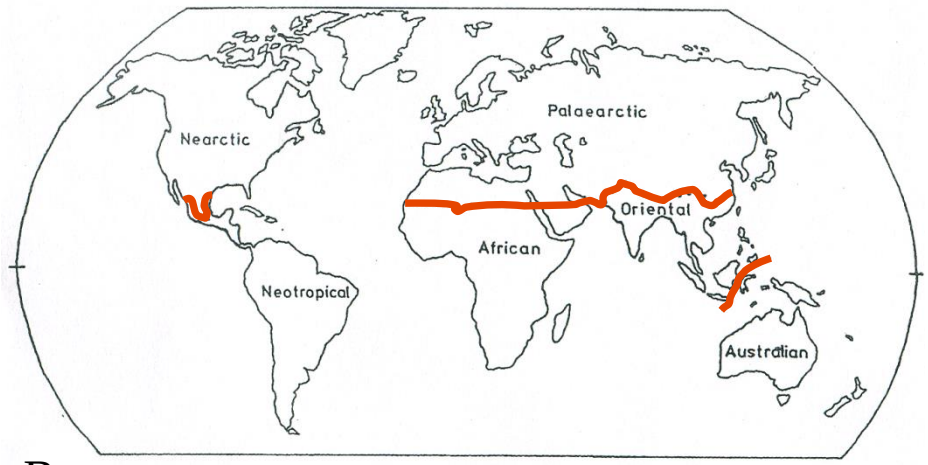

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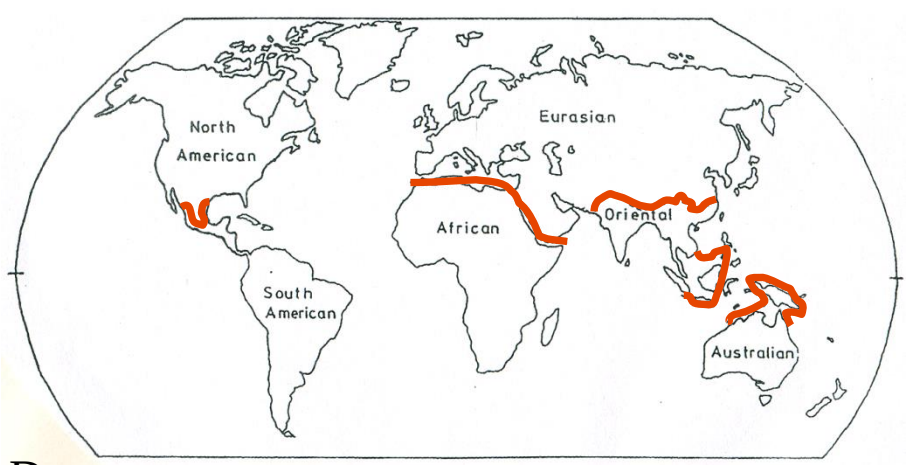


D

Floral Kingdons (A) and zoogeographic Regions (B), as currently recognized.

Floral Kingdons (C) and mammal zoogeographic Regions (D), as now suggested - **Cox 2001**

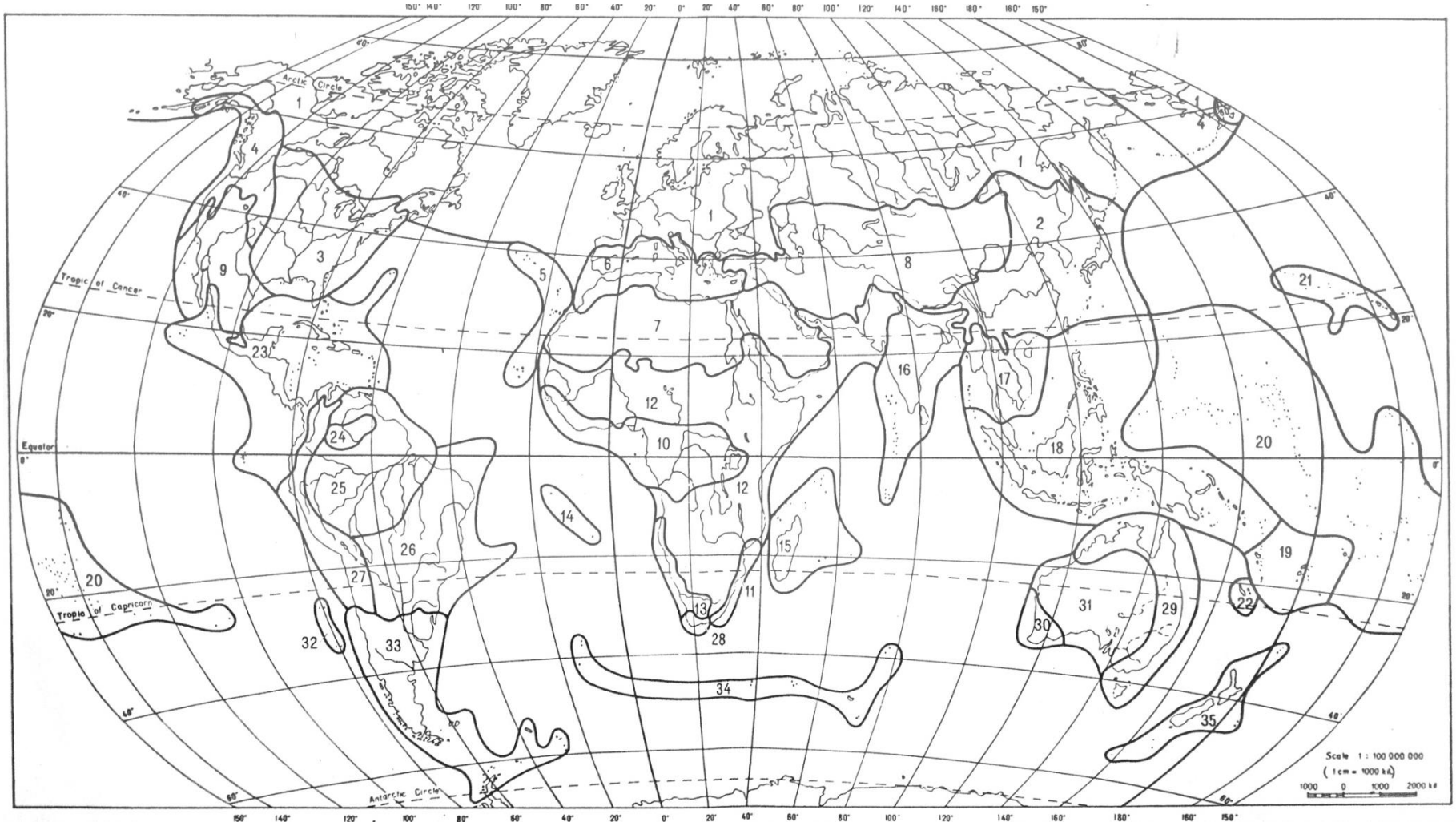
Unidades Biogeográficas – critérios (Braun-Blanquet 1979; Takhtajan 1986; Navarro & Maldonado 2004)

REINO BIOGEOGRÁFICO - delimitado por critérios em escala continental da origem das floras e faunas em relação à formação e separação dos continentes, e das grandes mudanças climáticas e geológicas. Possui numerosas famílias e gêneros endêmicos.

Região Biogeográfica - Território muito extenso, que abarca partes importantes de um continente. Flora muito característica, com numerosas espécies, gêneros e algumas famílias endêmicas. Possui grupos de vegetacionais próprios.

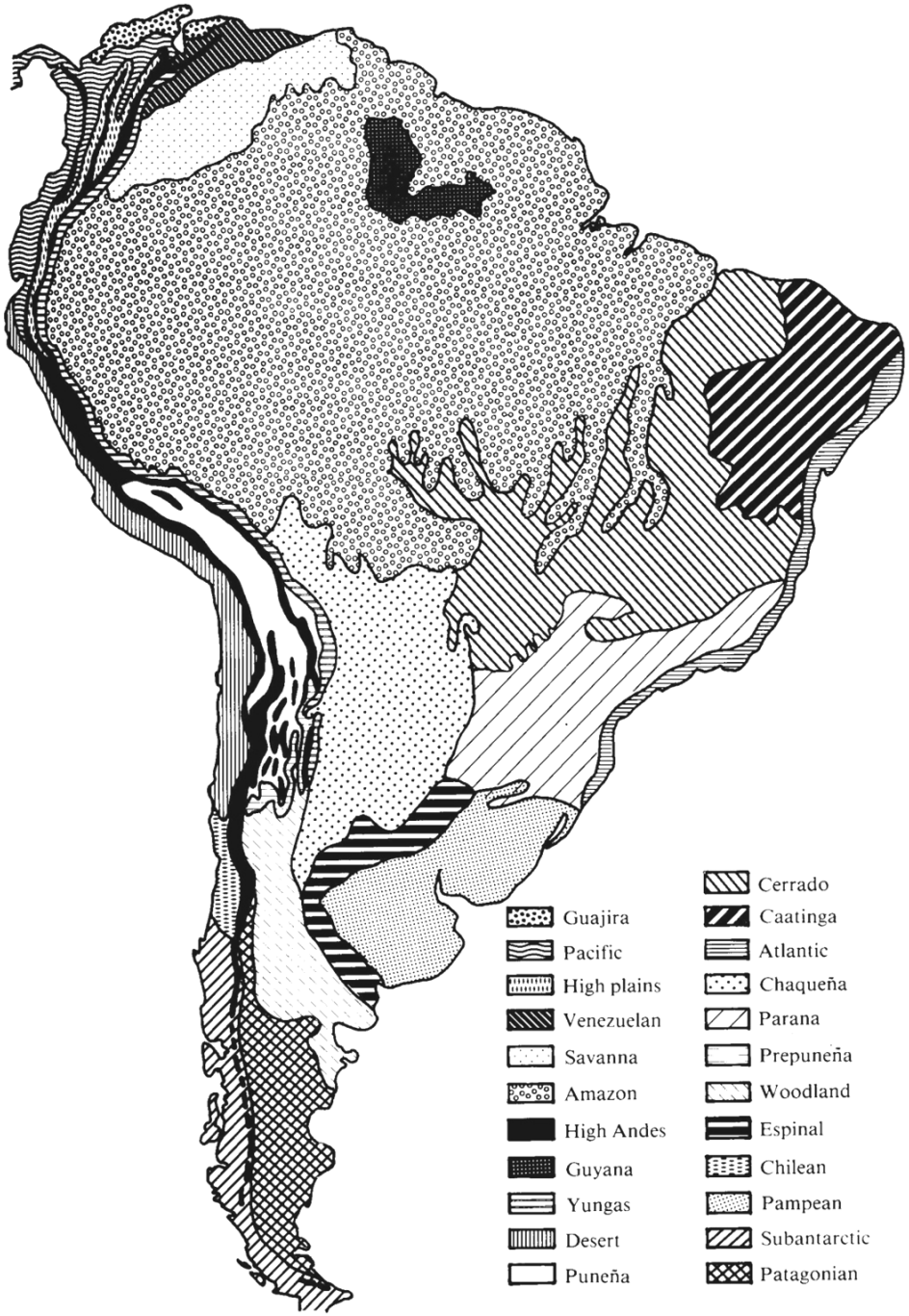
Província Biogeográfica - Território extenso que possui grande número de espécies e alguns gêneros endêmicos. Possui formações vegetacionais próprias ou mesmo exclusivas.

Setor Biogeográfico / Distrito Biogeográfico



REGIÕES FLORÍSTICAS DO MUNDO Takhtajan 1986

1, Circumboreal Region. 2, Eastern Asiatic Region. 3, North American Atlantic Region. 4, Rocky Mountain Region. 5, Macaronesian Region. 6, Mediterranean Region. 7. Saharo-Arabian Region. 8, Irano-Turanian Region. 9, Madrean Region. 10, Guineo-Congolian Region. 11, Uzambara-Zululand Region. 12, Sudano-Zambezian Region. 13, Karoo-Namib Region. 14, St. Helena and ascension Region. 15, Madagascan Region. 16, Indian Region. 17, Indochinese Region. 18, Malesian Region. 19, Fijian Region. 20, Polynesian Region. 21, Hawaiian Region. 22, Neocaledonian Region. 23, Caribbean Region. 24, Region of the Guayana Highlands. 25, Amazonian Region. 26, Brazilian Region. 27, Andean Region. 28, Cape Region. 29, Northeast Australian Region. 30, Southwest Australian Region. 31, Central Australian or Eremaean Region. 32, Fernándezian Region. 33, Chile-Patagonian Region. 34, Region of the South Subantarctic Islands. 35, Neozeylandic Region.



Biogeographic provinces of South America. The delineation of these regions is based primarily on the distributions of plants, and it largely reflects the relationship between distinctive vegetation types and climate.

Cabrera & Willink 1973

(Brown & Gibson 1983)

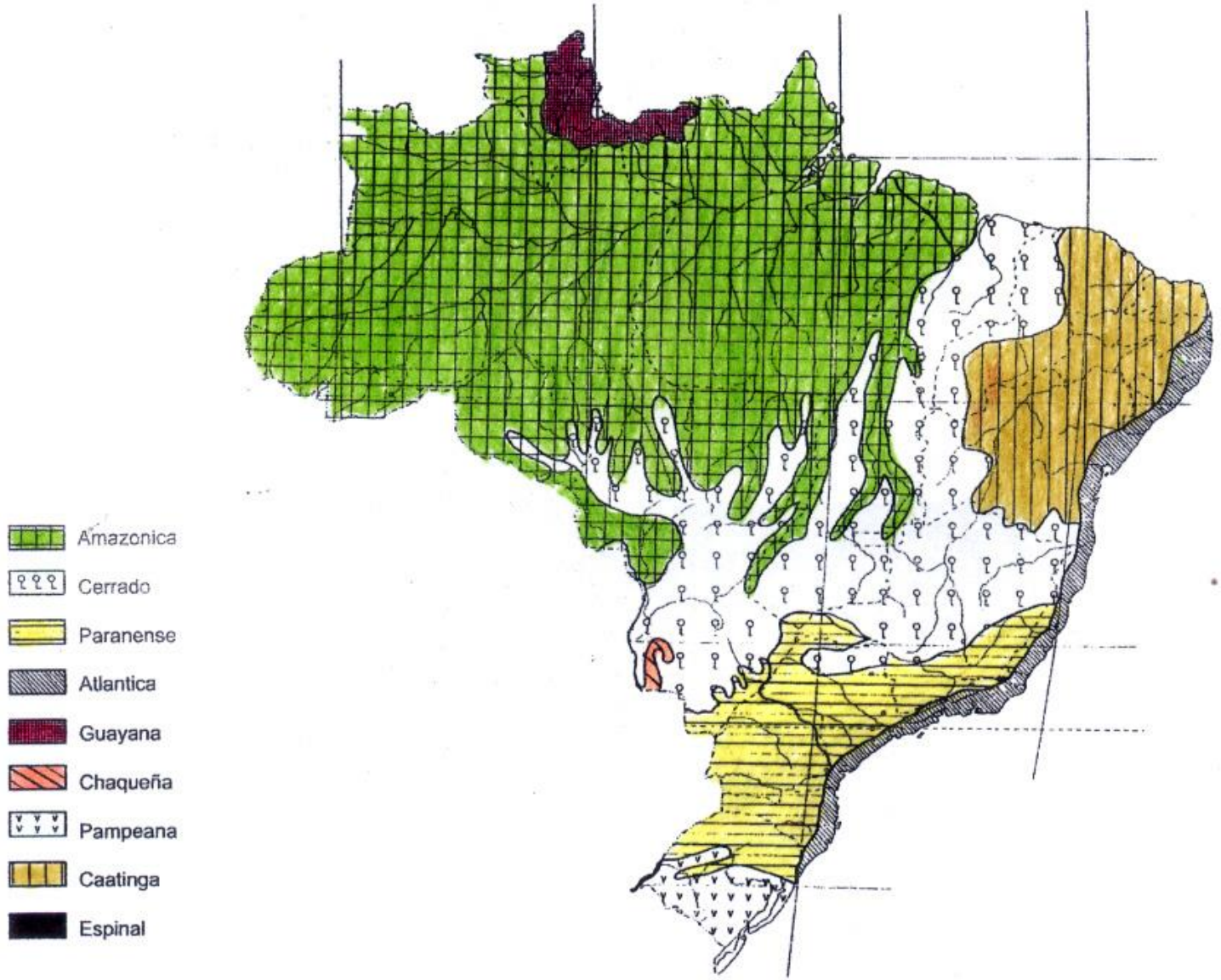
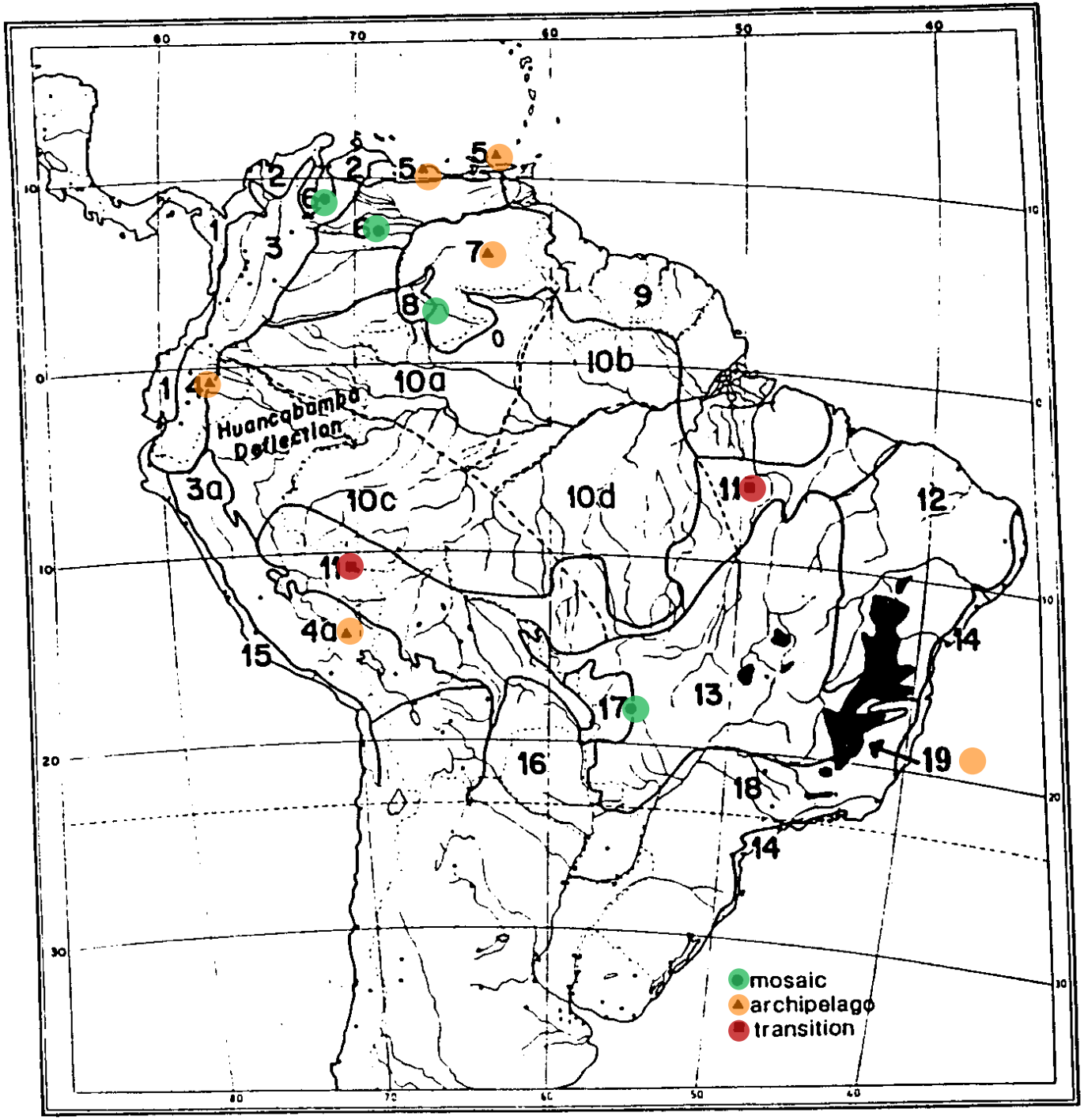


Figure 1 – Dominions and provinces represented in Brazil according to Cabrera & Willink (1980). (Modified map of Cabrera & Willink 1980).

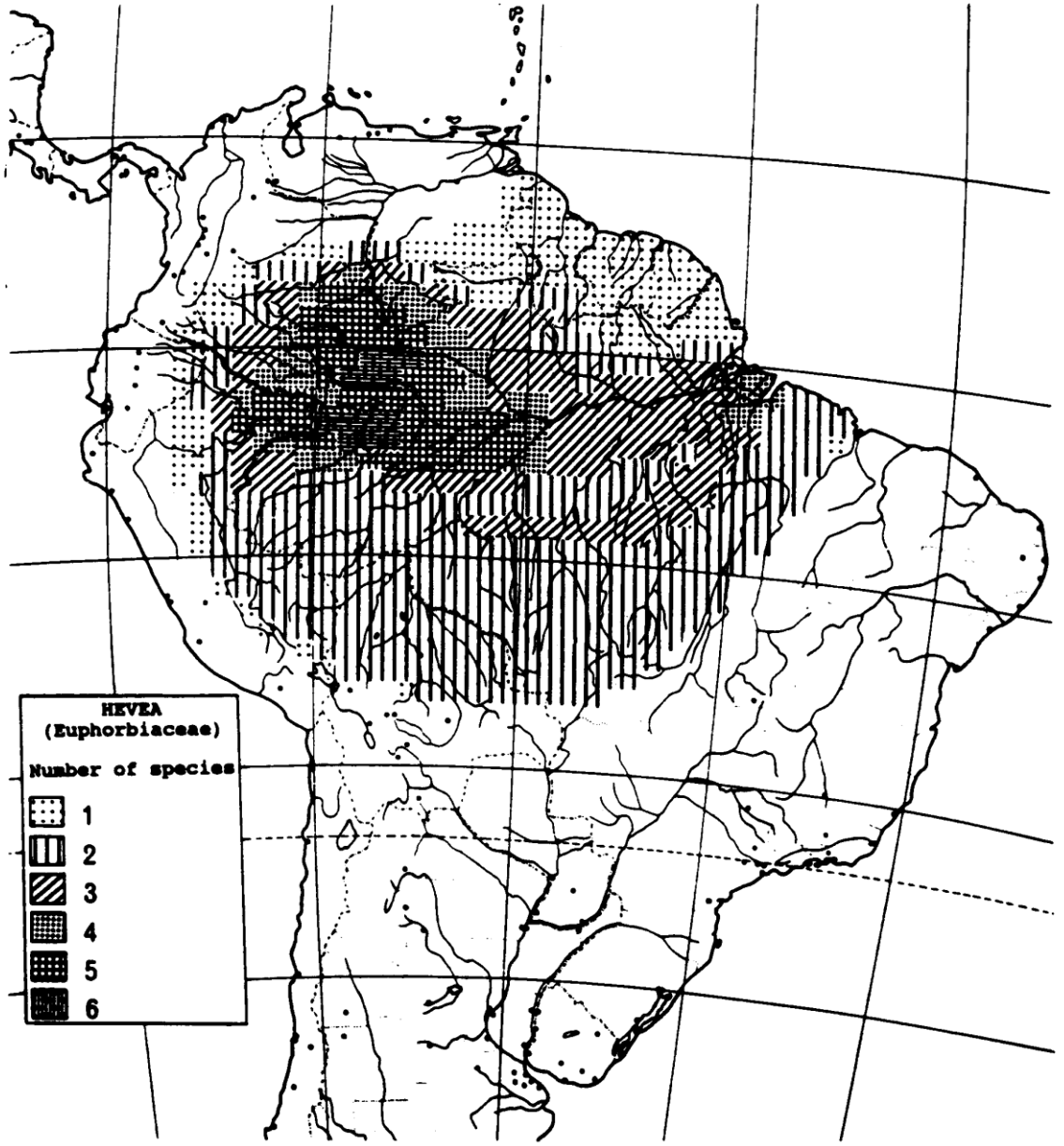
Cabrera & Willink 1973



Fitocórias da América do Sul tropical

Prance 1994

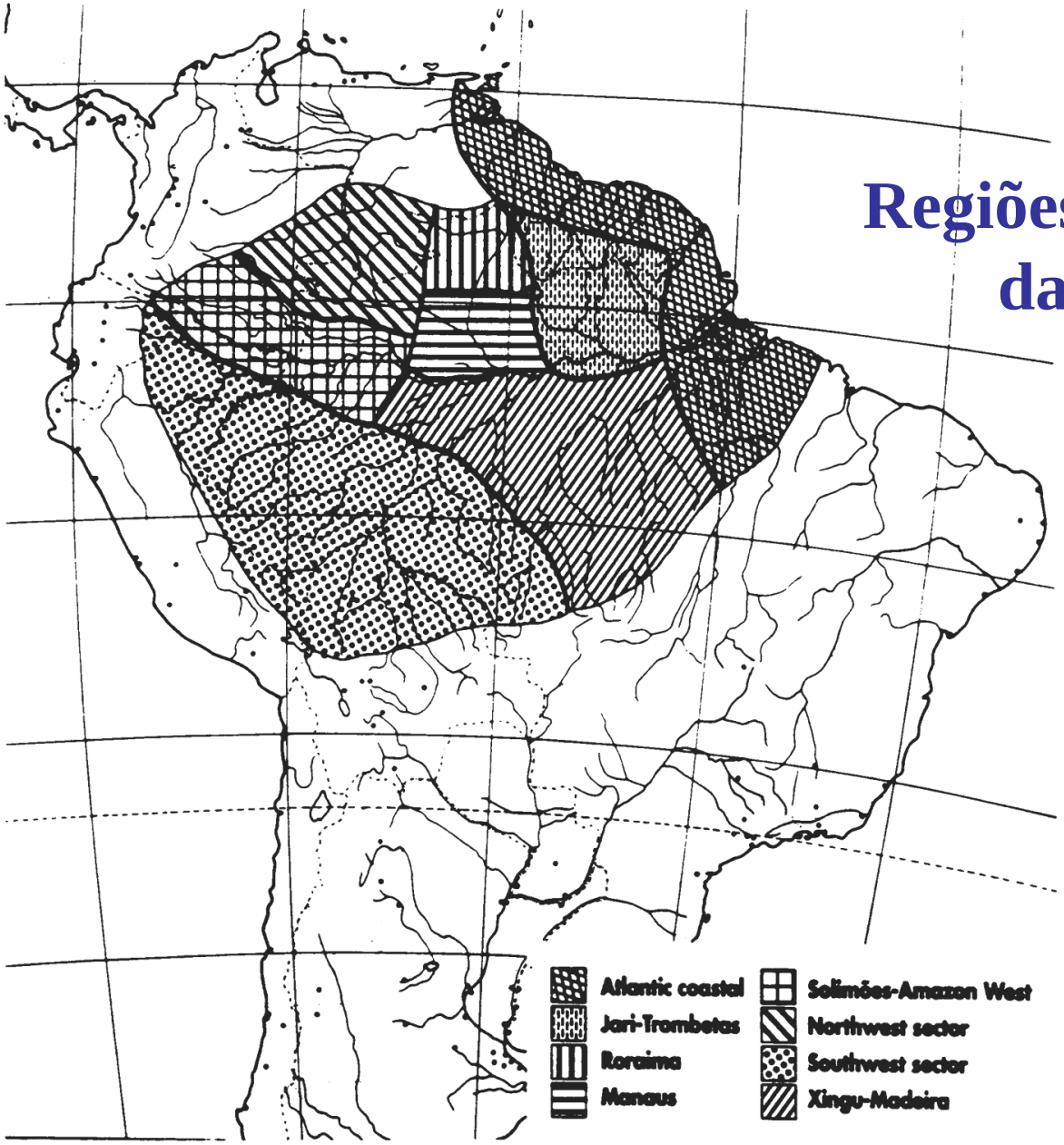
seringueira
Hevea brasiliensis
Euphorbiaceae



Distribution density map of species of *Hevea*

Prance 1994 in Forey *et al.*

Regiões fitogeográficas da Amazônia



Prance 1994

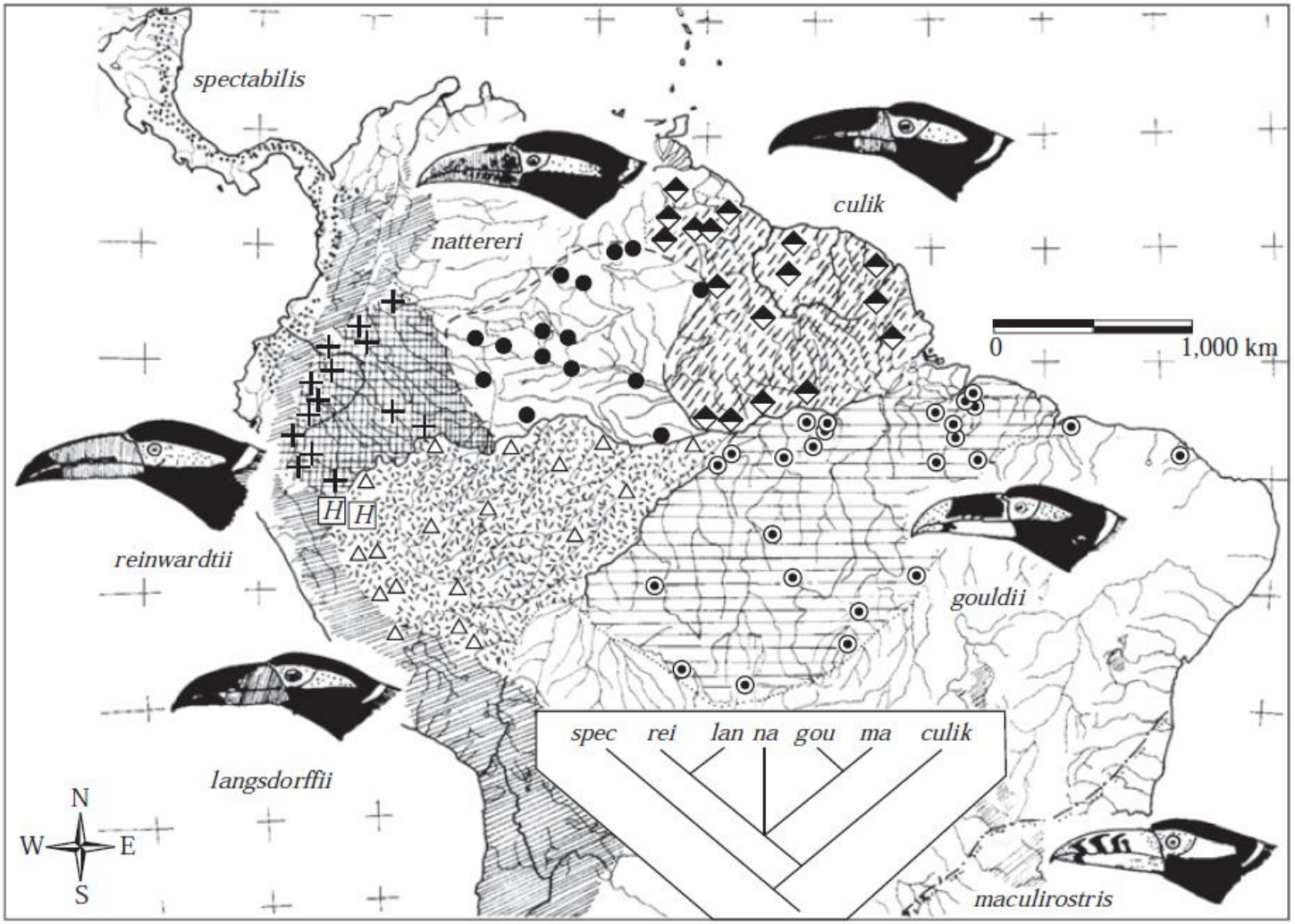


Figure 7. Distribution of the Lowland Toucanets *Selenidera* (updated from Haffer, 1974). Locality records (symbols) are given for the five Amazonian species; the two upper Amazonian forms hybridize where they meet (H) and are often treated as subspecies of one species. Color code for color of plumage and bill (adult male): stippled - yellow, hatched vertically - red, hatched obliquely - light green, blank - white. *S. nattereri* has several small blue marks on the sides of both mandibles near the base. Phylogenetic relations of taxa (bottom) are schematically illustrated after Prum (1988).

Haffer 2008

Provincias biogeográficas de América del Sur. Referencias = ama: Amapá, ara: de los Pinares, ata: Atacama, atl: Atlántica, ari: Puna Árida, bar: Barranquilla, caa: Caatinga, cau: Cauca, cer: Cerrado, cha: Chaqueña, cho: Chocó, coq: Coquimbo, cpa: Palagónica central, cpu: Puna Central, des: Desierto, dry: Ecuatoriana Seca, fal: Islas Malvinas, for: de las Selvas, fue: Patagónica Fueguina, gal: Islas Galápagos, gui: Guyana, hum: Puna Húmeda, ime: Imerí, jua: Islas Juan Fernández, lla: Llanos, mad: Madeira, maf: Bosque Magallánico, mag: Magdalena, mar: Maracaibo, mau: Maule, mav: Valle del Magdalena, moi: Guyana Húmeda, mon: Monte, moo: Pára,o Magallánico, nap: Napo, paa: Pará, pam: Pampeana, pan: Pantanal, par: Páramo, pay: Payunia, pre: Prepuna, ron: Rondonia, ror: Roraima, sam: Santa Marta, san: Santiago, sjo: Golfo de San Jorge, sub: Patagónica Subandina, tri: Trinidad y Tobago, tum: Tumbes-Piura, uca: Ucayali, val: Valdiviana, var: Varzea, ven: Venezolana Costera, wec: Ecuatoriana Occidental, wpa: Patagónica Occidental, xin: Xingu-Tapajós, yun: Yungas.

Morrone (1999, 2001) - total de 7 sub-regiões na região Neotropical: Caribe, Amazônica, Chaquenha, Andina, Paranaense, Subantártica e Patagônia.

Navarro & Maldonado 2004

Reino Neotropical-Austroamericano

2 subreinos: Neotropical Austroamericano

Figura I.14 Mapa Biogeográfico de América del Sur (Rivas-Martínez y G. Navarro, 2000).

Navarro & Maldonado 2004

Reino Neotropical-Austroamericano

Sub-reino Neotropical
- 3 super-regiões
- 7 regiões

Sub-reino Austroamericano
- 3 regiões

Navarro & Maldonado 2004

SUBREINO NEOTROPICAL

Superregión Caribeo-Amazónica

- **9. Región Caribeo-Mesoamericana**
  - 9.3 Provincia de Antillas
  - 9.5 Provincia Chiapas-Honduras
  - 9.6 Provincia Panamá-Costa Rica
  - 9.7 Provincia Guajira
- **10. Región Colombiano-Venezolana**
  - 10.1 Provincia Costera Ecuatoriano-Colombiana
  - 10.2 Provincia Río Magdalena
  - 10.3 Provincia Islas Galápagos
  - 10.4 Provincia Serrano-Venezolana
  - 10.5 Provincia de los Llanos
  - 10.6 Provincia de los Tepuís
- **11. Región Amazónica**
  - 11.1 Provincia Loreto
  - 11.2 Provincia Río Negro-Alto Orinoco
  - 11.3 Provincia Roraima y Bajo Amazonas
  - 11.4 Provincia Guayanas
  - 11.5 Provincia Delta Amazonas
  - 11.6 Provincia Acre y Madre de Dios
  - 11.7 Provincia Madeira y Tapajoz

Superregión Chaco-Brasileña

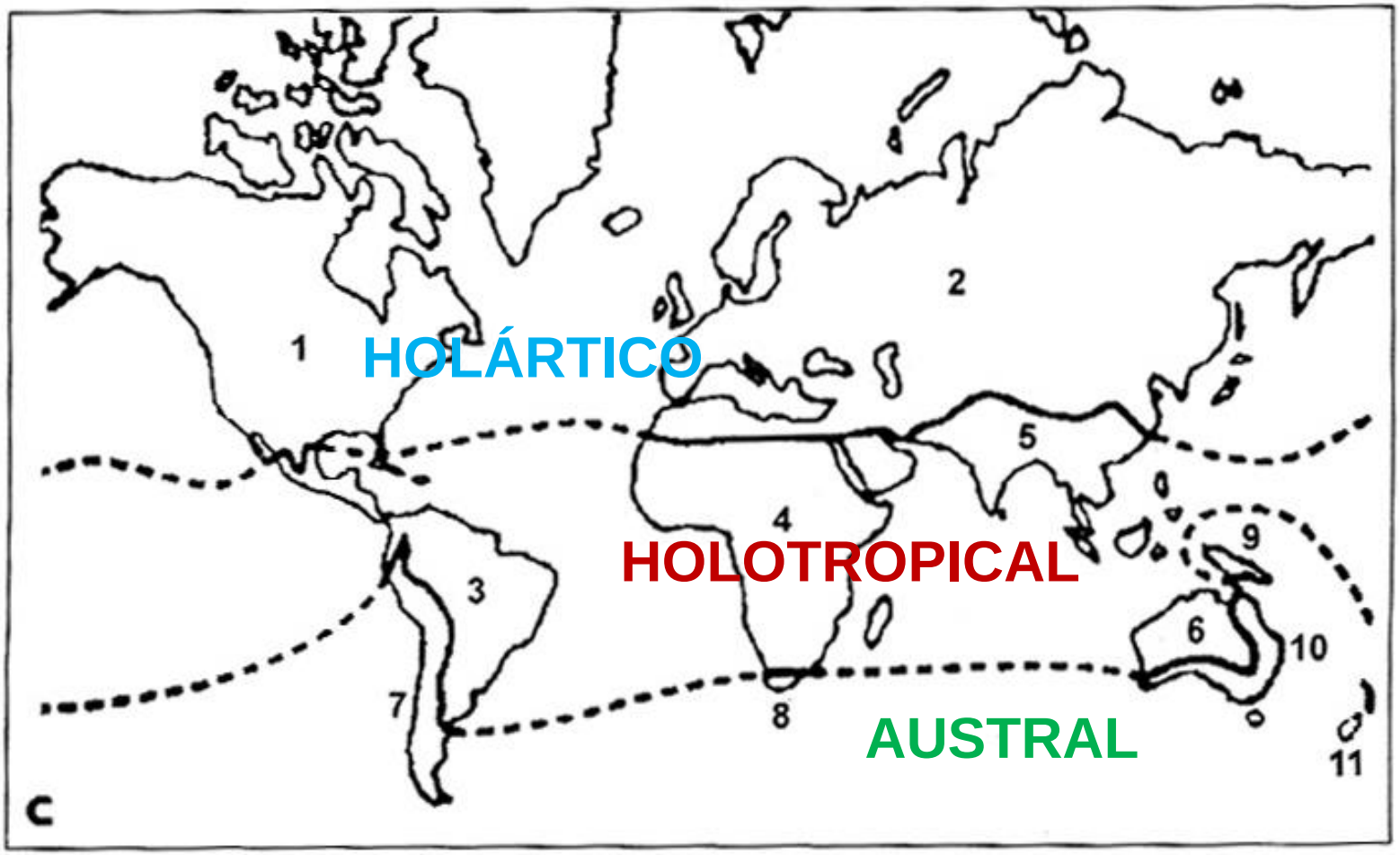
- **12. Región Brasileño-Paranense**
  - 12.1 Provincia Cerrado
  - 12.2 Provincia Tocantins
  - 12.3 Provincia Beni
  - 12.4 Provincia Pantanal
  - 12.5 Provincia Atlántico-Brasileña
  - 12.6 Provincia Paranense
  - 12.7 Provincia Caatinga
- **13. Región Chaqueña**
  - 13.1 Provincia Chaco Boreal
  - 13.2 Provincia Chaco Austral

Superregión Andina

- **14. Región Andina**
  - 14.1 Provincia del Páramo Andino
  - 14.2 Provincia Yungas Peruano-Bolivianos
  - 14.3 Provincia Puna Peruana
  - 14.4 Provincia del Altiplano Andino
  - 14.5 Provincia Boliviano-Tucumana
- **15. Región del Desierto del Pacífico**
  - 15.1 Provincia del Desierto del Perú
  - 15.2 Provincia del Desierto de Atacama

SUBREINO AUSTROAMERICANO

- **16. Región Pampeana**
  - 16.1 Provincia de la Pampa Lluviosa
  - 16.2 Provincia de la Pampa Xérica
- **17. Región Mesochileno-Patagónica**
  - 17.1 Provincia del Desierto Mesochileno
  - 17.2 Provincia de Chile Central
  - 17.3 Provincia Andino-Mediterránea
  - 17.4 Provincia del Monte
  - 17.5 Provincia Patagónica Boreal
  - 17.6 Provincia Patagónica Austral
- **18. Región Valdiviano-Magallánica**
  - 18.1 Provincia Valdiviana
  - 18.2 Provincia Austroandino-Magallánica
  - 18.3 Provincia Tierra de Fuego
  - 18.4 Provincia Islas Juan Fernandez
  - 18.5 Provincia Antártica



Reinos biogeográficos e suas regiões, segundo Morrone (2002, 2009):

Reino HOLÁRTICO (= Laurásia) – regiões 1-Neártica e 2-Paleártica.

Reino HOLOTROPICAL (= Gonduana Oriental) – regiões 3-Neotropical, 4-Afrotropical, 5-Oriental, a 6-Australiana Tropical.

Reino AUSTRAL (= Gonduana Ocidental) – regiões 7-Andina, 8-Capense, 9-Novaguineana, 10-Australiana Temperada, 11-Neozelandesa.

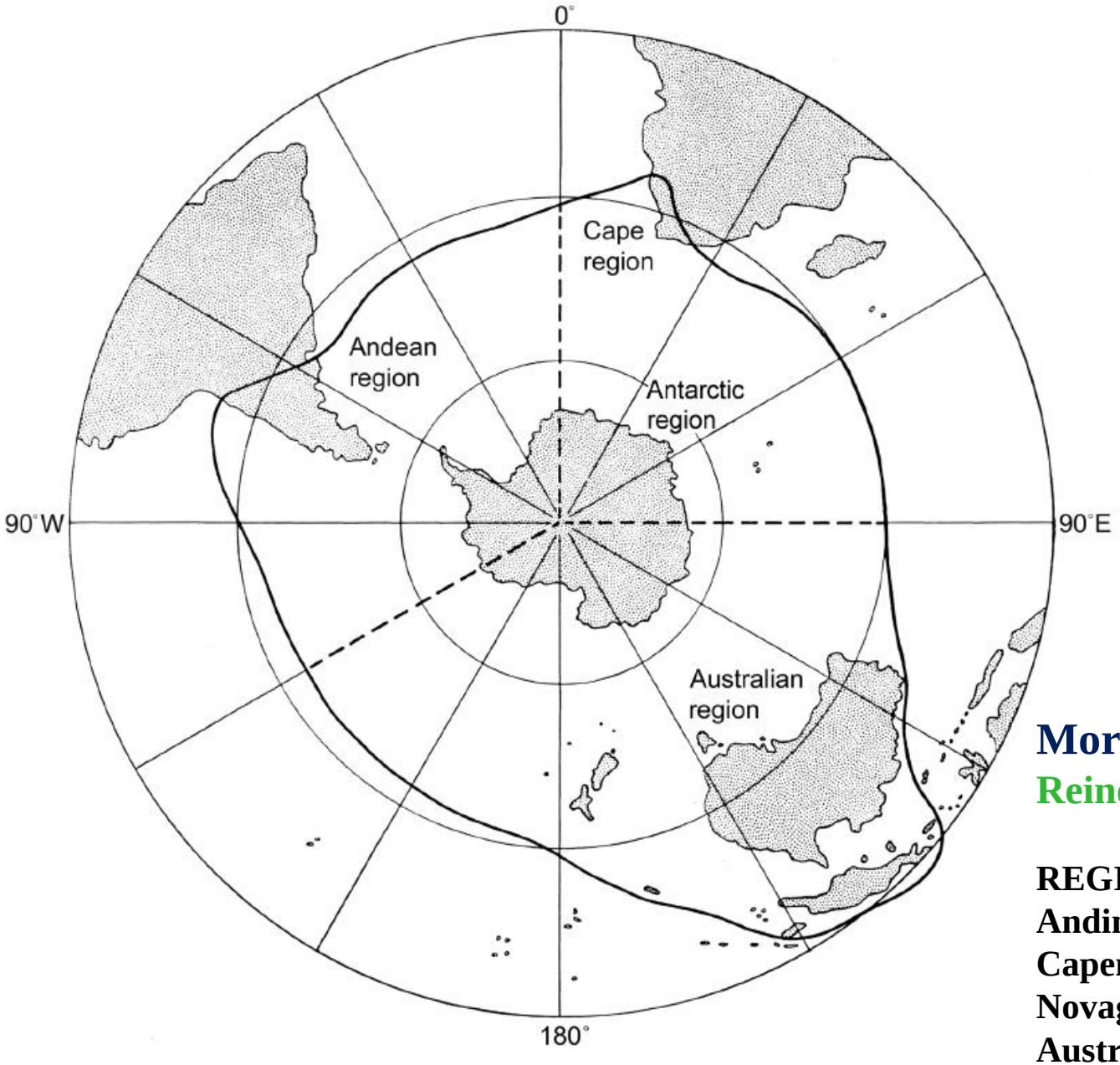


FIGURE 1. The Austral kingdom (modified from Kuschel 1964).

Morrone (2015)
Reino AUSTRAL

REGIÕES:
Andina
Capense
Novaguineana
Australiana Temperada
Neozelandesa

Zootaxa 3936 (2): 207–236
www.mapress.com/zootaxa/

Article

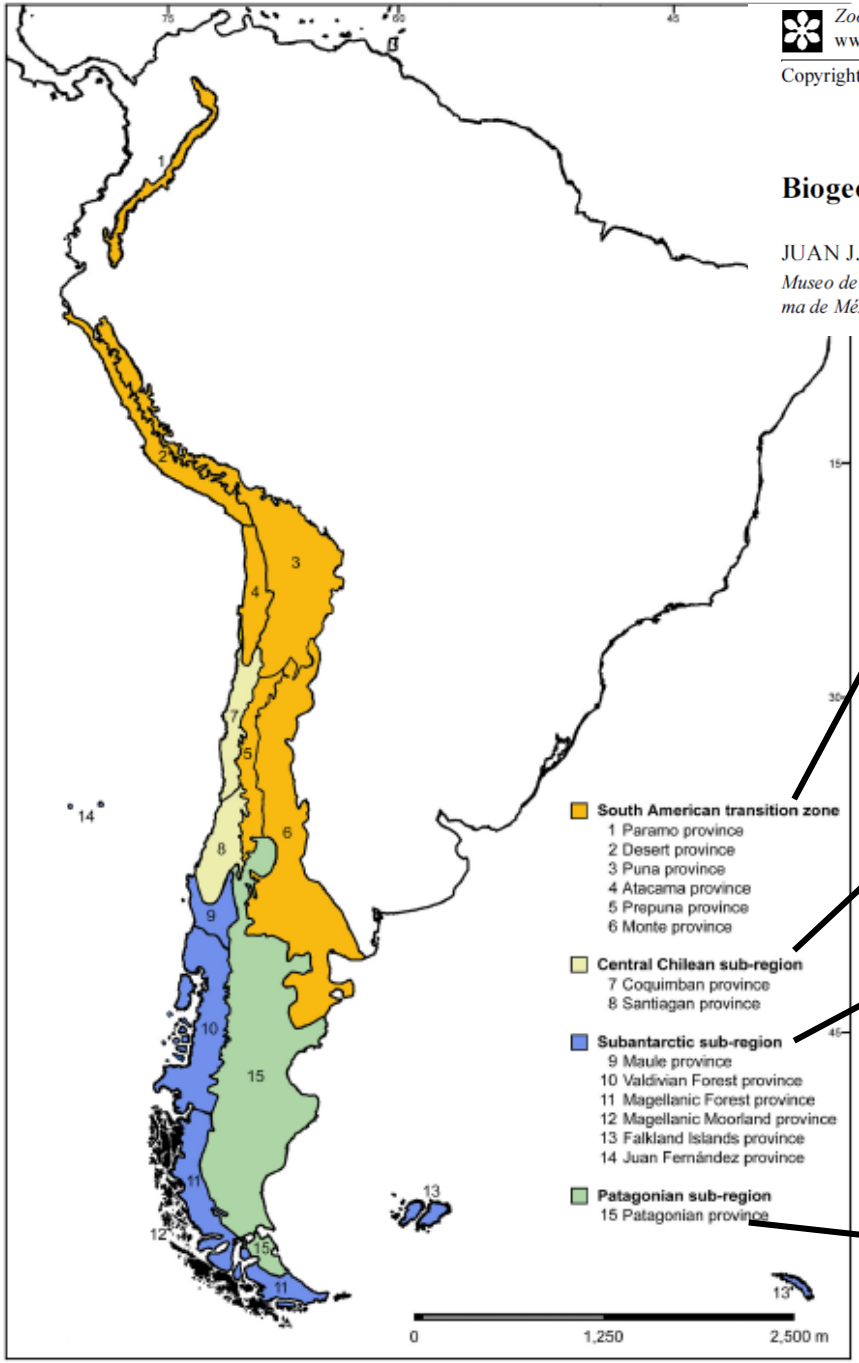
ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3936.2.3
http://zoobank.org/urn:lsid:zoobank.org:pub:8BDC5503-185B-436E-9F75-D6D68C2029D8

Biogeographical regionalisation of the Andean region

JUAN J. MORRONE

Museo de Zoología "Alfonso L. Herrera, Departamento de Biología Evolutiva, Facultad de Ciencias, Universidad Nacional Autónoma de México (UNAM), Apartado Postal 70-399, 04510 Mexico City, Mexico. E-mail: juanmorrone2001@yahoo.com.mx



South American transition zone
1 Paramo province
2 Desert province
3 Puna province
4 Atacama province
5 Prepuna province
6 Monte province

Central Chilean sub-region
7 Coquimban province
8 Santiagan province

Subantarctic sub-region
9 Maule province
10 Valdivian Forest province
11 Magellanic Forest province
12 Magellanic Moorland province
13 Falkland Islands province
14 Juan Fernández province

Patagonian sub-region
15 Patagonian province

Morrone (2015)
Reino AUSTRAL
REGIÃO ANDINA
e subregiões

2. Biogeographic regionalisation of the Andean region proposed herein.

FIGURE 12. Biogeographic regionalisation proposed herein.

Morrone (2014)

Reino HOLOTROPICAL

REGIÃO NEOTROPICAL

Zootaxa 3782 (1): 001–110
www.mapress.com/zootaxa/

Monograph

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3782.1.1
http://zoobank.org/urn:lsid:zoobank.org:pub:3640F0A6-A657-4B22-9362-E7103C8683DF

Biogeographical regionalisation of the Neotropical region

JUAN J. MORRONE

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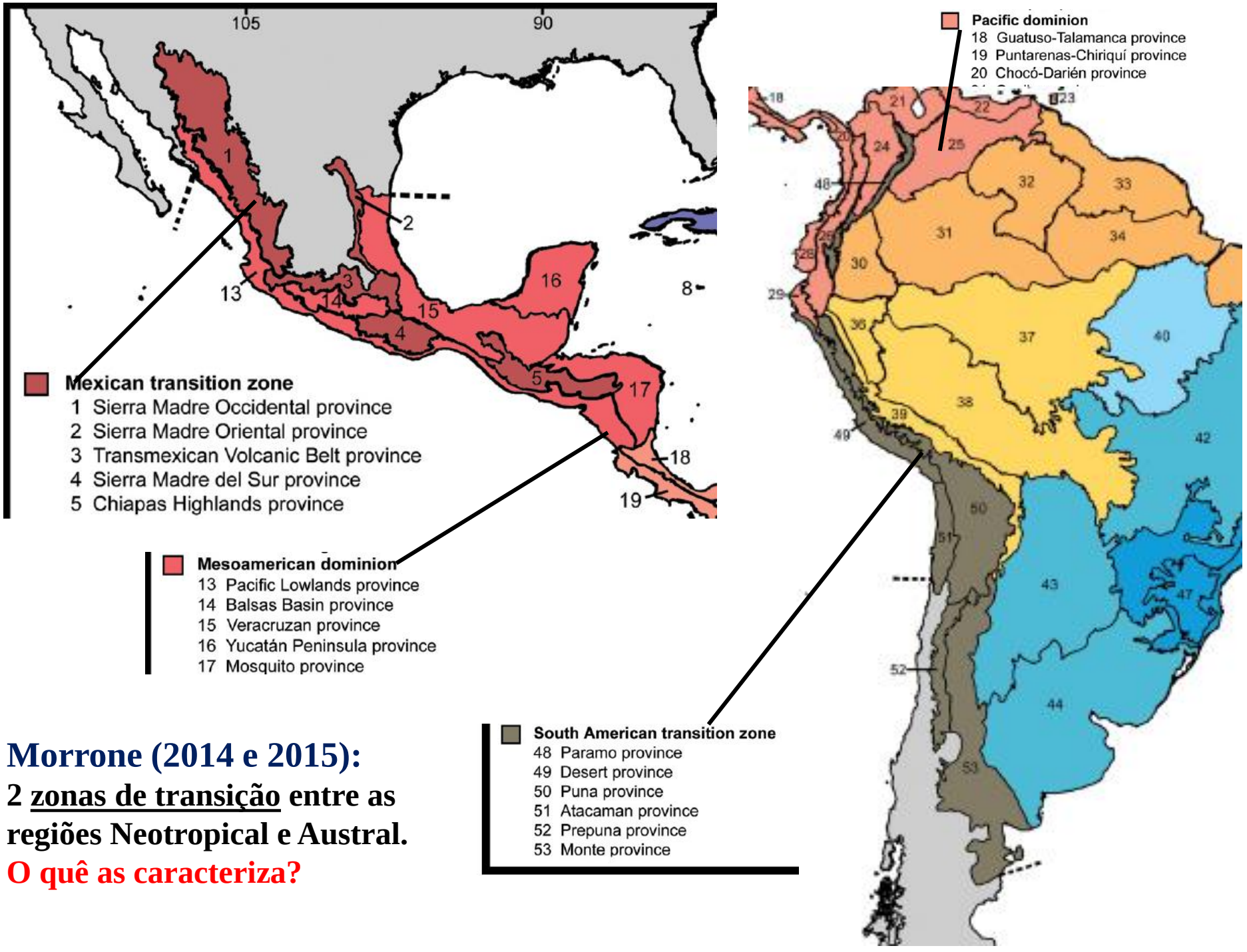
Atlantic province Cabrera & Willink 1973

Tupí province Mello-Leitão 1937: 246; Fittkau 1969: 642.
Atlantic province Cabrera & Willink 1973: 64; Rivas-Martínez & Navarro 1994: map; Fernandes & Bezerra 1990: 99; Fernandes 2006: 67.
Serra do Mar centre Müller 1973: 125; Cracraft 1985: 72.
Serra do Mar province Udvardy 1975: 41.
Atlantic Tropical dominion Ab'Sáber 1977: map.
Southeastern Brazil area Cracraft 1988: 223.
Litoral or Coastal sub-province Fernandes & Bezerra 1990: 114; Fernandes 2006: 84.
Brazilian Atlantic Coast Restingas ecoregion Dinerstein *et al.* 1995: 106.
Brazilian Coastal Atlantic Forests ecoregion Dinerstein *et al.* 1995: 93.
Brazilian Atlantic Forest province Morrone 1999: 11, 2001e: 98, 2006: 482.
Brazilian Atlantic Coast province Morrone 2001b: 2.
Serra do Mar area Silva *et al.* 2004: 88.
Atlantic Forest area Porzecanski & Cracraft 2005: 266.

Diagnosis. Narrow strip along the Brazilian Atlantic coast east of the coastal cordillera, between 7-32 south latitude (Morrone 2001b, 2006).

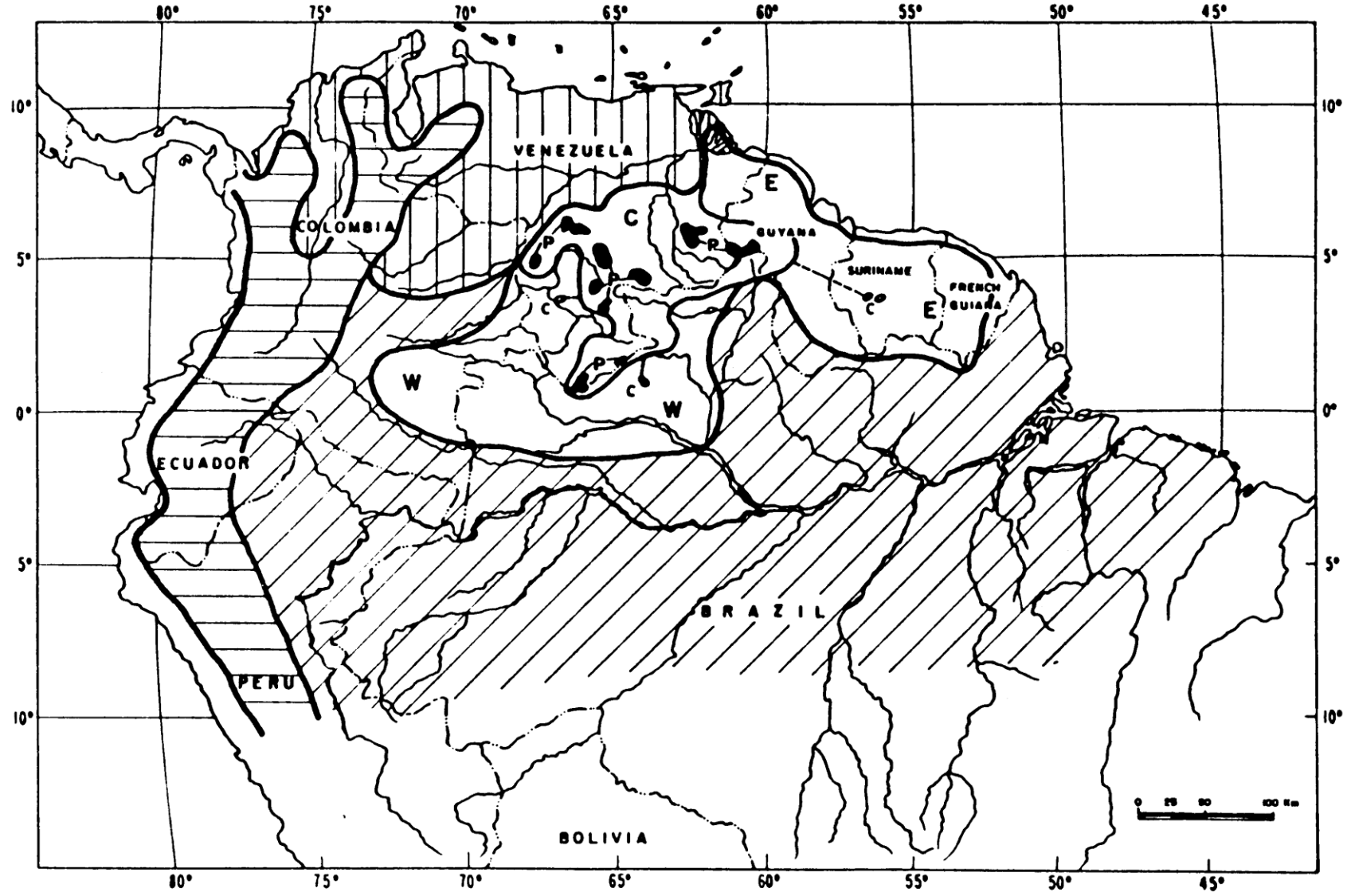
Endemic taxa. MAGNOLIOPHYTA. Asteraceae: *Chionolaena capitata*, *C. isabellae*, *C. phylicoides* and *C. wittigiana* (Freire 1993); Cecropiaceae: *Cecropia hololeuca* (Franco & Berg 1997); Elaeocarpaceae: *Crinodendron brasiliense* (Coode 1987); Onagraceae: *Fuchsia alpestris*, *F. brevilobis*, *F. glazioviana* and *F. regia* subsp. *serrae* (Berry 1989). ARTHROPODA. Carabidae: *Amblygnathus braziliensis* (Ball & Maddison 1987); Corixidae: *Sigara denseconscripta* (Bachmann 1981); Curculionidae: *Ericydeus bahiensis*, *Erodiscus denticollis*, *E. caruaru*, *Lancearius longirostris*, *Pimelerodius ardea*, *P. birai*, *P. elongatulus*, *P. gryphus*, *P. obsoletus*, *P. pascoei*, *P. sulcatipennis*, *Prosicoderus crassipes*, *Sicoderus analis*, *S. apicalis*, *S. bondari*, *S. ciconia*, *S. distinguendus*, *S. prolatus* and *S. subcoronatus* (Vanin 1986; Lanteri 1995); Ditomyiidae: *Calliceratomyia pectinata* (Amorim & Pires 1996); Elmidae: *Stenhelmoides submaculatus* (Spangler & Perkins 1989); Membracidae: *Nicomia interrupta* and *N. monticola* (Albertson & Dietrich 2005; Sigrist & Carvalho 2009); Miridae: *Rhinacloa carvalhoi* (Schuh & Schwartz 1985); Mycetophilidae: *Cluzobra* spp. (Amorim & Oliveira 2008); Nepidae: *Curicta bilobata*, *C. lenti* and *C. longimanus* (Keffer 1996); Pholcidae: *Carapoia crasto, C. genitalis, C. ubatuba* and *C. una* (Huber 2005; Sigrist & Carvalho 2009); Reduviidae: *Rasahus grandis* and *Sirthenea atra* (Morrone & Coscarón 1996); Scarabaeidae: *Coprophaneus bellicosus* (Edmonds & Zidek 2013); Schendylidae: *Schendylops coscaroni, S. iguapensis, S. olivaceus, S. parahybae, S. perditus* and *S. luederwaldi* (Morrone & Pereira 1999); Sciaridae: *Rhynchosciara americana* (Amorim & Pires 1996); Sciomyzidae: *Sepedonea incipiens*, *S. neffi* and *S. veredae* (Freidberg *et al.* 1991); Simuliidae: Simuliidae *Simulium brachycladum* (Coscarón & Coscarón-Arias 1995); Staphylinidae: *Neolindus schubarti*, *N. unilobus* (Herman 1991); Stenomidae: *Setiostoma argyrobasis* (Duckworth



Morrone (2014 e 2015):

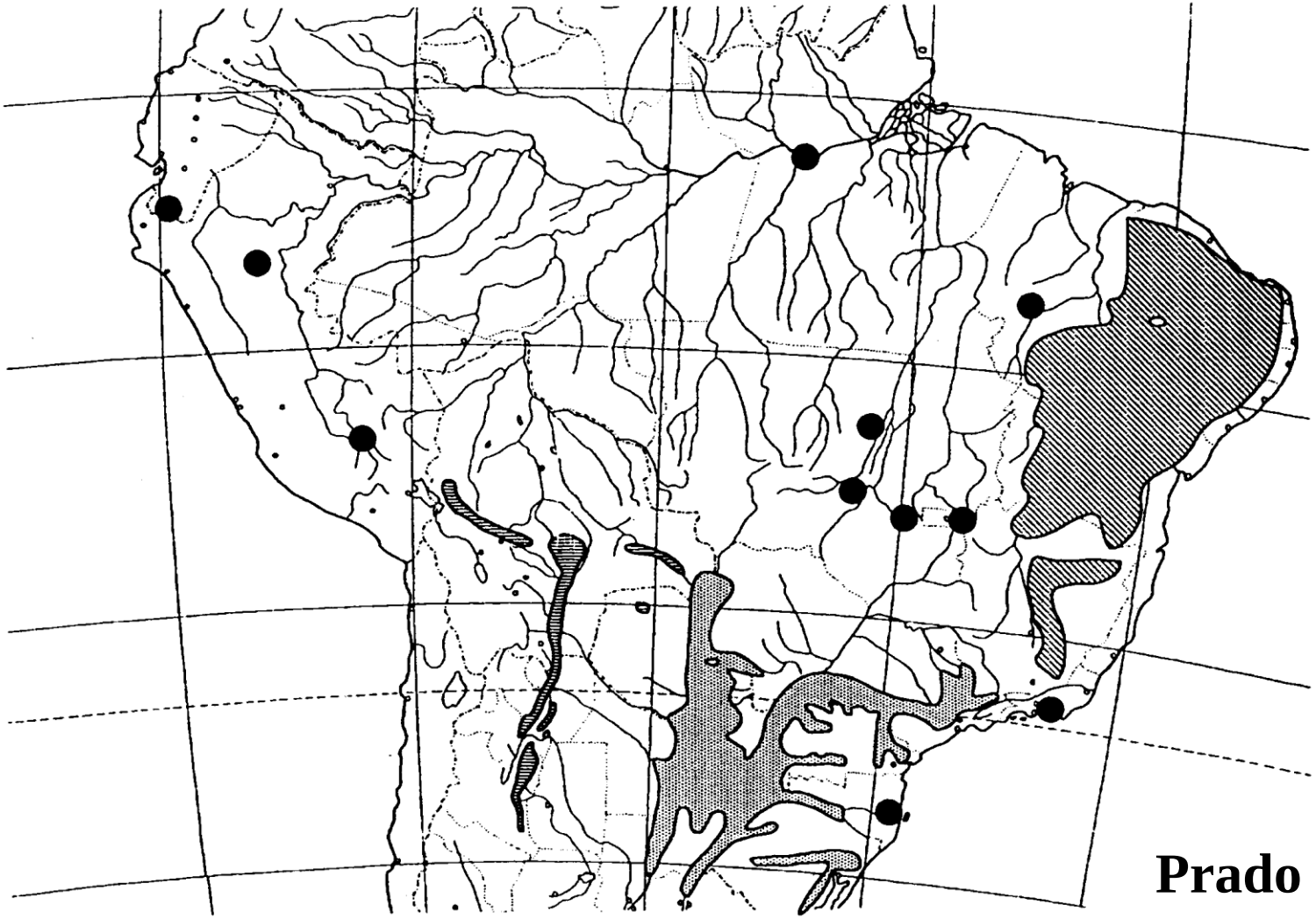
2 <u>zonas de transição</u> entre as regiões Neotropical e Austral.

O quê as caracteriza?

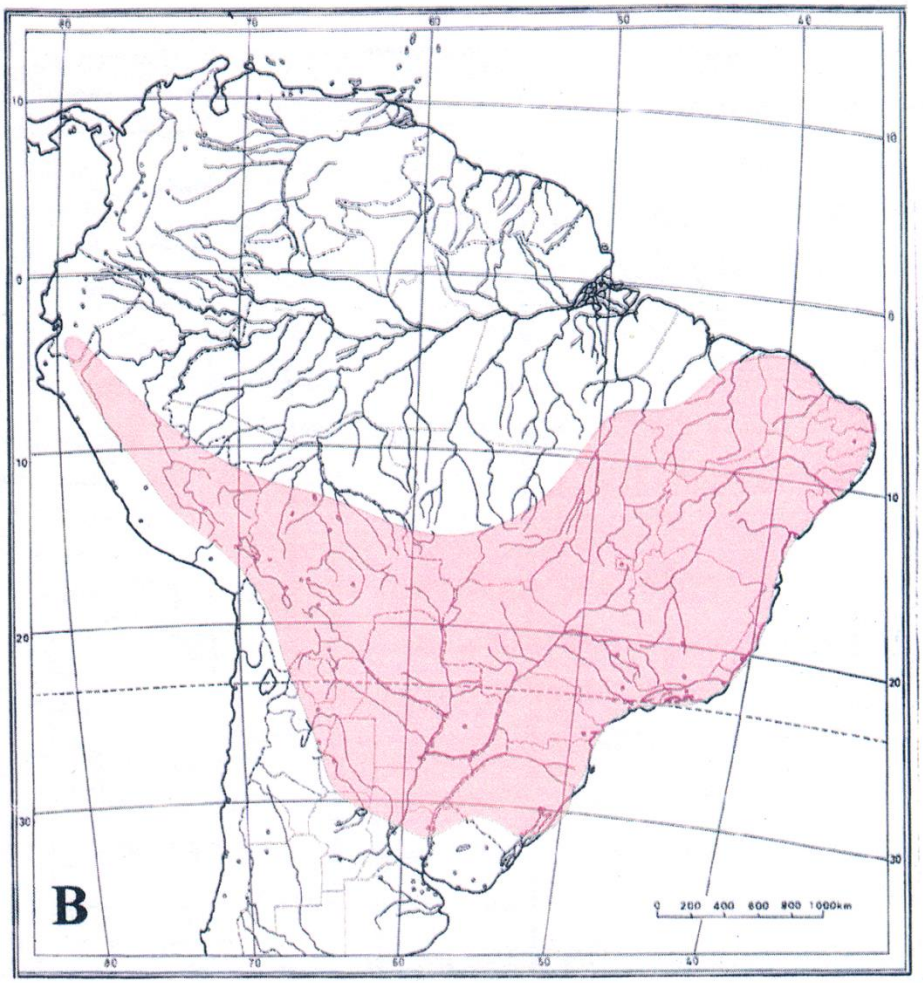


Location and extension of the phytogeographical Region of Guiana. **E**. Eastern Guayana Province; **C**. Central Guayana Province; **P**. Pantepui Province; **W**. Western Guayana Province.

Huber 1994



Tentative mapping of the new **Tropical Seasonal Forests Region of South America**. Oblique hatching: the Caatingas province *sensu lato*; stippled: the Paranense province *sensu auctor*; horizontal hatching: the Subandean Piedmont Forests province. □: areas with enigmatic concentration of collections that cannot be safely ascribed to the region with the present knowledge of their vegetation.



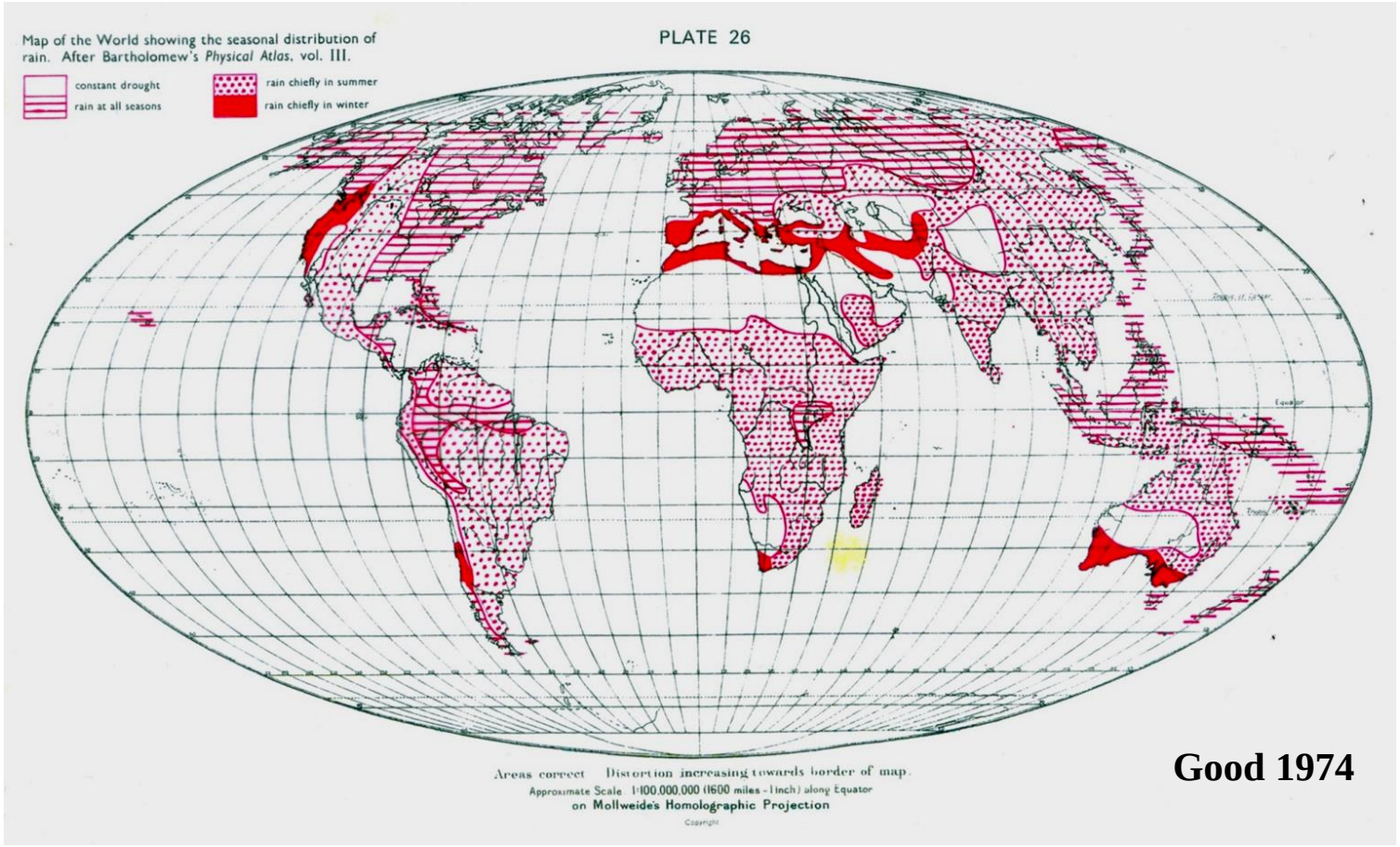
A- Principal padrão generalizado de distribuição sugerido por Prado & Gibbs (1993) para as espécies das **florestas secas** da América do Sul;

B- Padrão de distribuição de todos os **gêneros de hábito tuberoso da tribo Spathicarpeae.**

Gonçalves 2002

Relevância do Provincialismo e Endemismo:

Padrões de provincialismo seriam muito diversos dos atuais caso a distribuição dos organismos fosse limitada só por fatores ecológicos. Táxons seriam encontrados pelo mundo em áreas de clima, solo e topografia semelhantes, em vez de ocuparem vários regimes ecológicos numa só área.

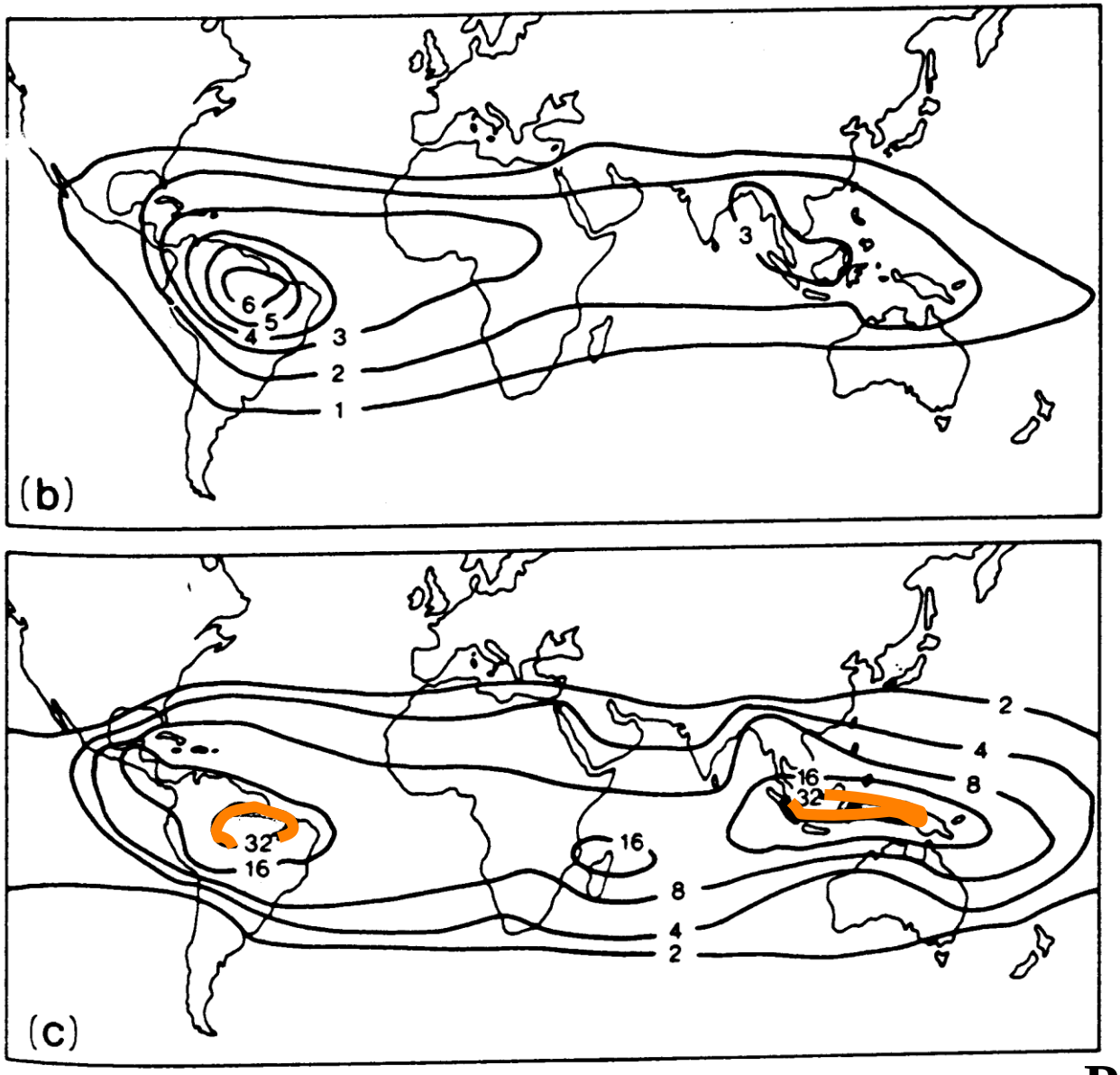


Good 1974

Relevância do Provincialismo e Endemismo:

Padrões de provincialismo seriam muito diversos dos atuais caso a distribuição dos organismos fosse limitada só por fatores ecológicos. Táxons seriam encontrados pelo mundo em áreas de clima, solo e topografia semelhantes, em vez de ocuparem vários regimes ecológicos numa só área.

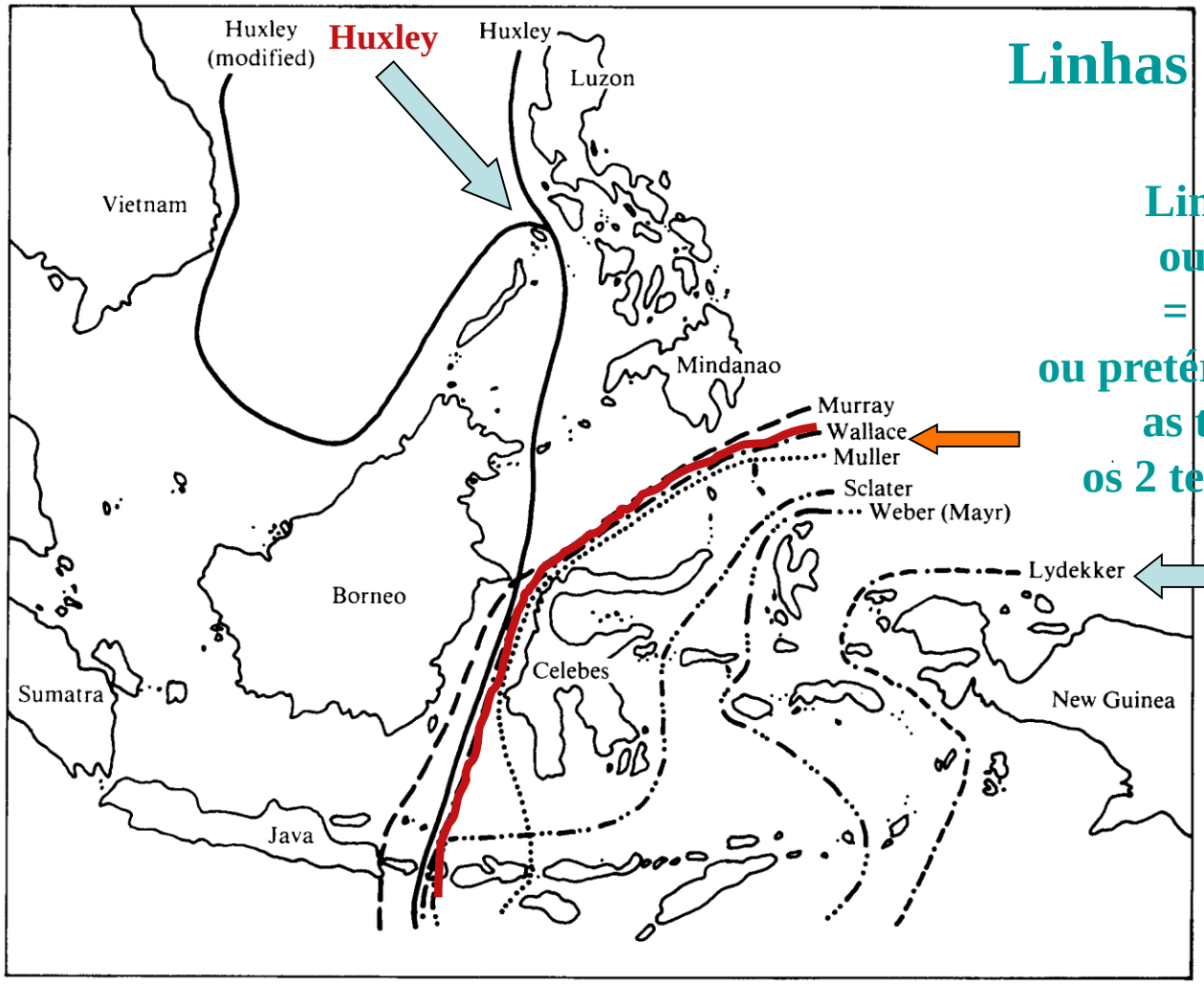
Famílias cosmopolitas são raras e mesmo famílias circuntropicias (Palmae), claramente limitadas pelo frio, mostram endemismo intra-familiar nos vários continentes.
10% das famílias de angiospermas e de vertebrados são pantropicais, mas explicações históricas são necessária para os padrões de endemismo dentre elas.
Exemplos:
isolinhas de densidade taxonômica em Palmae e Crocodilia (Pielou 1979)



Pielou 1979

Centers of origin of *(b)* species of Crocodilia: (c) **genera of palms (Palmae)**. The isopleths join points of equal taxon density. (Adapted from Stehli, 1968).

Linhas Biogeográficas



Limites entre 2 regiões ou províncias maiores = barreiras presentes ou pretéritas limitam(aram) as trocas bióticas entre os 2 territórios adjacentes

Lydekker

Brown & Gibson 1983

Various lines drawn by zoogeographers to define the boundaries between the Oriental and Australasian biotas. The multiplicity of lines reflects the fact that different taxa have managed to penetrate different distances from their continent of origin into the islands of the East Indies. The only two lines that appear to have general significance are Lydekker's and Huxley's (modified), which coincide with the limits of the continental shelves and consequently indicate regions that were largely above water during past periods of lower sea levels. (After Simpson, 1977.)

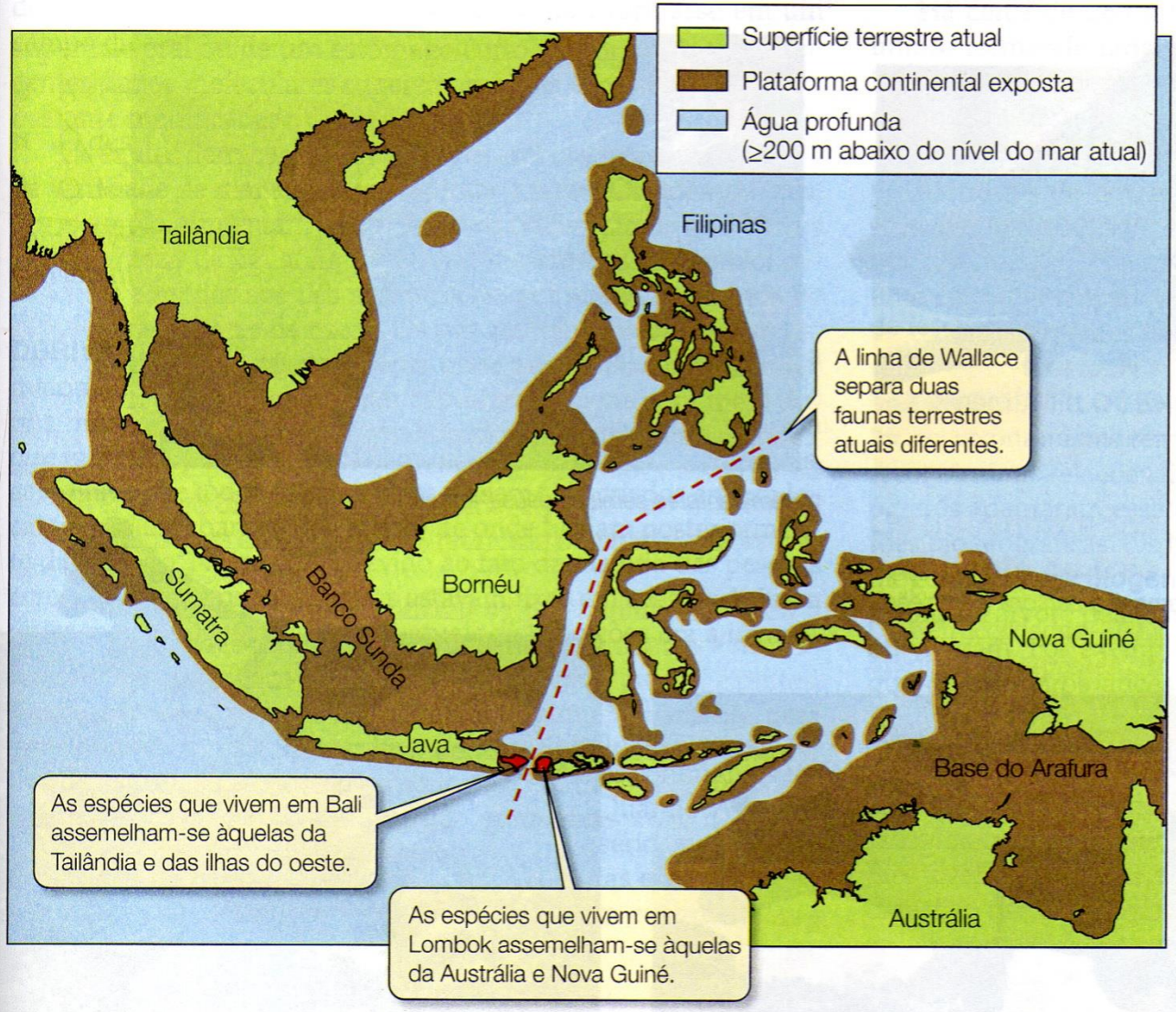
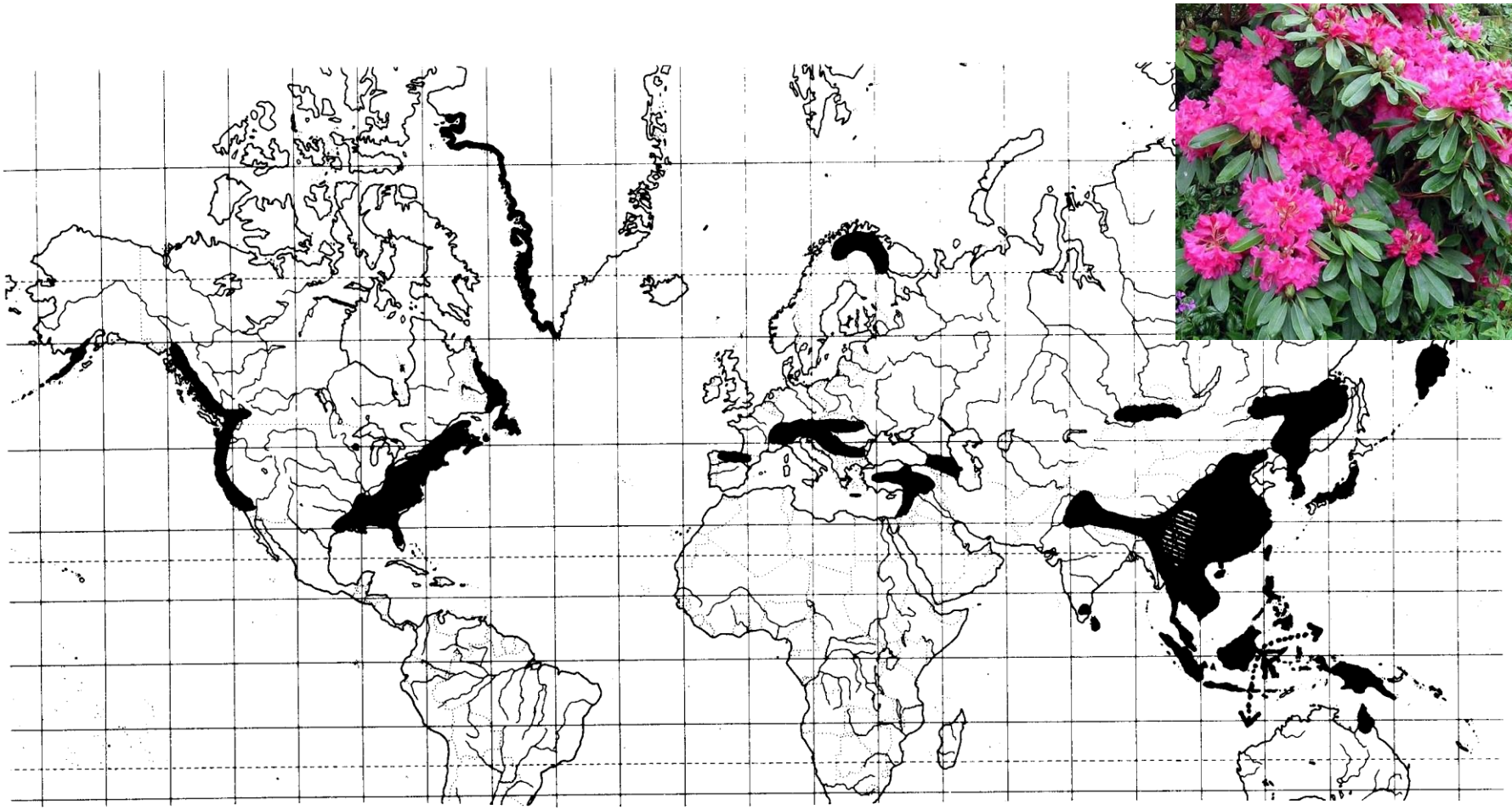


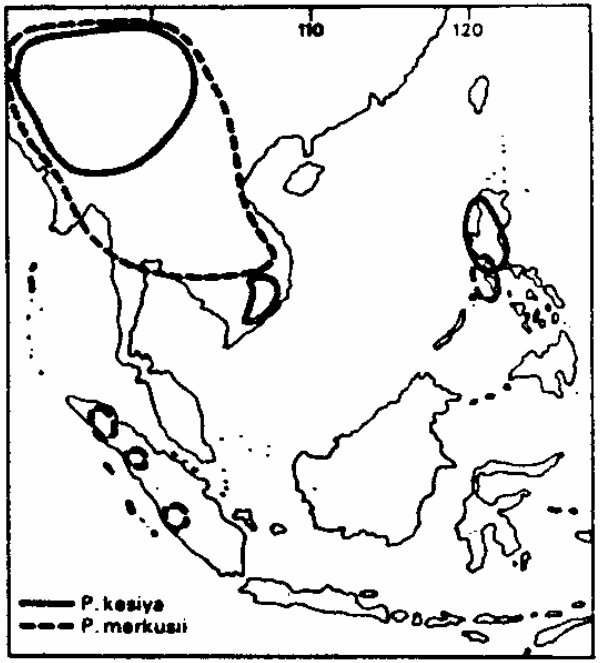
Figura 34.7 O Arquipélago Malai durante o máximo glacial mais recente A linha de Wallace, que divide duas regiões geográficas dist tas, corresponde ao canal de águas profundas entre as ilhas de Bali e Lombok. Este canal é suficientemer profundo para ter bloqueado o mov mento de seres vivos terrestres mes mo durante as glaciações do Pleisto ceno, quando o nível do mar era 10 metros mais baixo do que hoje.

Sadava et al. 2009

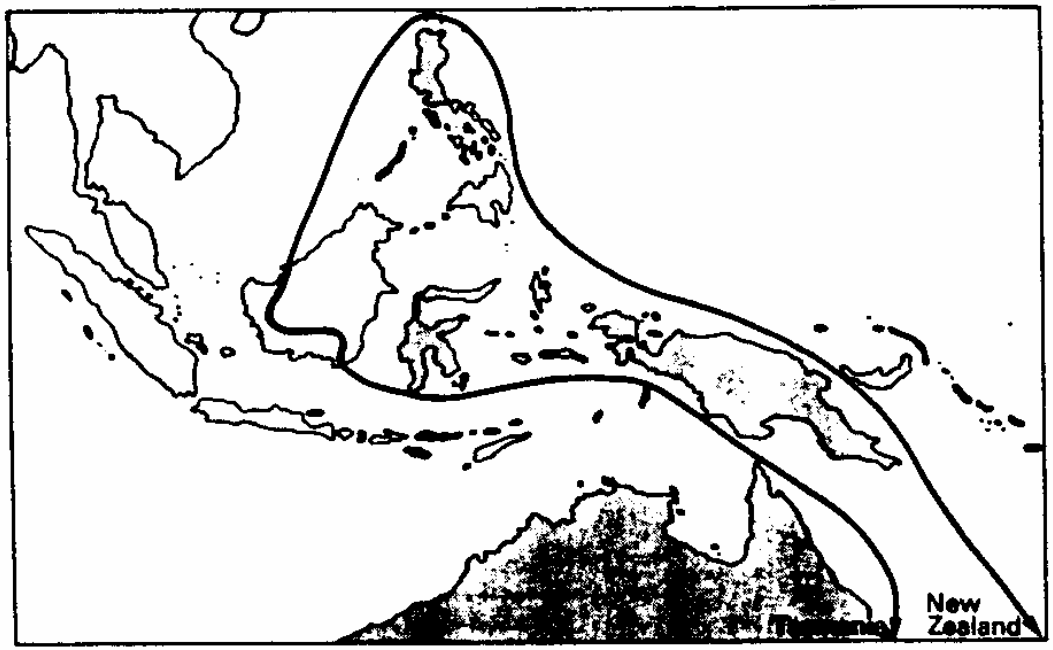


Total range of ***Rhododendron*** (Ericaceae), illustrating the basically Laurasian range with rapid extension (and subsequent speciation) west of Wallace's line (dotted arrows), especially in upland New Guinea, after the uplift (in the last 1-3 million years) of the last island. Only isolated taxa reach Australia and the Solomon Islands. (Range showing late Tertiary and Pleistocene contraction: R. *pont/cum,* now in southern Europe, was in Tertiary times in Britain.)

Schuster in Beck (1976)

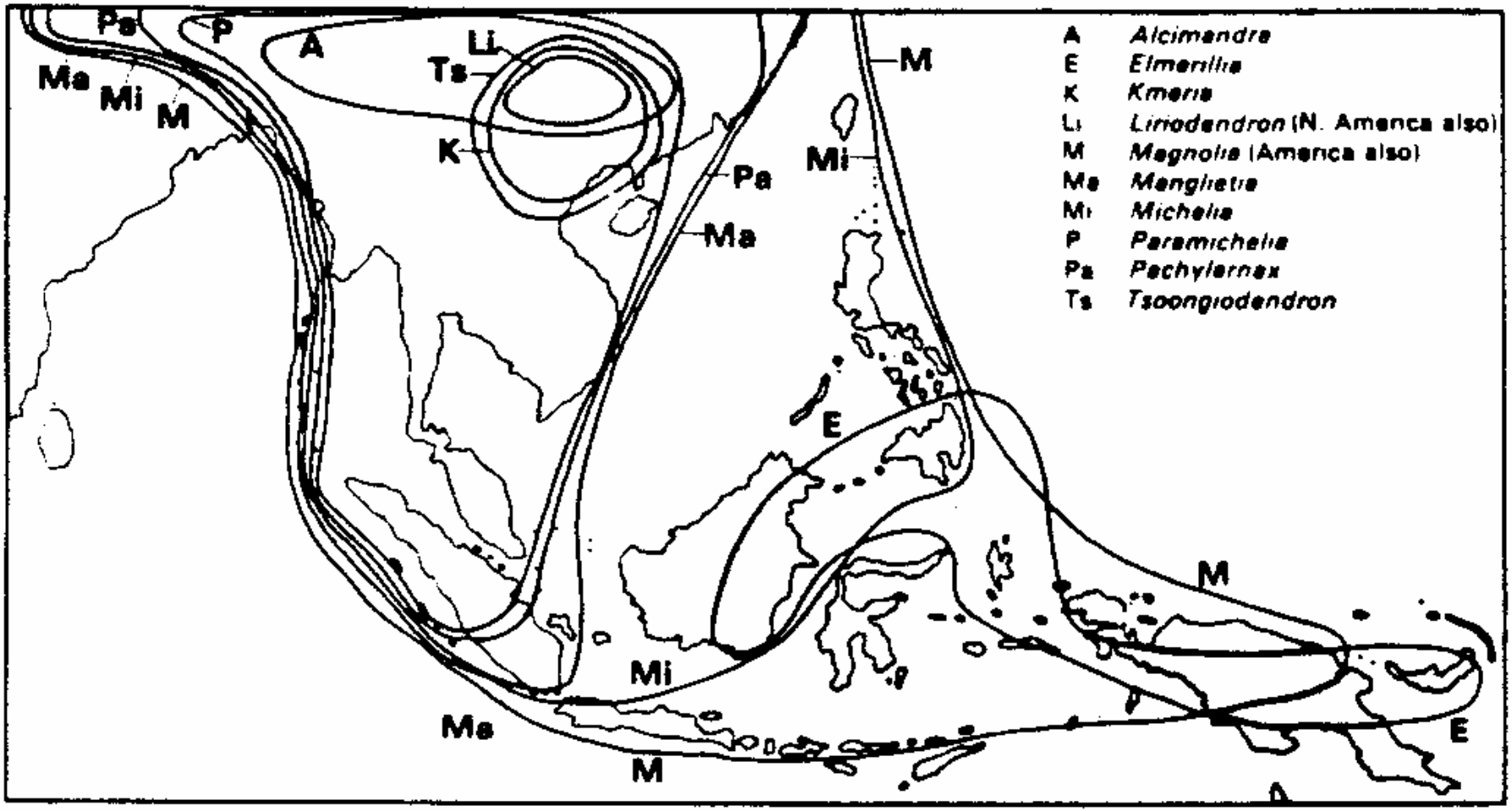


***Pinus* in Malesia**



The range of *Phyllocladus*, Podocarpaceae

Whitmore 1981



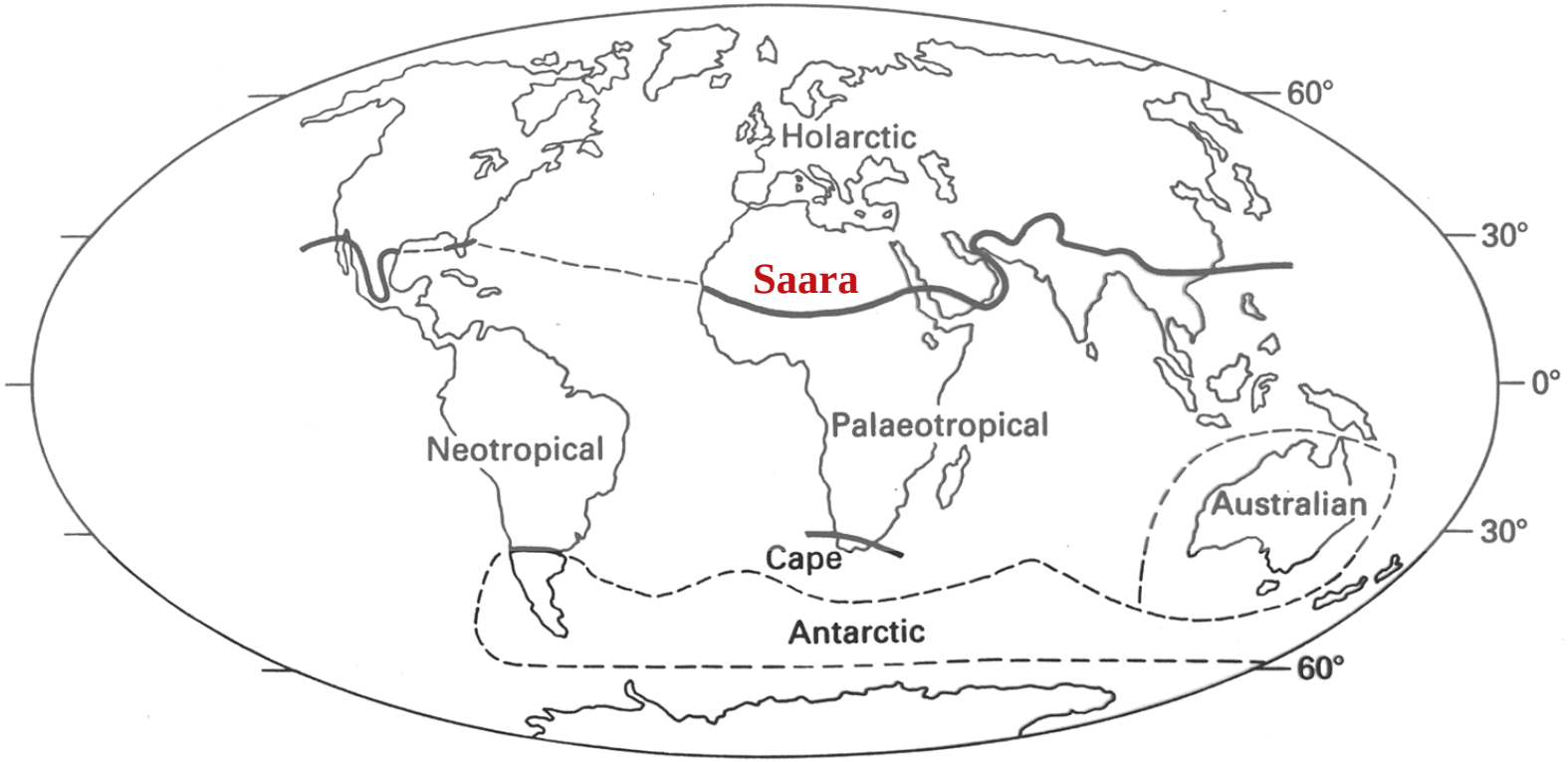
The ranges of the genera of Magnoliaceae in Malesia and southeast Asia

Whitmore 1981

Linhas Biogeográficas

Limites entre 2 regiões
ou províncias maiores
= barreiras presentes
ou pretéritas limitam(aram)
as trocas bióticas entre
os 2 territórios adjacentes

Saara: linha biogeográfica
separando Reinos Holártico e Paleotropical
(ou Paleártico de Etiópico na zoogeografia)



Reinos biogeográficos do mundo - Takhtajan 1986

in Churchill et al. 1995

GRADY L. WEBSTER

FIGURE 4. Northward extent of spread of Gondwana genera in tropical America.

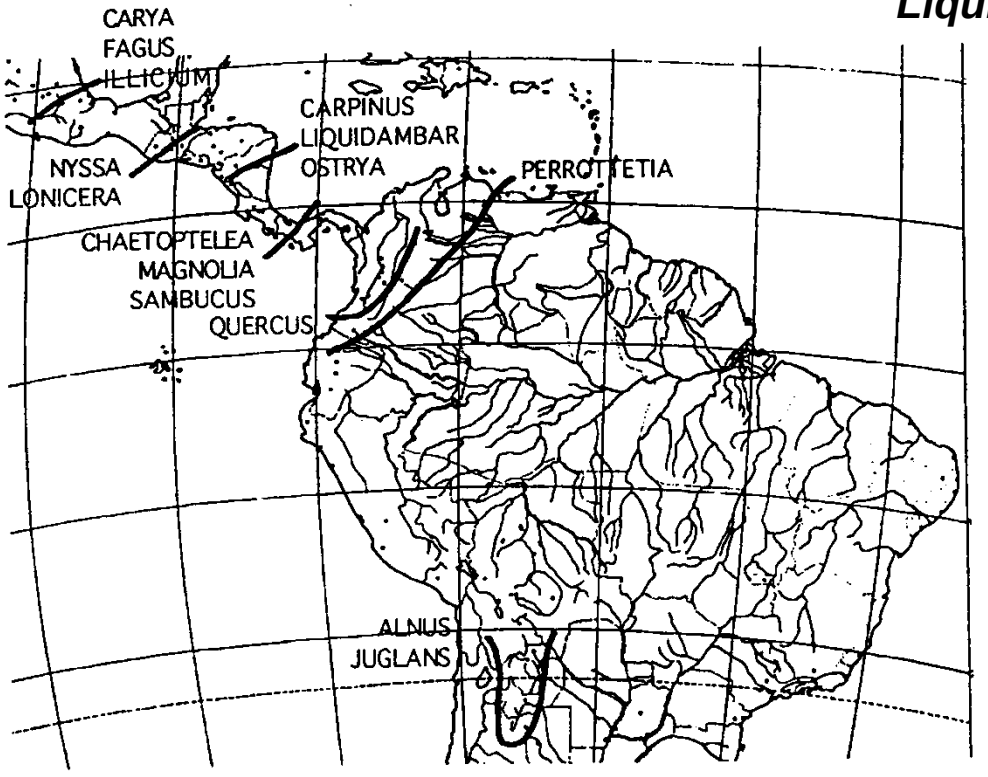


FIGURE 3. Southward extent of spread of Holarctic genera in tropical America.

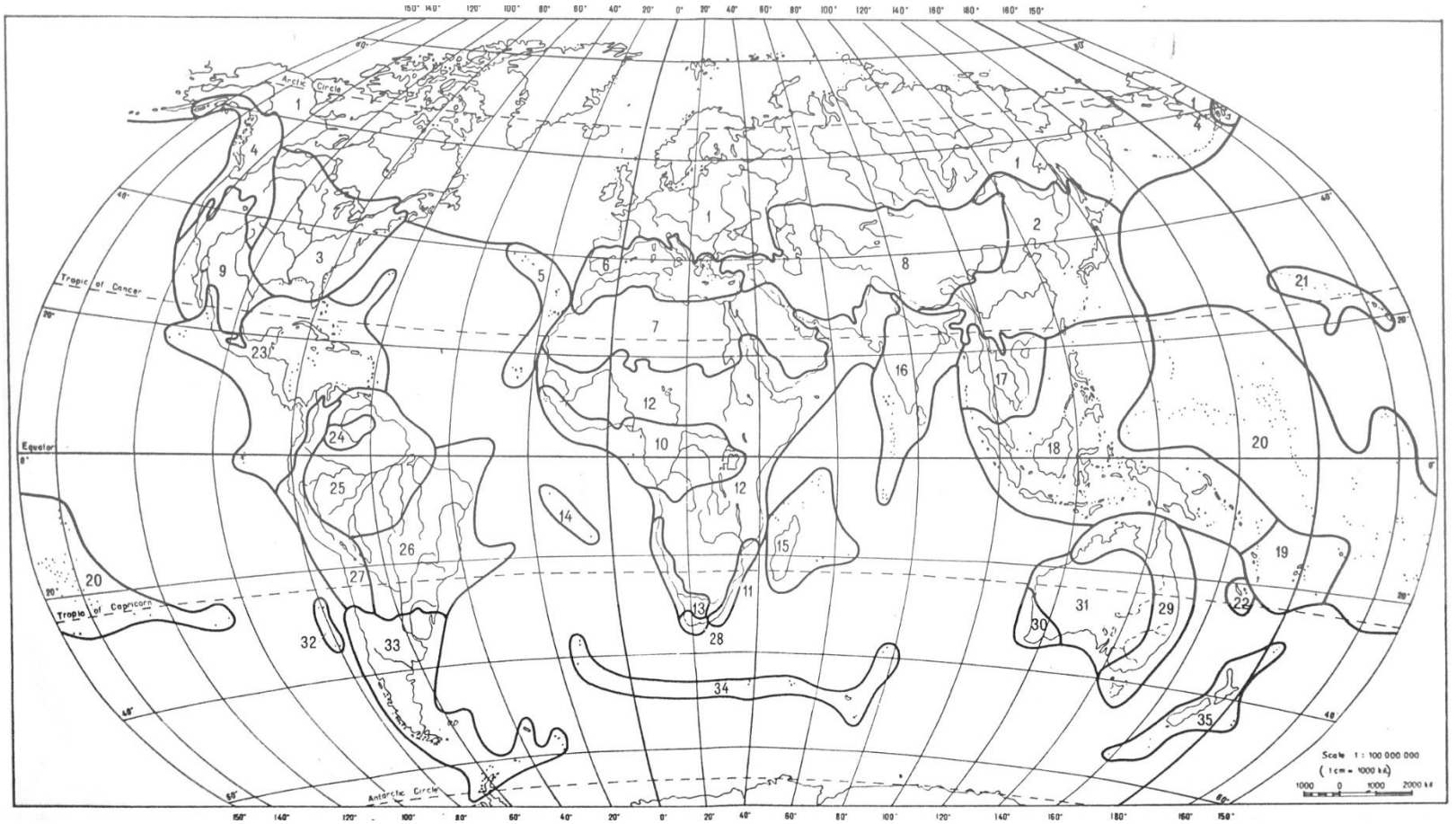
Linha separando Holártico de Neotropical

não é bem distinta, nem corresponde à barreira marinha pretérita que separava 2 continentes no K e maior parte do Cenozóico.

Atualmente o limite desses 2 reinos biogrogr. é influenciado primariamente por fatores de habitat e climáticos.

América Central tem mistura de floras: Floresta temperada estende-se para o sul no México (nas montanhas) – *Liquidambar e Pinus* alcançam a Nicarágua; *Alnus, Juglans, Salix e Quercus* vão até os Andes.

Webster in Churchill et al. 1995



FLORISTIC REGIONS OF THE WORLD

Takhtajan 1986

1, Circumboreal Region. 2, Eastern Asiatic Region. 3, North American Atlantic Region. 4, Rocky Mountain Region. 5, Macaronesian Region. 6, Mediterranean Region. 7. Saharo-Arabian Region. 8, Irano-Turanian Region. 9, Madrean Region. 10, Guineo-Congolian Region. 11, Uzambara-Zululand Region. 12, Sudano-Zambezian Region. 13, Karoo-Namib Region. 14, St. Helena and ascension Region. 15, Madagascan Region. 16, Indian Region. 17, Indochinese Region. 18, Malesian Region. 19, Fijian Region. 20, Polynesian Region. 21, Hawaiian Region. 22, Neocaledonian Region. 23, Caribbean Region. 24, Region of the Guayana Highlands. 25, Amazonian Region. 26, Brazilian Region. 27, Andean Region. 28, Cape Region. 29, Northeast Australian Region. 30, Southwest Australian Region. 31, Central Australian or Eremaean Region. 32, Fernándezian Region. 33, Chile-Patagonian Region. 34, Region of the South Subantarctic Islands. 35, Neozeylandic Region.

Phylogenetic classification of the world's tropical forests

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Modern phylogenies, in combination with broad coverage of species inventory data, now allow for global biogeographic analyses that take species evolutionary distance into account. Here we present a classification of the world's tropical forests based on their phylogenetic similarity.

We identify five principal floristic regions and their floristic relationships: (i) Indo-Pacific, (ii) Subtropical, (iii) African, (iv) American, and (v) Dry forests.

Our results do not support the traditional neo- versus paleotropical forest division but instead separate the combined American and African forests from their Indo-Pacific counterparts.

We also find indications for the existence of a global dry forest region, with representatives in America, Africa, Madagascar, and India.

Additionally, a northern-hemisphere Subtropical forest region was identified with representatives in Asia and America, providing support for a link between Asian and American northernhemisphere forests.

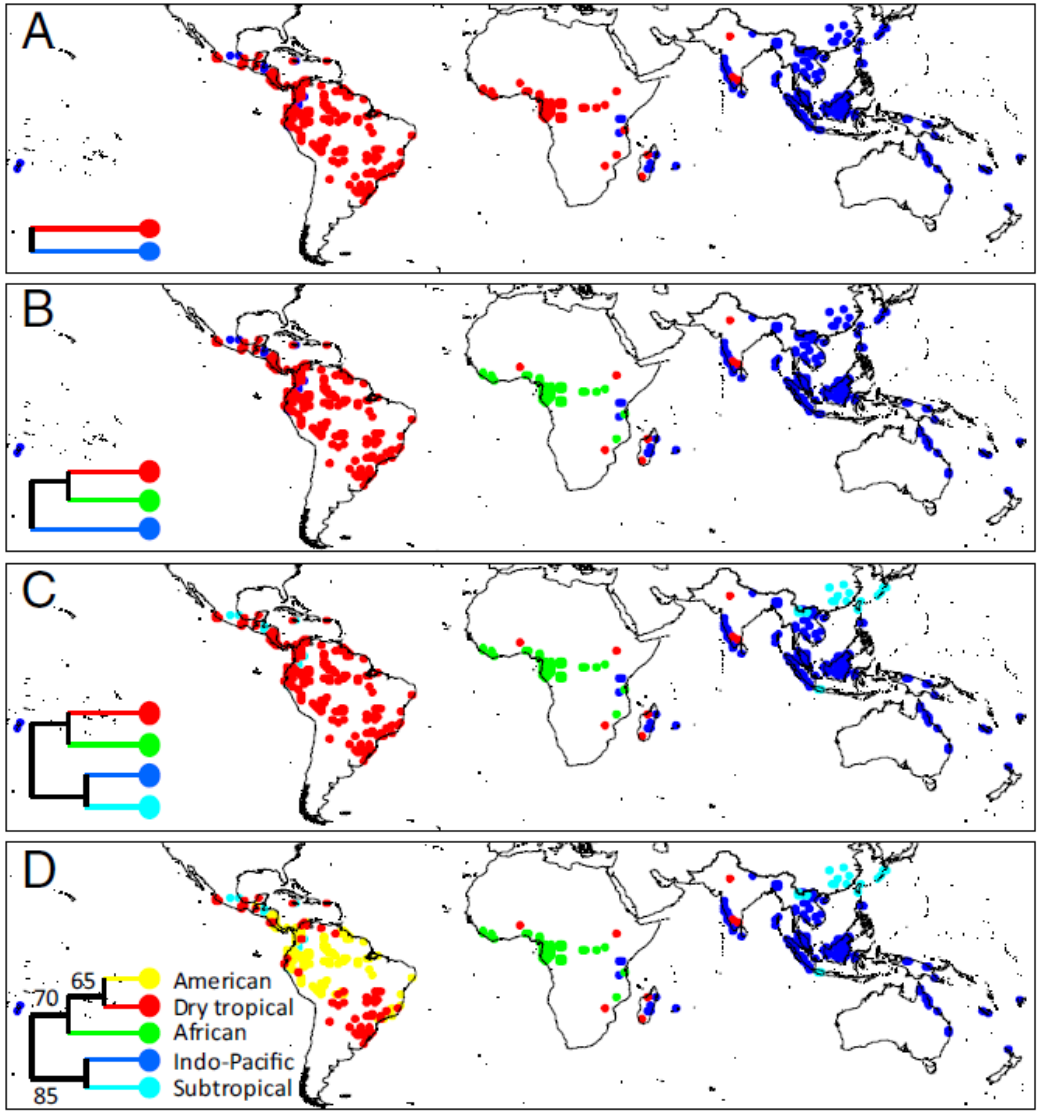
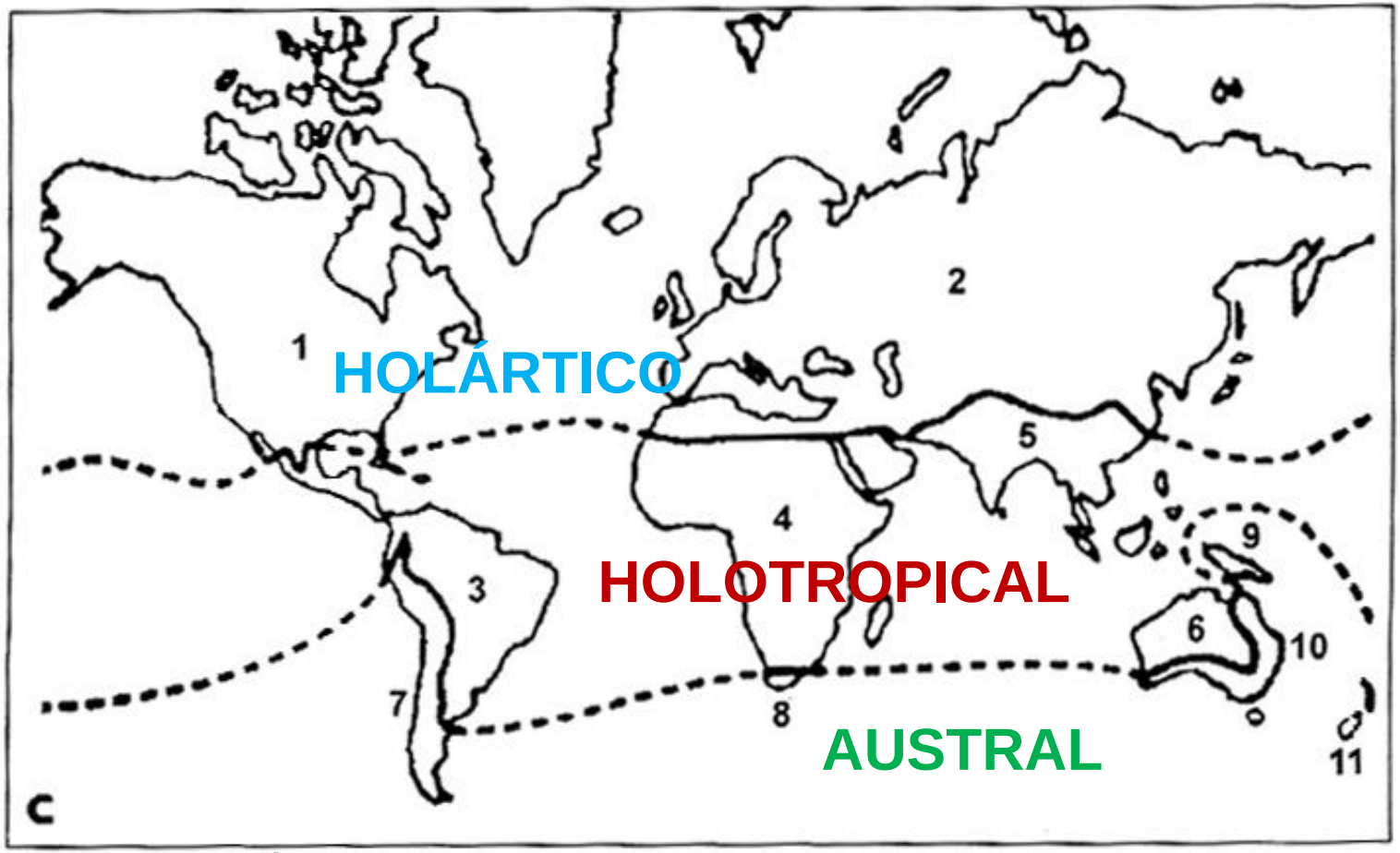


Fig. 1. Classification maps of the world's tropical forests, showing two (*A*), three (*B*), four (*C*), and five (*D*) clusters. Cluster result represents a majority rule consensus tree, with the percentage of times that each grouping was observed in the 20 separate cluster analyses shown in *D*. Only locations that could be classified with certainty ($P < 0.05$) are shown ($n = 392$).



Reinos biogeográficos e suas regiões, segundo Morrone (2002, 2009):

Reino HOLÁRTICO (= Laurásia) – regiões 1-Neártica e 2-Paleártica.

Reino HOLOTROPICAL (= Gonduana Oriental) – regiões 3-Neotropical, 4-Afrotropical, 5-Oriental, a 6-Australiana Tropical.

Reino AUSTRAL (= Gonduana Ocidental) – regiões 7-Andina, 8-Capense, 9-Novaguineana, 10-Australiana Temperada, 11-Neozelandesa.

(Subdivisões das Regiões Neotropical e Andina: ver Morrone 2014 e 2015)