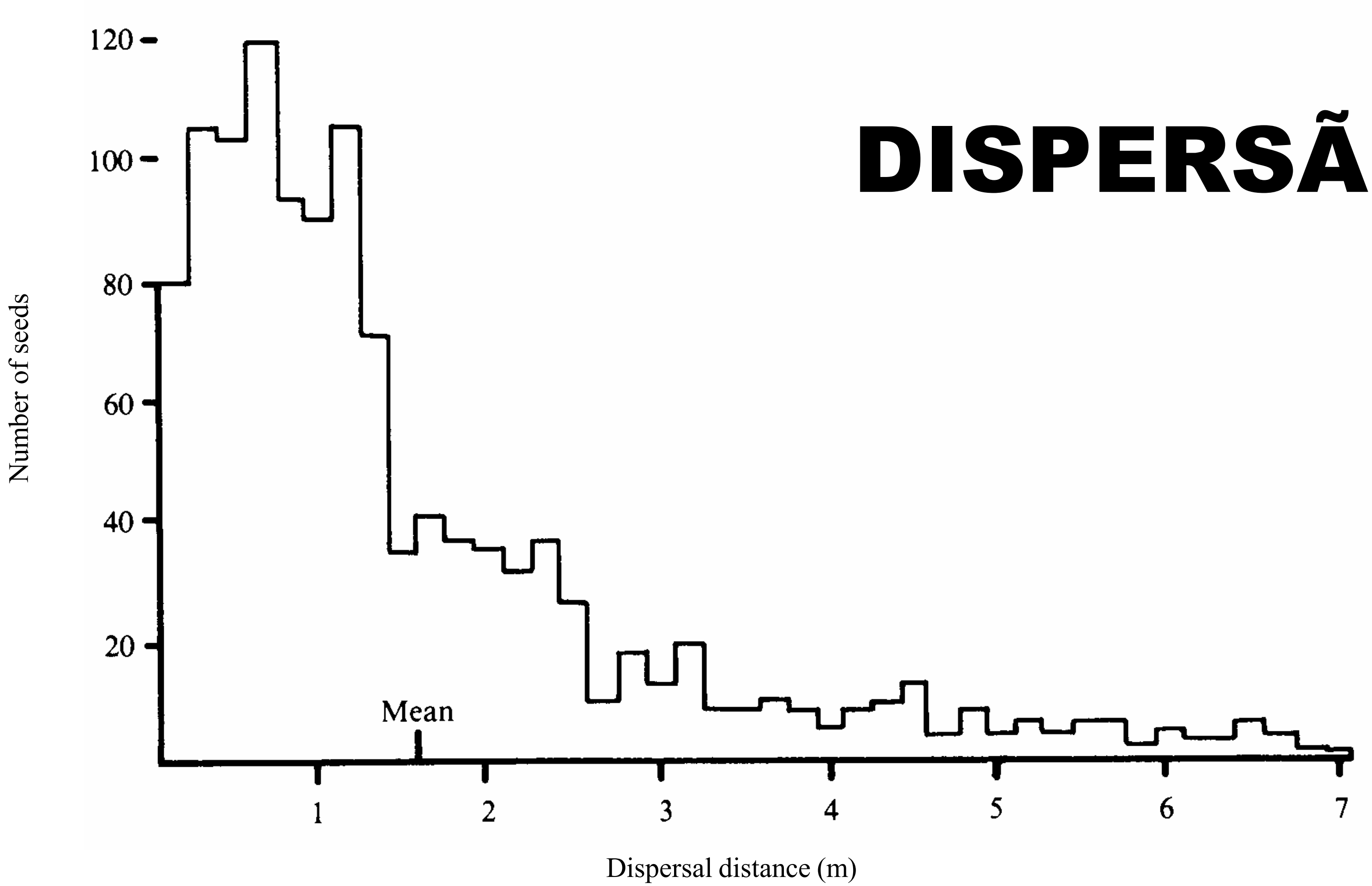
DISPERSÃO



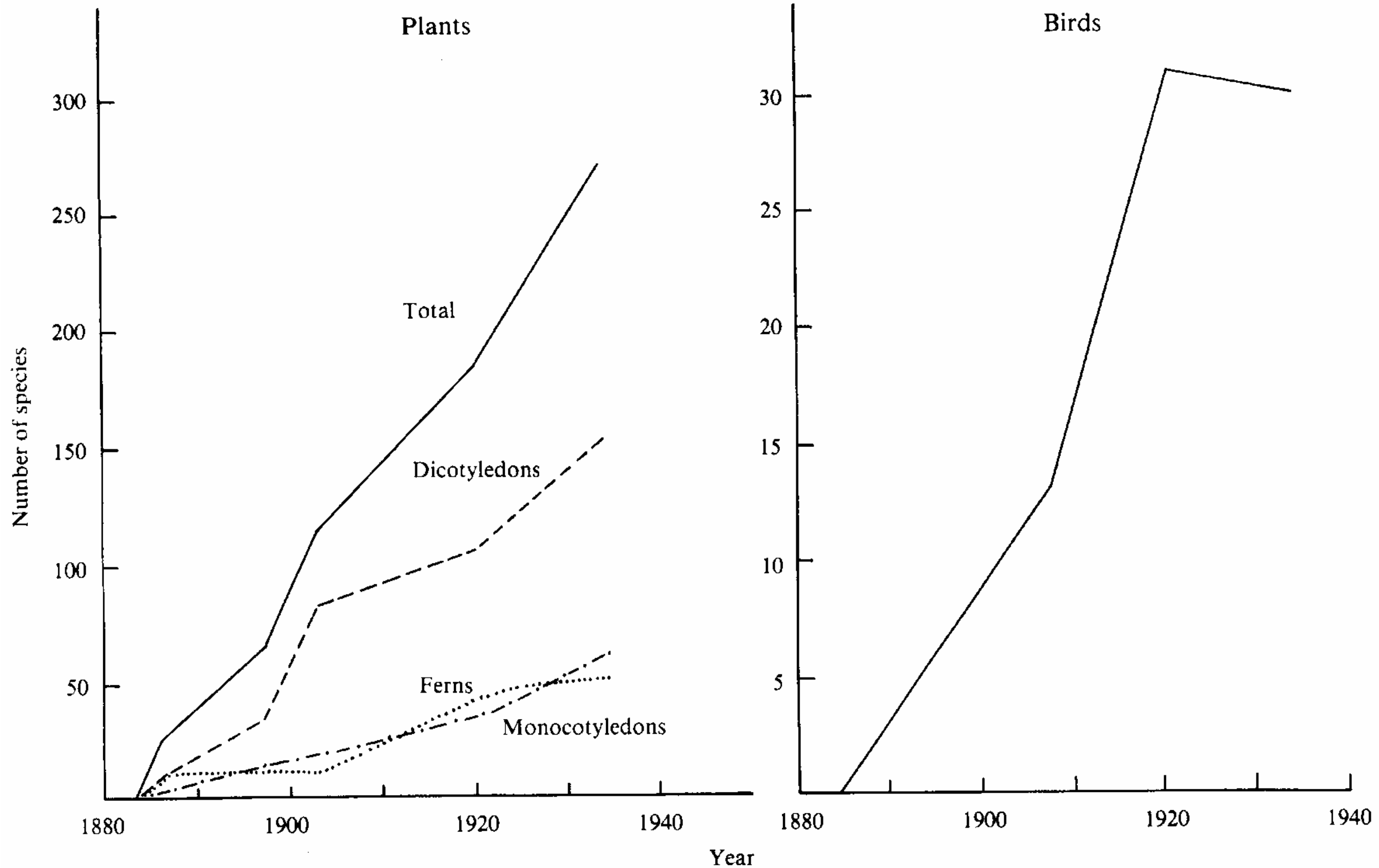
Frequency distribution of seeds (achenes) of the composite ***Liatris cylindracea*** (Asteraceae) showing the distance traveled from the parent plant. This is a typical pattern for dispersal of seeds and other passively transported disseminules; most end up very near the source, but the distribution is highly leptokurtic and a few are carried long distances. (After Schaal and Levin, 1978.)

DISPERSÃO

Dispersão predizível (Ronquist 1997) =
dispersão por difusão (Brown & Lomolino 1998)
Processo ecológico

Dispersão ao acaso = dispersão a longa distância
Processo histórico biogeográfico.

Evidência abundante de dispersão de táxons além de barreiras:
Galápagos (800 km do Equador!)
Havaí (4.000 km do México!)



Rapid recolonization of the island of Krakatau by plants *(left)* and birds *(right)* that had dispersed successfully across the ocean. All life on the island was destroyed by a volcanic eruption in 1883, and several biological surveys recorded the colonizing species, which had probably traveled across at least 40 km of ocean. (After MacArthur and Wilson, 1967.)

TABELA 34.1 Número de espécies de aves terrestres residentes em Krakatoa

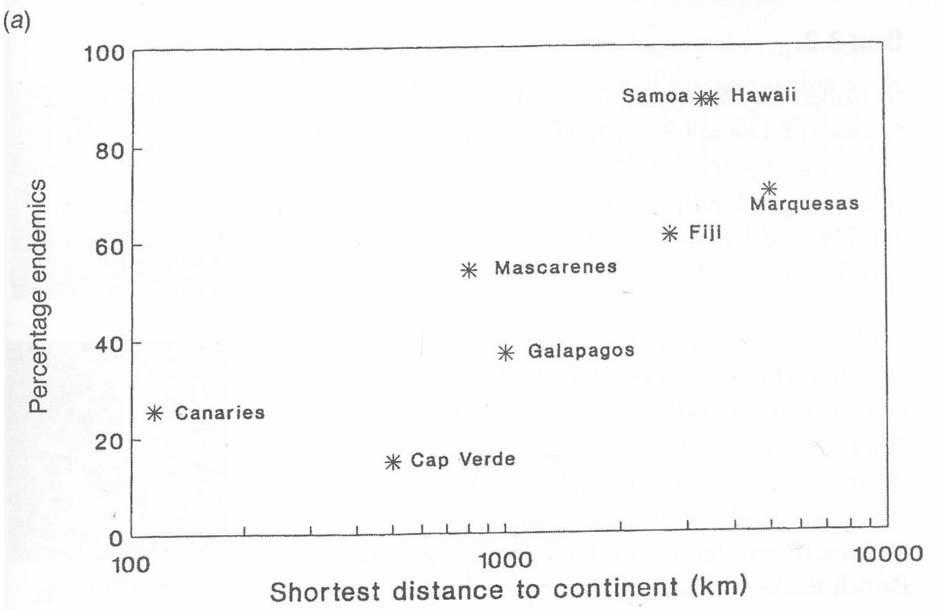
PERÍODO	NÚMERO DE ESPÉCIES	EXTINÇÕES	COLONIZAÇÕES
1908	13		
1908 a 1919		2	17
1919 a 1921	28		
1921 a 1933		3	4
1933 a 1934	29		
1934 a 1951		3	7
1951	33		
1952 a 1984		4	7
1984 a 1996	36		

Sadava et al. 2009

Altas taxas de endemismo em ilhas

Distância do continente

Dimensões dos diásporos



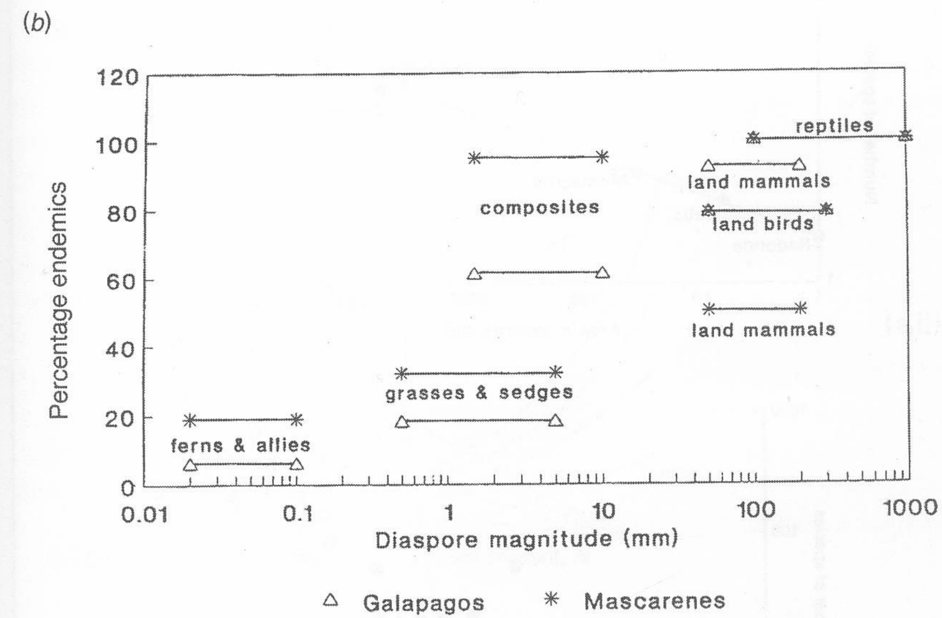
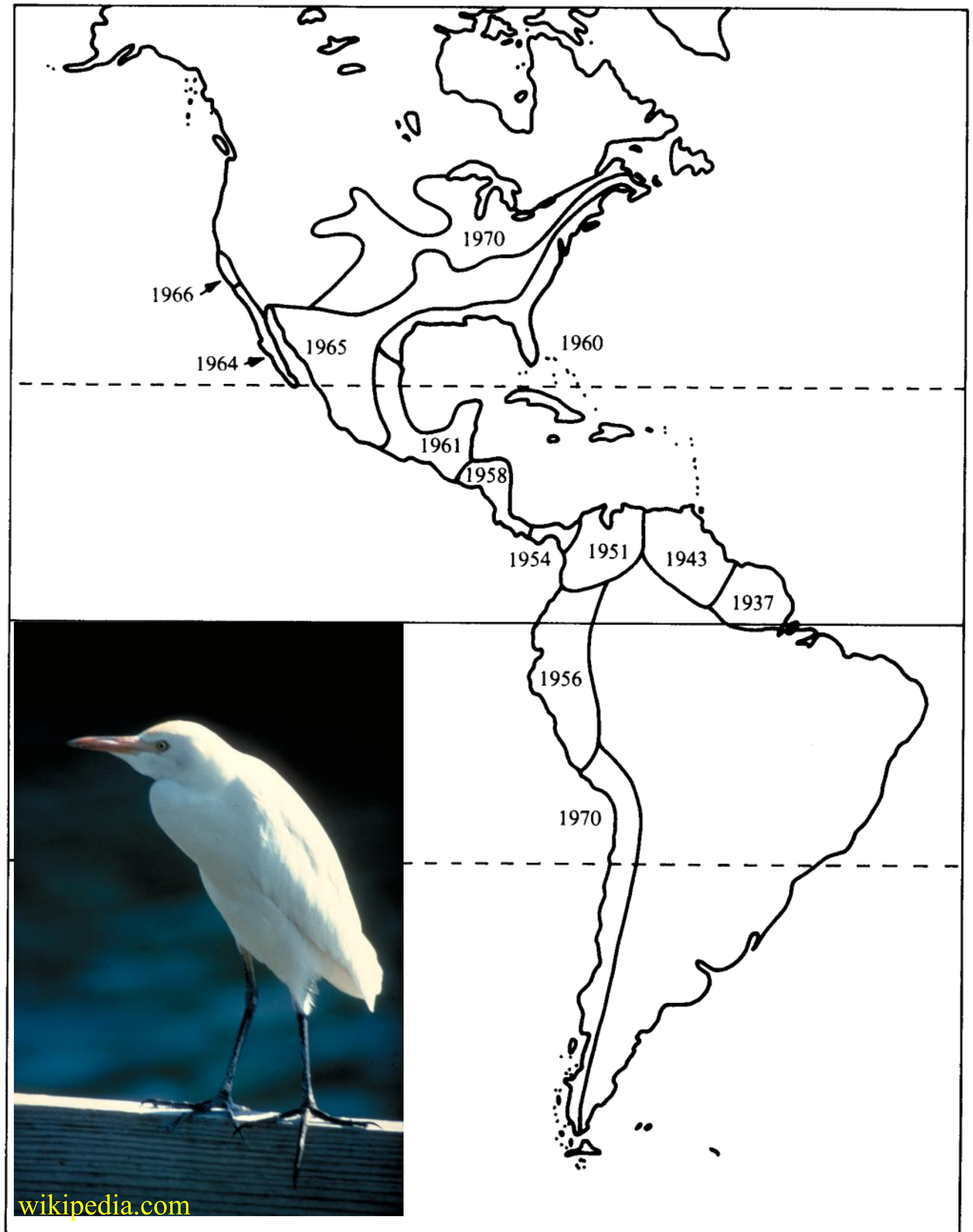


Fig. 3.6. Levels of endemism on islands and (*a*) distance to closest continent and (*b*) diaspore magnitude. (From Adsersen, H. 1995, *Research on Islands: Classic, Recent, and Prospective Approaches*, pp. 7–22. In Vitousek, P. M., Loope, L. L. & Adsersen, H. (eds.), Springer-Verlag, Berling. Material used with kind permission of the Author and Springer-Verlag, New York.)

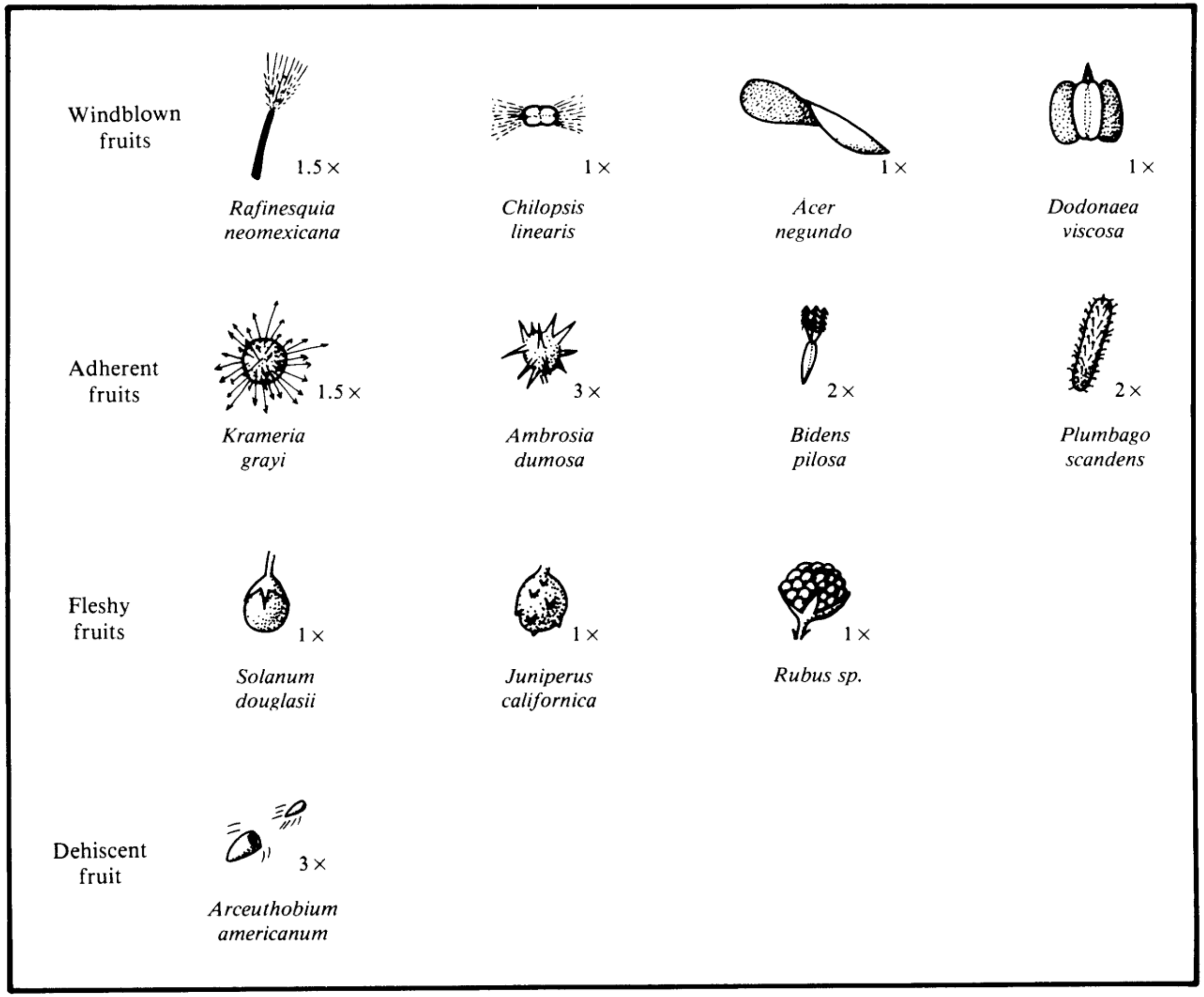
Spellerberg & Sawyer 1999



Mecanismos de dispersão

Dispersão Ativa:

Colonization of the New World by the cattle egret, ***Bubulcus ibis***. This heron crossed the South Atlantic from Africa under its own power, becoming established in northeastern South America by the late 1800s. From there it dispersed rapidly, and it is now one of the most widespread and abundant herons in the New World. (After Figure II-19 [po 353] from *Ecology and Field Biologyy* second edition, by Robert Leo Smith. Copyright @ 1974- by Robert Leo Smith. Reprinted by permission of Harper & Row, Publishers, Inc.)

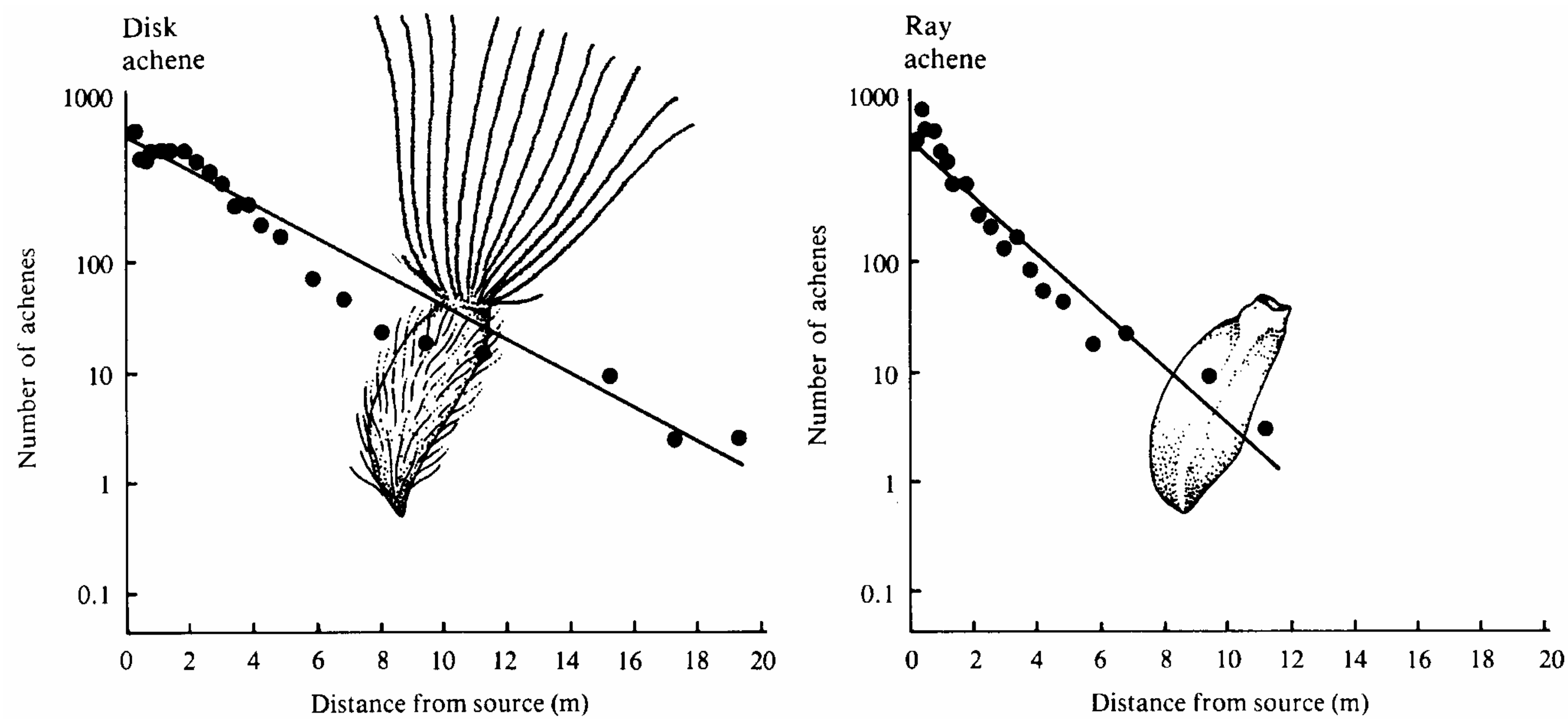


Mecanismos de dispersão

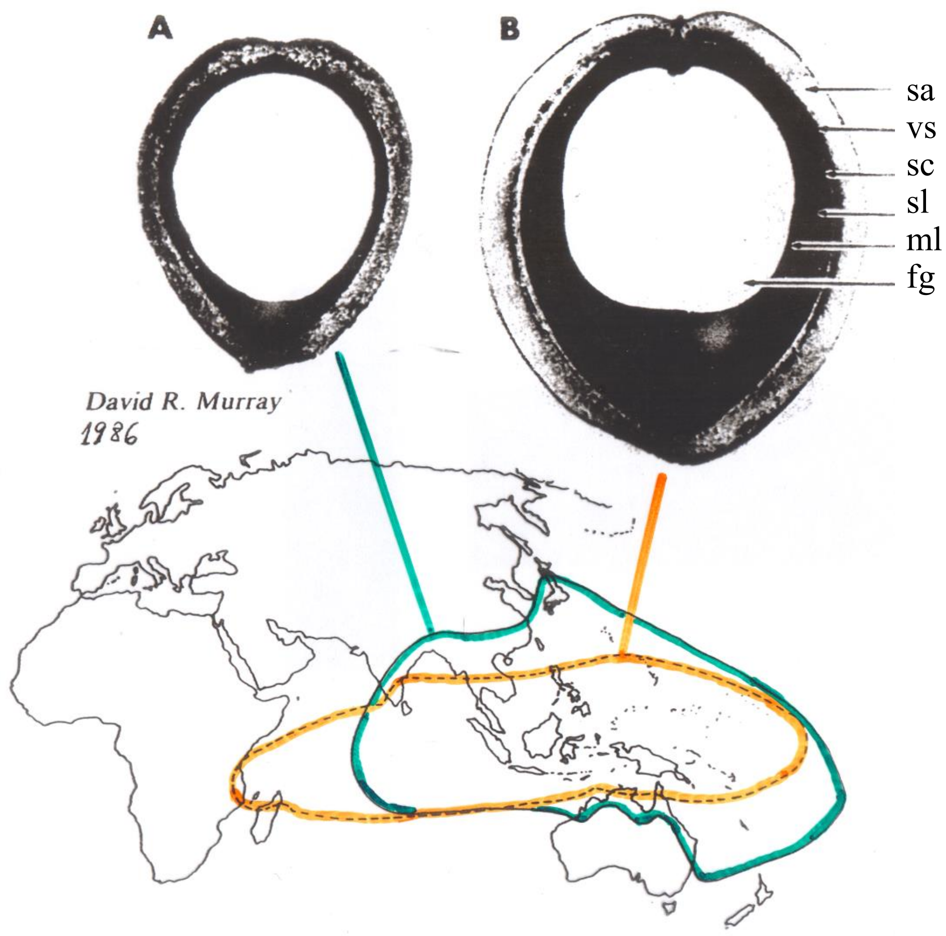
Dispersão Passiva

Variety of diaspores designed to enable seeds to disperse from the mother plant:
Anemocoric wings *(Rafinesquia*, *Chilopsis*, *Acer* and *Dodonaea);*
Epizoocoric *(Krameria*, *Bidens*, *Ambrosia*, *Plumbago);*
Endozoocoric (birds and mammals) *(Solanum*, *Juniperus* and *Rubus).*
In an unusual case, seeds of dwarf mistletoe *(Arceuthobium)* are explosively discharged from a fleshy base.

Brown & Gibson 1983



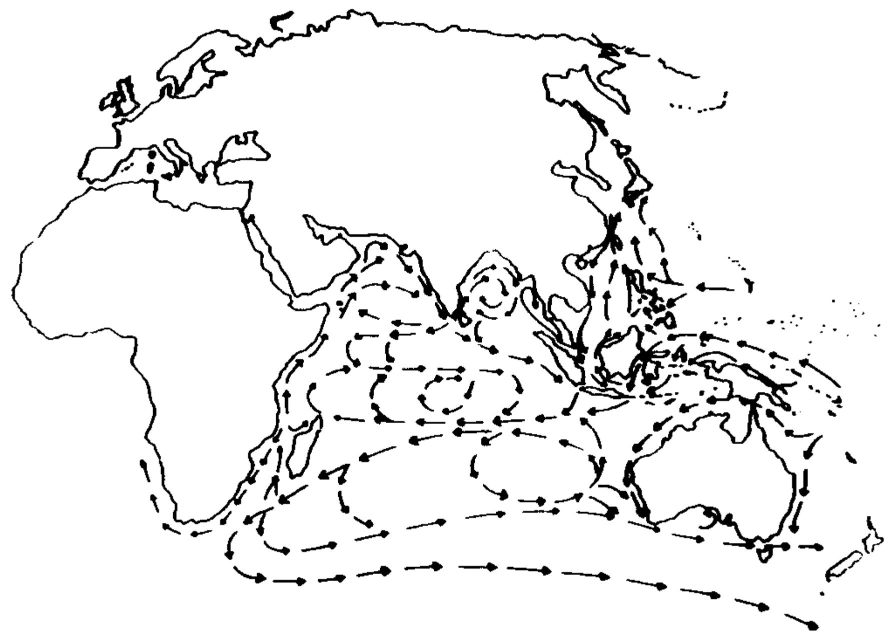
Seed dimorphism in the composite ***Heterotheca latifolia*** affects dispersal distance. This plant produces two kinds of fruits (achenes): disk achenes, which have an attached parachute-like structure that causes them to be carried by wind some distance from the parent, and ray achenes, which lack dispersal IttUctures but have a thicker fruit wall and can survive for longer periods in the soil. (Courtesy L. Venable.) **Brown & Gibson 1983**



Transverse sections of mature seeds of *Cycas revoluta* (A) and *Cycas circillalis* (B). Sarcotesta (sa), vascular bundle in sarcotesta (vs), sclerotesta (sc), spongy layer (sl), membranous layer (ml) and female gametophyte tissue (fg) are all present in *C. circinalis* (B), but note the absence of the spongy layer in *C. revoluta* (A). The sclerotesta is so hard that it was necessary to use a jeweller's saw to obtain the sections. Bar = 1 cm.

Hidrocoria

Distribution of the genus Cycas. Species with mature seeds capable of floating are distributed within the dashed line; other species are found within the solid line.



Major currents in the Indian Ocean

Dehgan & Yuen, 1983

Hidrocoria

S30 INTERNATIONAL JOURNAL OF PLANT SCIENCES

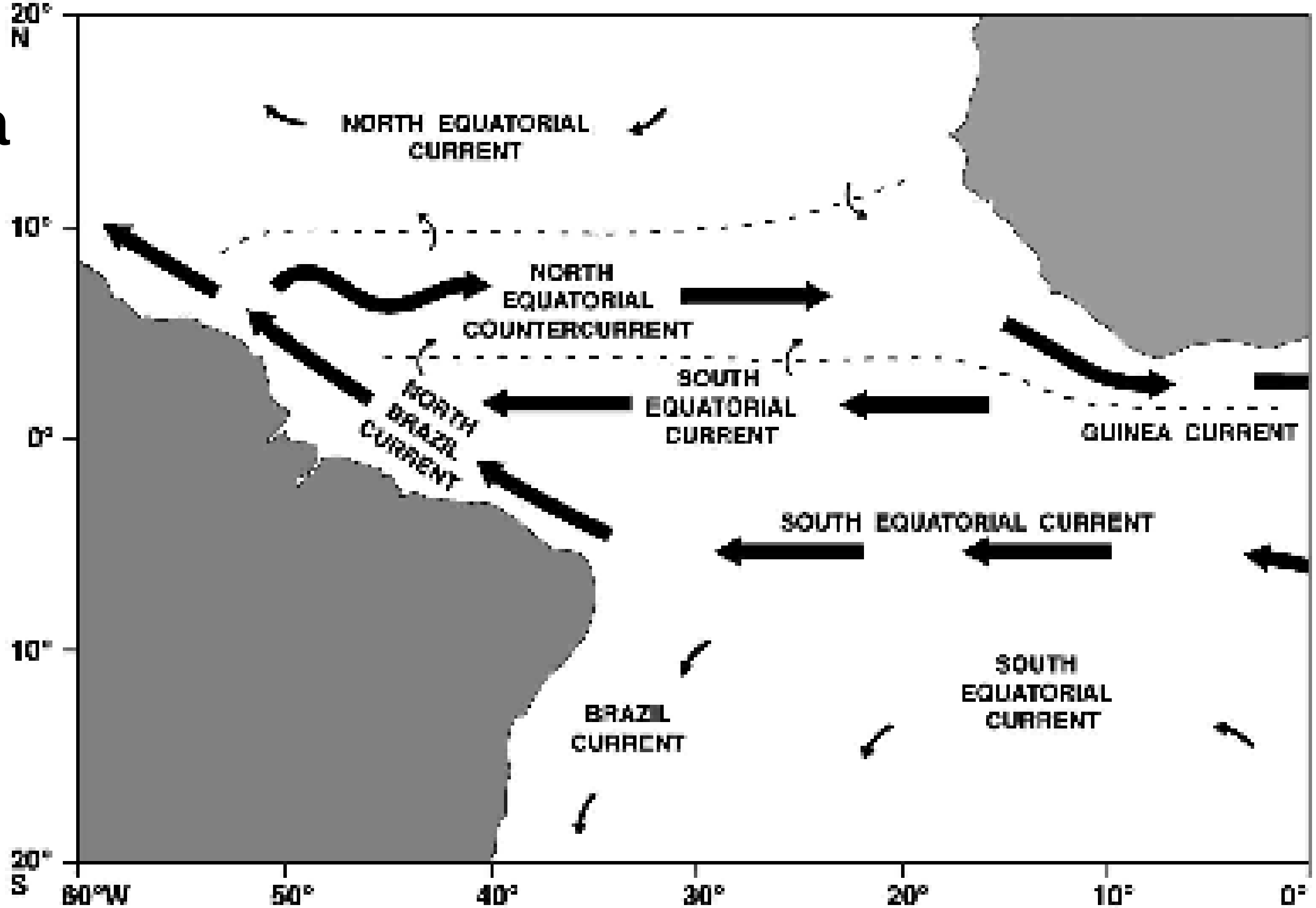
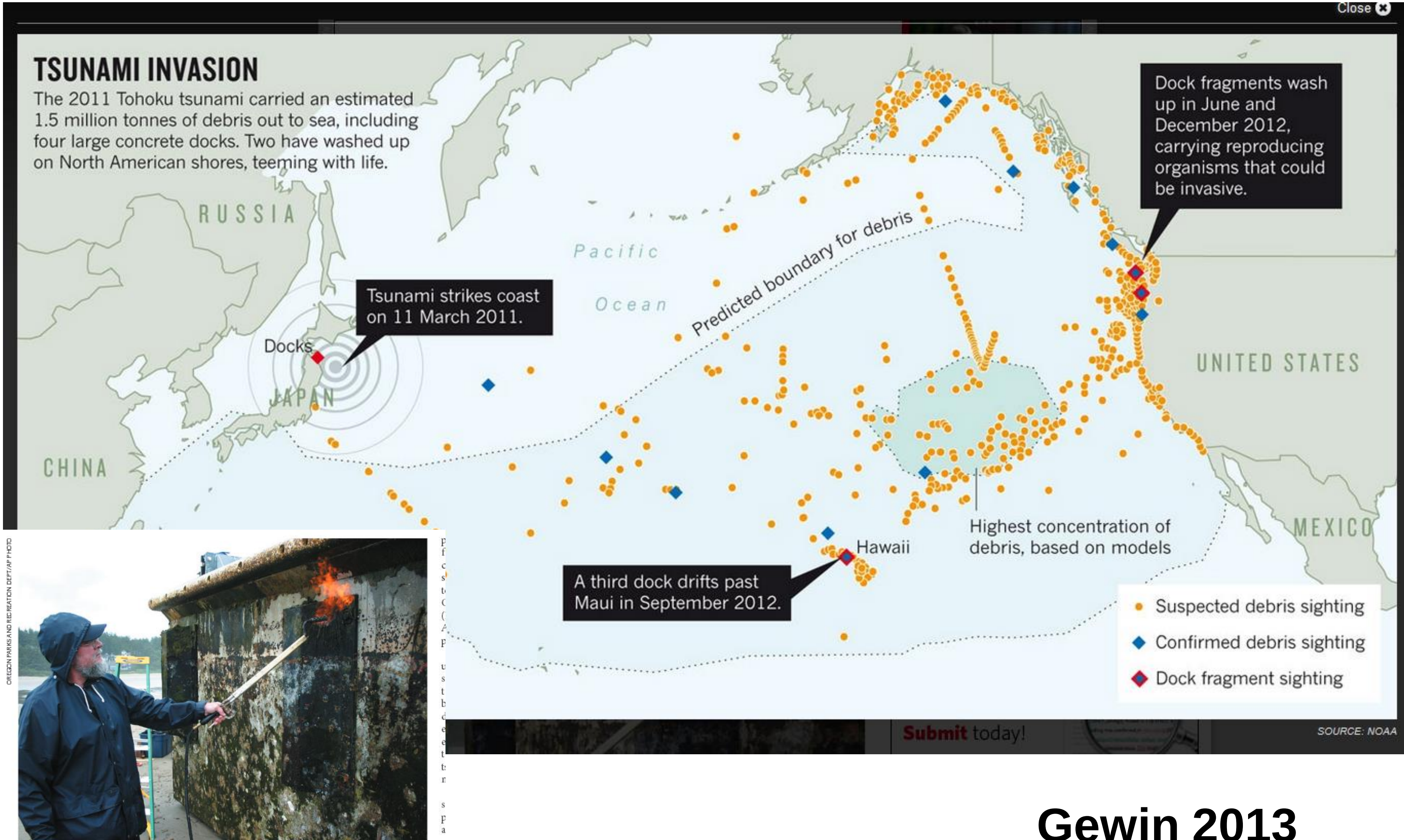


Fig. 1 The major tropical Atlantic surface currents (after Fratantoni et al. 2000)

"ilhas flutuantes" com diásporos lançadas pelos
deltas do Congo, Senegal e Amazonas:
2 semanas para cruzar o Atlântico S, em ambas direções.

Renner 2004



A worker in Newport, Oregon, burns debris off a Japanese concrete dock that washed across the Pacific.

ECOLOGY

Tsunami triggers invasion concerns

Hidrocoria

Gewin 2013
Nature

Molecular Ecology (2007) **16**, 3039–3049 doi: 10.1111/j.1365-294X.2007.03341.x

Extreme long-distance dispersal of the lowland tropical rainforest tree *Ceiba pentandra* L. (Malvaceae) in Africa and the Neotropics

CHRISTOPHER W. DICK,*† ELDREDGE BERMINGHAM,† MARISTERRA R. LEMES‡ and ROGERIO GRIBEL‡

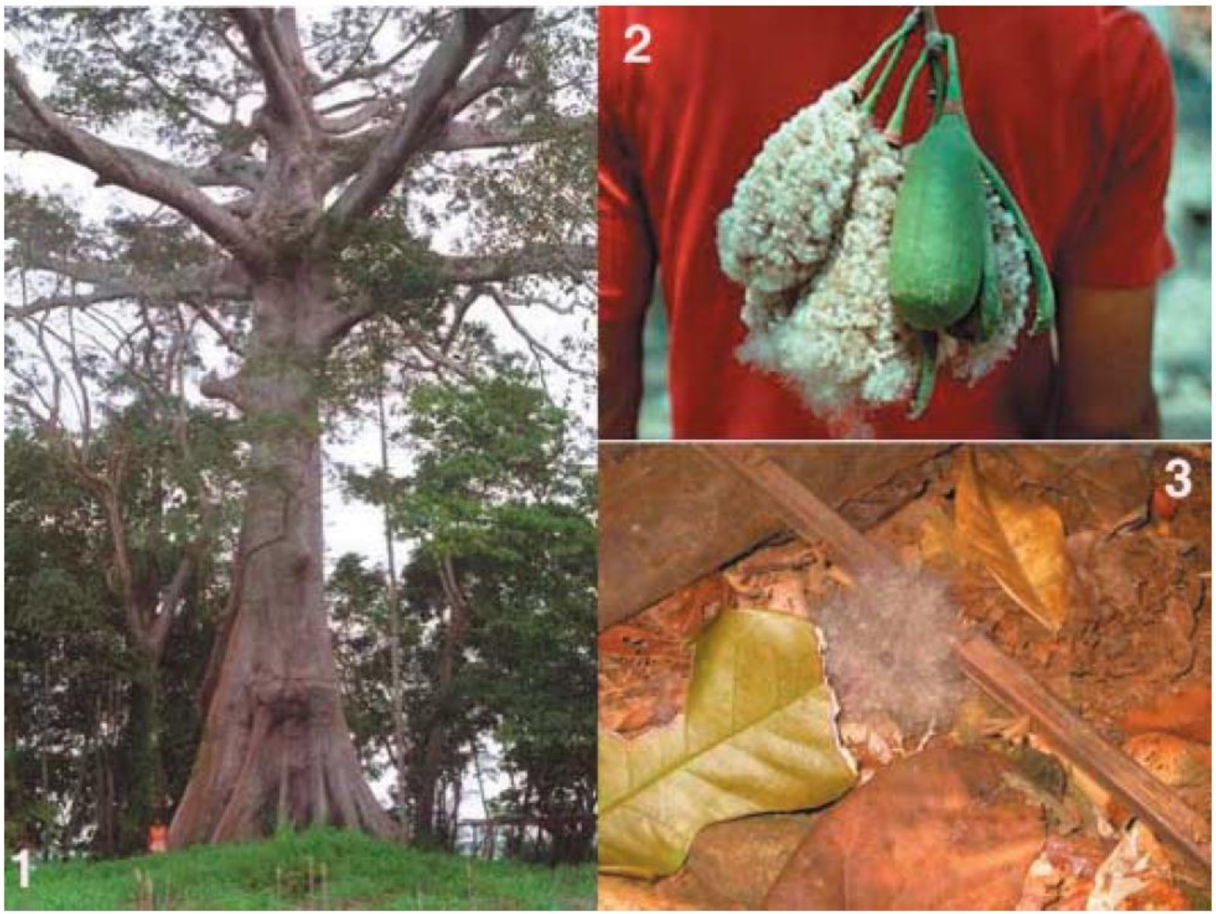


Fig. 1 *Ceiba pentandra* clockwise from left (1) emergent Amazon tree with a person beside the characteristic buttress trunk (photo credit R. Gribel); (2) dehiscing fruit with kapok (photo credit A. Gentry); (3) seed enveloped in kapok (photo credit C. Dick).

Anemocoria

Ceiba pentandra

Dick et al. 2007

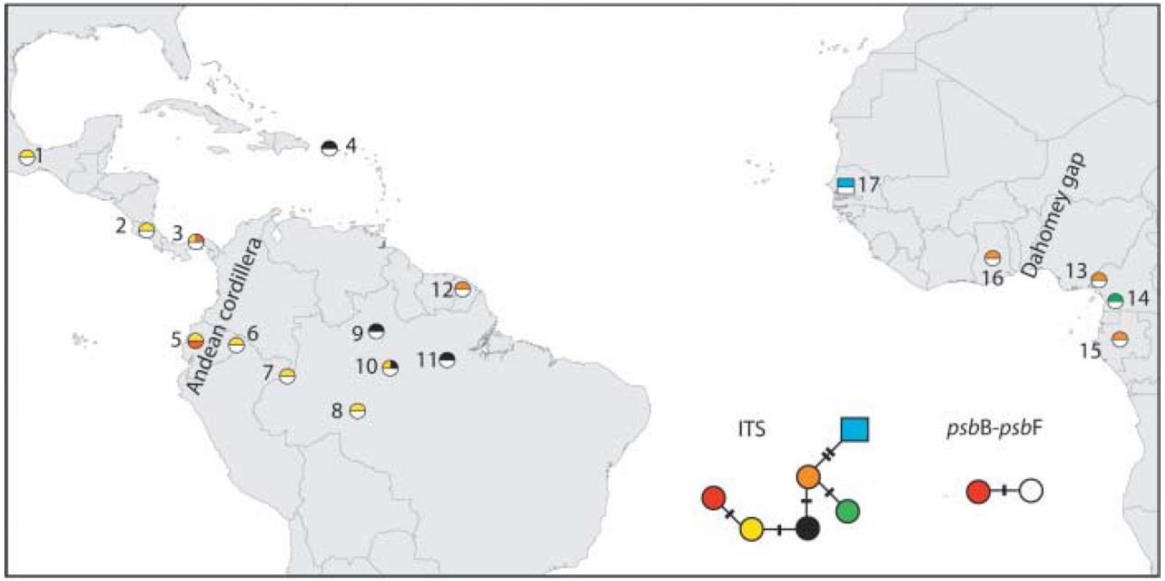


Fig. 2 Geographical distribution of ITS (upper semicircle) and *psb*B-*psb*F (lower semicircle) haplotypes sampled from Neotropical and Western African *Ceiba pentandra*. The square haplotype (site 17, Senegal) represents the savanna form. Numbered collection sites correspond to column one in Table 3. Hatches correspond to numbers of nucleotide substitutions in the haplotype networks. Identical *psb*B-*psb*F and ITS haplotypes across the Andes and between Africa and the Neotropics are evidence of long-distance dispersal.

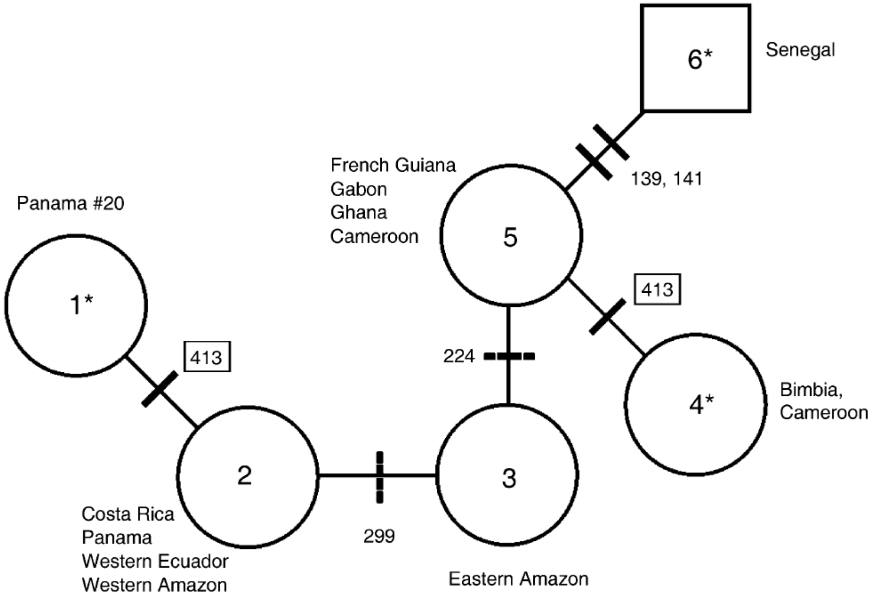


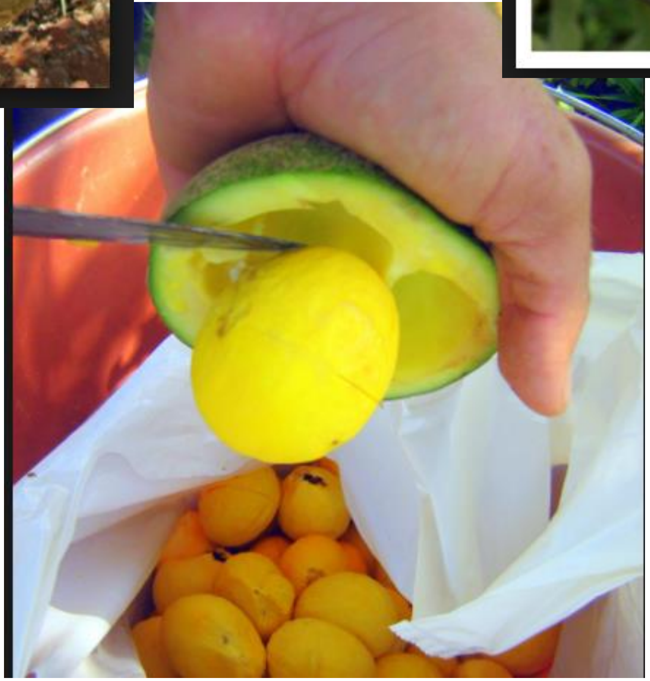
Fig. 3 Shallow phylogeographical structure of *Ceiba pentandra* is indicated by the ITS haplotype network (see also Fig. 2). Hatch marks indicate nucleotide changes at numbered positions in the consensus sequence. Sites 299 and 224, represented by dashed lines, were heterozygous in some individuals in Manaus. The substitution at site 413 is homoplasic in haplotypes 1 and 4 in this network. The squared haplotype is from the savanna form of *C. pentandra*. *represented by a single individual.

Approximate molecular clocks were applied to nuclear ribosomal [ITS (internal transcribed spacer)] and chloroplast (*psb*B-*psb*F) spacer DNA sampled from 12 Neotropical and five West African populations.

The ITS (*N*= 5) and *psb*B-*psb*F (*N*= 2) haplotypes exhibited few nucleotide differences, and ITS and *psb*B-*psb* F haplotypes were shared by populations on both continents.

The low levels of nucleotide divergence falsify vicariance explanations for transatlantic and cross-Andean range disjunctions.

The study shows how extreme long-distance dispersal, via wind or marine currents, creates taxonomic similarities in the plant communities of Africa and the Neotropics.



Zoocoria

Caryocar brasiliense

Pequi

CARYOCARACEAE

[Useful Tropical Plants]

Reconstructing past ecological networks: the reconfiguration of seed-dispersal interactions after megafaunal extinction

Pires et al. 2014

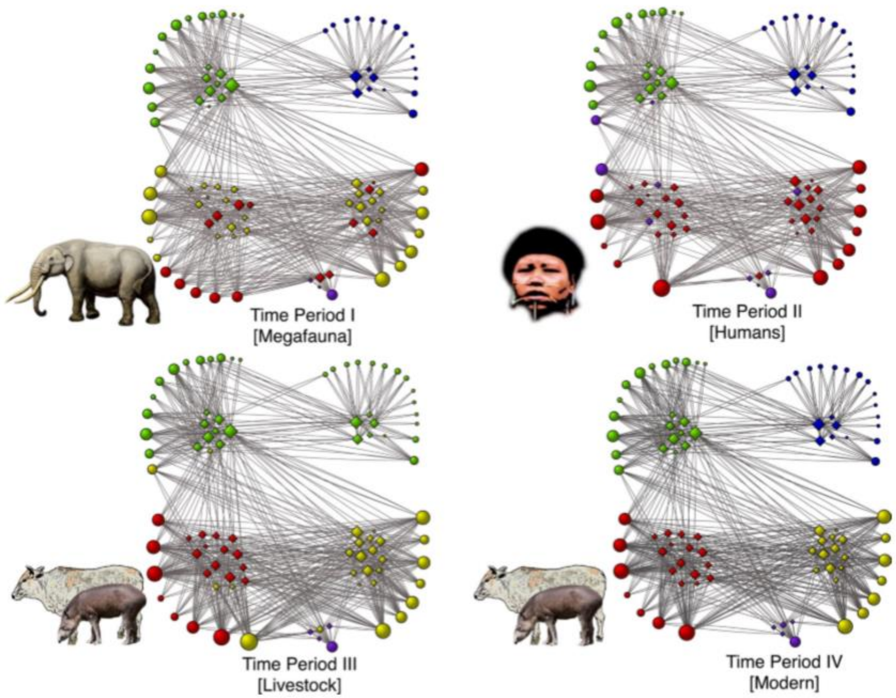


Fig. 1 Seed-dispersal networks representing different time periods in the network time series. *Nodes* represent animals (*circles*) and plants (*diamonds*) and the *size* of a node is proportional to its number of interactions. *Colors* identify the modules to which each species is assigned. *Green* and *blue* modules are dominated by large and small birds, respectively; *red* and *yellow* modules are dominated by large and small mammals; the *purple* module is defined by a fish species (*Piaractus mesopotamicus*). In all networks, species occupy the same position defined for the modern network, even when assigned to different modules, to allow comparisons. When the *color* of a given node changes from one network to the other, that species was assigned to different modules in different periods. Representative species within the module dominated by large mammals are represented by illustrations to highlight the changes across time periods. See Online Resource 5 for the species composition of each module

Oecologia (2014) 175:1247–1256

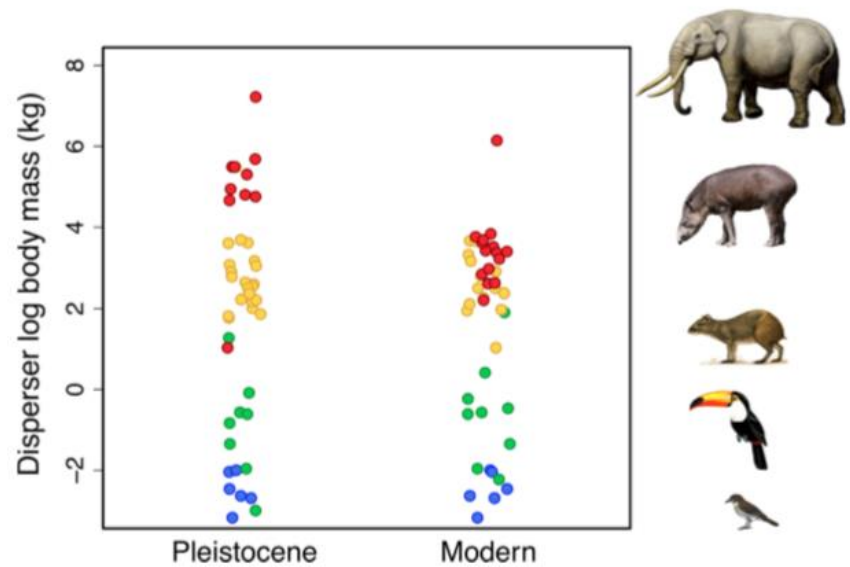


Fig. 3 Average body size of dispersers of each plant species in the Pleistocene and modern seed-dispersal networks. *Colors* indicate the module to which each plant species was assigned: *red* large mammal-dominated module, *yellow* small mammal-dominated module, *green* large bird-dominated module, and *blue* small bird-dominated model

Pleistocene megafaunal extinctions and the functional loss of long-distance seed-dispersal services

Mathias M. Pires, Paulo R. Guimarães Jr, Mauro Galetti and Pedro Jordano

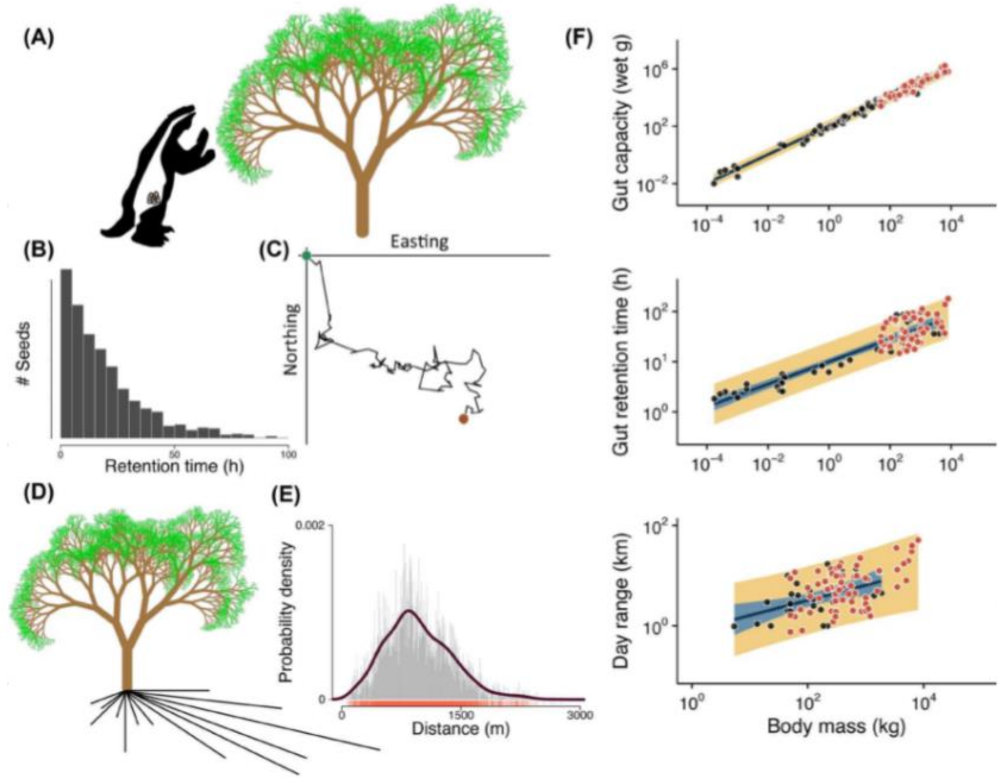


Figure 1. Modeling seed dispersal as a multistage process. (A) Seed ingestion is constrained by the gut capacity of the frugivore, here illustrated by a giant sloth (Megatheriidae). (B) Seed retention is modeled as a fat-tailed distribution representing the relative frequency of seeds eliminated at different times after ingestion. (C) Animal movement is simulated under models where individuals can move in any direction after ingesting the seeds of a plant or plant aggregate. The trajectory from the starting (green dot) to the final position (brown dot) is depicted as a solid line. (D) While moving, the frugivore deposits the seeds at different distances from the source. (E) Seed dispersal kernels – probability density functions of dispersal distances – are estimated by combining information on retention time of ingested seeds and movement. (F) Empirical relationships between variables related to the processes illustrated in panels (A–C) and body mass. Black dots represent compiled data for extant mammals. Shaded regions depict the confidence (blue) and prediction (yellow) intervals for the regression. Colored points represent extinct megafauna species. For extinct species, the positions on the y-axis are random locations within the prediction interval estimated from the species-specific estimated body mass (x-axis).

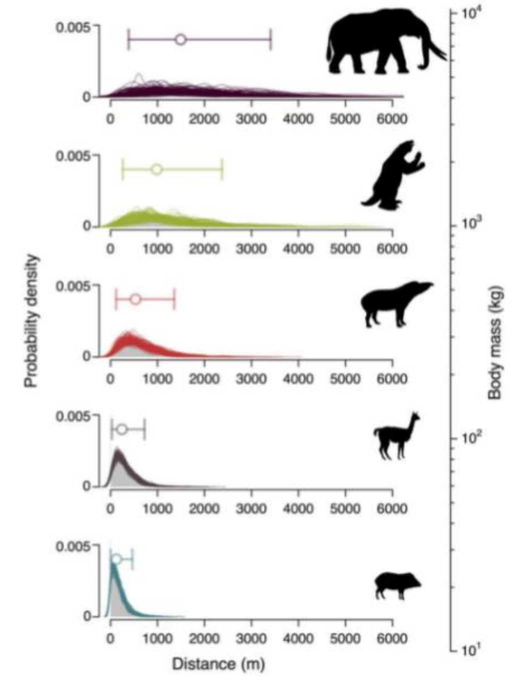
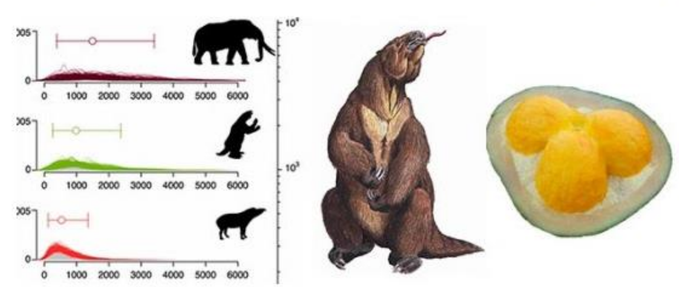


Figure 2. Seed-dispersal kernels depicting seed dispersal of a large-seeded plant by populations of mammalian frugivores within different body size ranges. Animal movement was simulated as a Brownian walk (BW). Each line represents one of 100 simulations. Each kernel panel is located within the approximate body mass range used in the simulation. Circles represent the median and bars determine the 5th and 95th percentiles. The 95th percentile value defines the minimum threshold value considered a LDD event.

Pires et al. 2018
Ecography

Agência FAPESP | Inicial | Agenda | Vídeos | Assine | Quem Somos | English | Español

08 de março de 2018



Fim da megafauna reduziu a distância de dispersão de sementes grandes

Hipótese da perda de dispersão em ilhas (Darwin 1859)

Evolution of reduced dispersability in wild populations were inspired by island animals, when researchers described peculiar examples of flightless species (Darwin, 1859; Zimmerman, 1948).
Both field observations and empirical studies to date have suggested that plants also tend to produce less dispersive seeds and fruits on insular environments than those produced by close relatives elsewhere (Carlquist 1966; Cody & Overton 1996; Fresnillo & Ehlers 2008; Kudoh et al. 2013)**.**

The loss of dispersal on islands hypothesis (LDIH) posits that wind-dispersed plants should exhibit reduced dispersal potential, particularly if island populations are old.

García-Verdugo et al. (2017) tested this hypothesis using a detailed phylogeographical framework (plastid and nuclear microsatellite data) across mainland and island areas of the Mediterranean region (strait of Sicily) and of the Atlantic (Macaronesia: Canary Islands and Cape Verde).
45 populations of *Periploca laevigata*, a wind-dispersed shrub (Apocynnaceae).
Reconstruction of spatio-temporal patterns of island colonization; estimation of seed terminal velocity used as a surrogate for dispersal ability under both field and common garden conditions.

Periploca laevigata
Apocynaceae
anemocórica

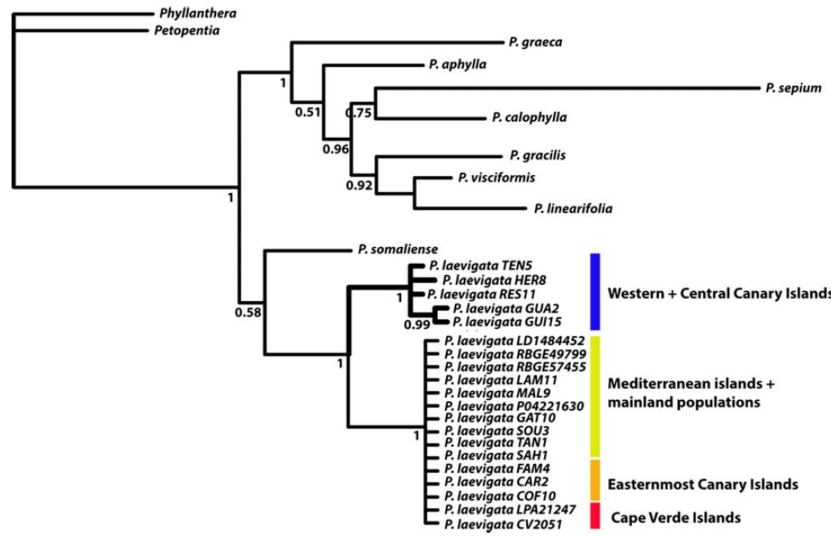
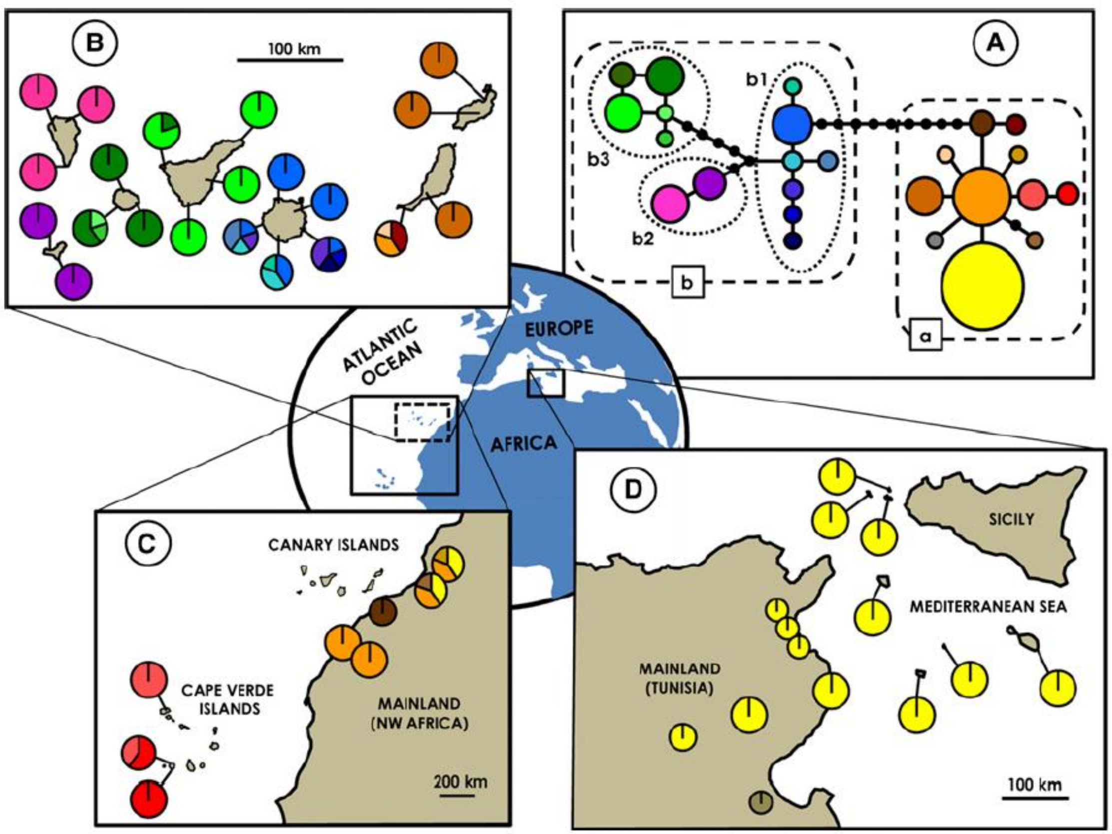


FIGURE 1 Bayesian consensus tree showing phylogenetic relationships among samples representative of the species of genus *Periploca* section *Periploca*. The two main *Periploca laevigata* clades recovered by the analysis are highlighted in the tree. Numbers in nodes indicate bootstrap (posterior probability) support [Colour figure can be viewed at wileyonlinelibrary.com]



García-Verdugo et al. (2017)

FIGURE 2 Haplotype network based on plastid polymorphism detected in 195 *Periploca laevigata* samples A and distribution of haplotypes in populations sampled in this study: Canary Islands B, NW Africa and Cape Verde Islands C and mainland Tunisia and Mediterranean islands D. The size of each pie chart is proportional to the number of individuals sampled. Black circles in A indicate missing haplotypes, and different codes identify main lineages (a, b) and sublineages (b1, b2, b3) [Colour figure can be viewed at wileyonlinelibrary.com]

Hipótese da perda de dispersão em ilhas (Darwin 1859)

Periploca laevigata

García-Verdugo et al. (2017)

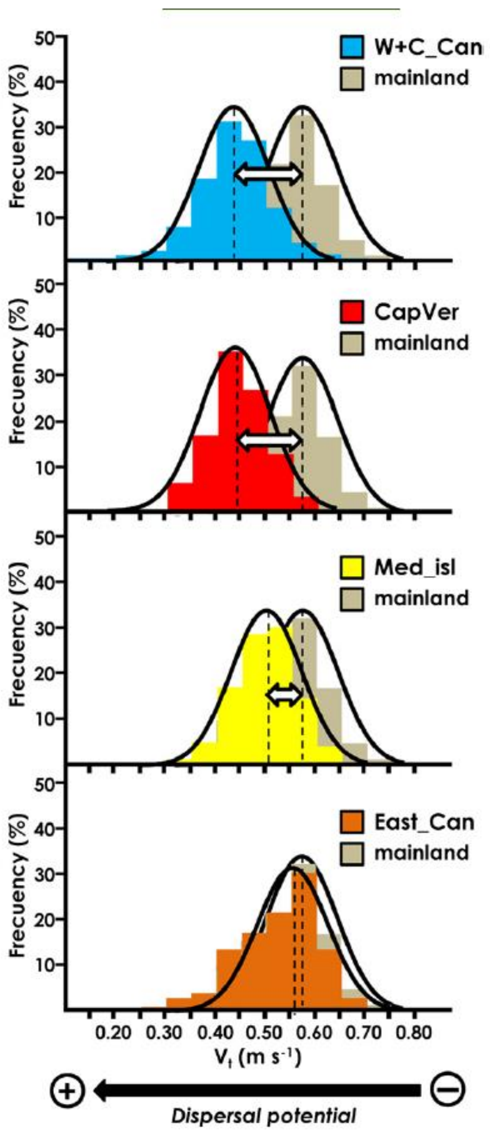


TABLE 1 Mean (±SE) values of morphological traits and seed dispersal ability (inverse of V_t) in *Periploca laevigata* for the geographical areas considered in this study: mainland (N = 4 populations), Mediterranean islands (N = 6), Cape Verde Islands (N = 3), easternmost Canary Islands (N = 3) and western+central Canary Islands (N = 17). Results from nested ANOVA for factor "area" (F-ratios) and significance levels are shown. Different letters among areas indicate significant differences following post hoc tests. ***$p < .001$

Area	Pod size (mm)	Seed mass (mg)	Coma length (mm)	V_t (m s^{-1})
Mainland areas	61.0 (2.1)^A	9.3 (0.2)^A	23.8 (0.7)^A	0.543 (0.007)^A
Mediterranean islands	75.7 (1.2)^B	8.7 (0.2)^A	31.7 (0.3)^B	0.494 (0.005)^B
Cape Verde islands	94.7 (2.2)^D	12.3 (0.3)^B	38.8 (0.6)^C	0.443 (0.006)^C
Eastern Canaries	82.2 (1.8)^C	11.2 (0.2)^B	32.7 (0.7)^B	0.526 (0.008)^A
West+Central Canaries	97.9 (0.9)^D	11.6 (0.1)^B	38.9 (0.3)^C	0.437 (0.004)^C
	$F_{4,25}$ = 15.5***	$F_{4,25}$ = 11.0***	$F_{4,25}$ = 23.7***	$F_{4,25}$ = 19.0***

FIGURE 3 Comparison of frequency distributions of seed dispersal ability (expressed as terminal velocity, V_t) in *Periploca laevigata* between island and mainland samples considered in this study (sample sizes: mainland, N = 275; western + central (W+C) Canaries, N = 1136; Cape Verdes, N = 192; Mediterranean islands, N = 519; easternmost Canary Islands, N = 325. Each dataset was adjusted to a normal distribution, and arrows represent the magnitude of differences in mean values between mainland and island distributions [Colour figure can be viewed at wileyonlinelibrary.com]

Hipótese da perda de dispersão em ilhas (Darwin 1859)

Periploca laevigata

García-Verdugo et al. (2017)

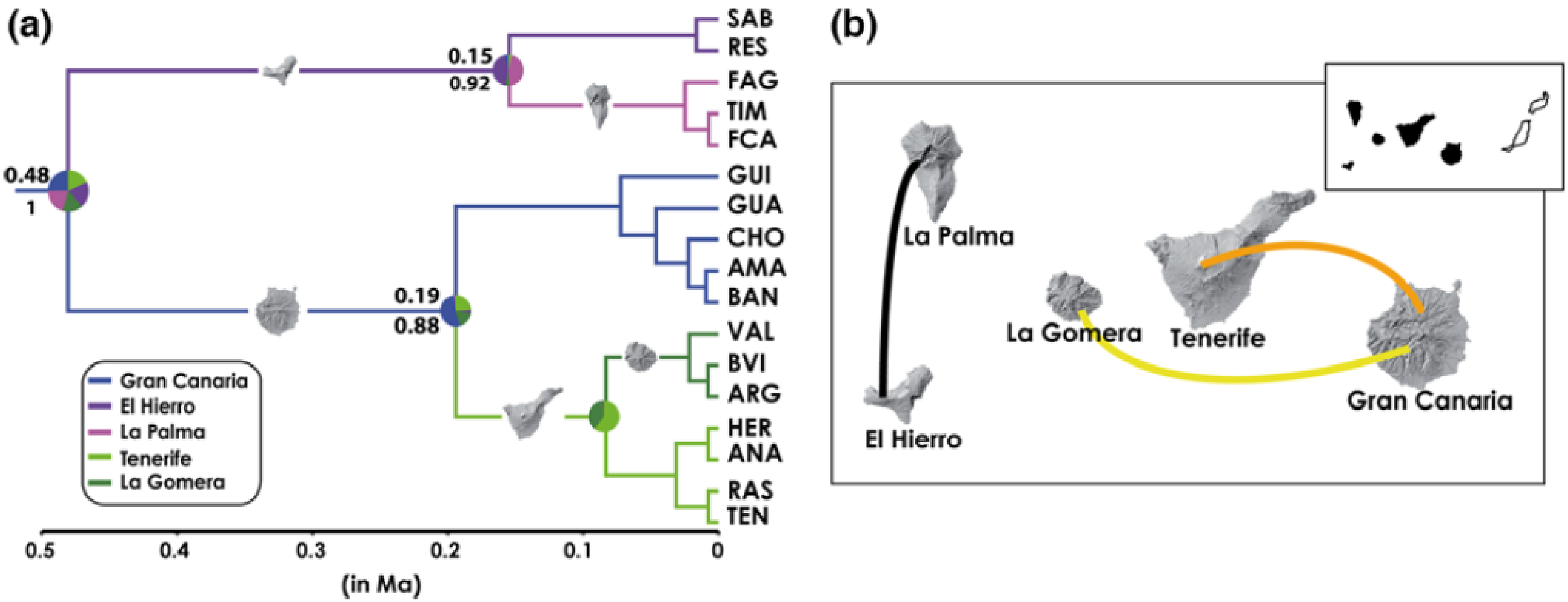


FIGURE 5 Phylogeographical reconstructions of *Periploca laevigata* populations in the Western Canarian lineage. Pie charts (a) represent marginal probabilities for potential ancestral areas (with each island represented by a different colour), whereas the colour of each branch indicates the ancestral area with the highest posterior probabilities for a given clade. Numbers in nodes show mean estimated ages of divergence (above) and Bayesian posterior probabilities (below). Migration events among islands with high Bayes Factor support are highlighted (b; colours represent the level of support: black > orange > yellow) [Colour figure can be viewed at wileyonlinelibrary.com]

Hipótese da perda de dispersão em ilhas (Darwin 1859)

Periploca laevigata

García-Verdugo et al. (2017)

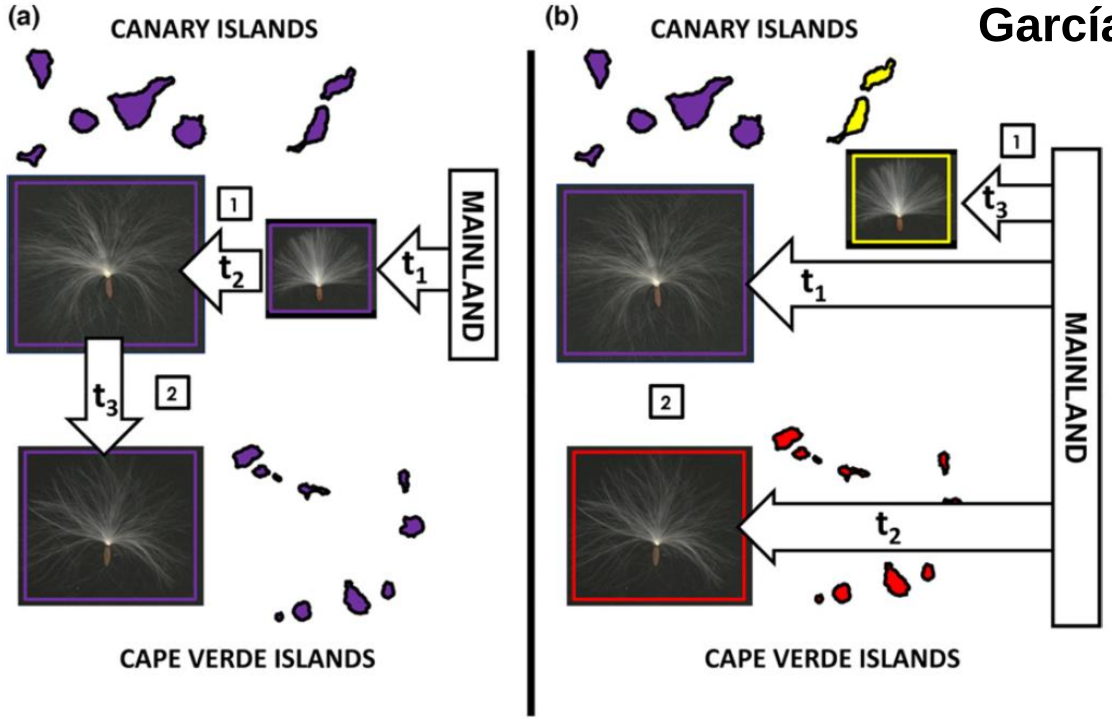
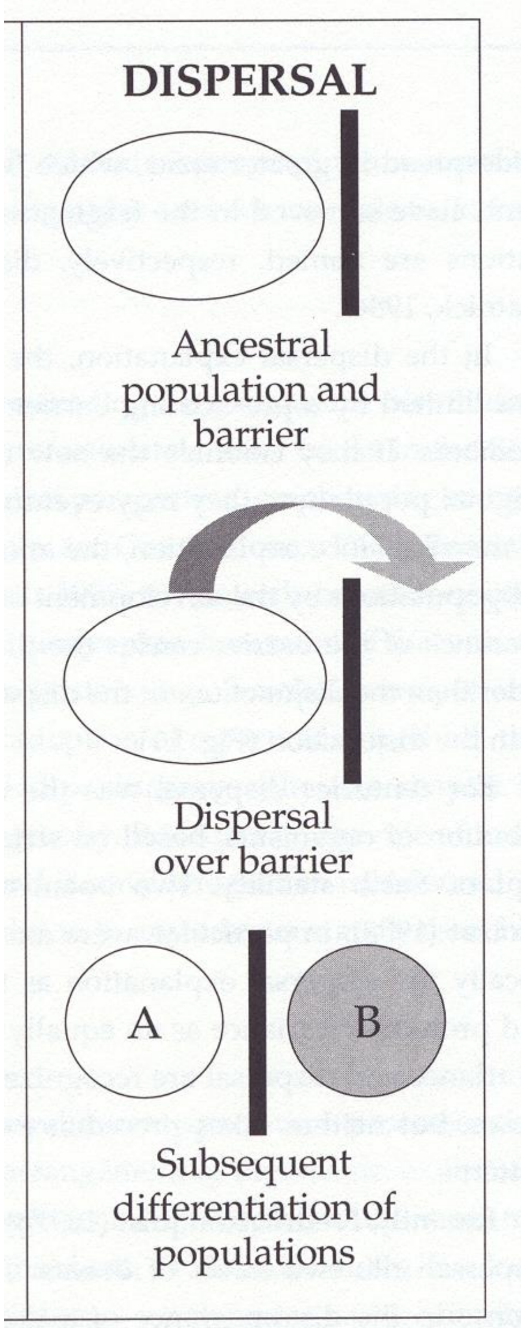


FIGURE 6 Diagram showing contrasting inferences (represented by numbers; see main text) on the evolution of dispersal traits in Macaronesian lineages of *Periploca laevigata* depending on the biogeographical scenario considered: (a) assuming monophyly of *Periploca* in the islands, with colonization starting on the easternmost Canary Islands, followed by colonization of central and western islands and Cape Verdes; and (b) implementing phylogeographical reconstructions that support three waves of island colonization: western and central Canaries, Cape Verdes, and easternmost Canaries. Arrows represent colonization events at different periods of time (t_1, t_2, t_3) [Colour figure can be viewed at wileyonlinelibrary.com]

Conclusions: the findings did not provide evidence of loss of dispersability in any island lineage. In all of the regions considered, dispersal ability was similar on island and mainland populations, or higher on islands. Contrary to LDIH expectations, lineages inferred as the oldest (western Canaries and Cape Verde) converged towards the most dispersive seed phenotype. Within the western Canarian lineage, successful dispersal was shown to be very rare among islands and extensive within islands, but dispersability did not vary significantly from older to more recent sublineages.

Considering all the study islands, we found a strong, positive correlation between dispersal hability and estimates of within-island habitat availability.



Dispersão

Crisci *et al.* 2003

Natureza das barreiras

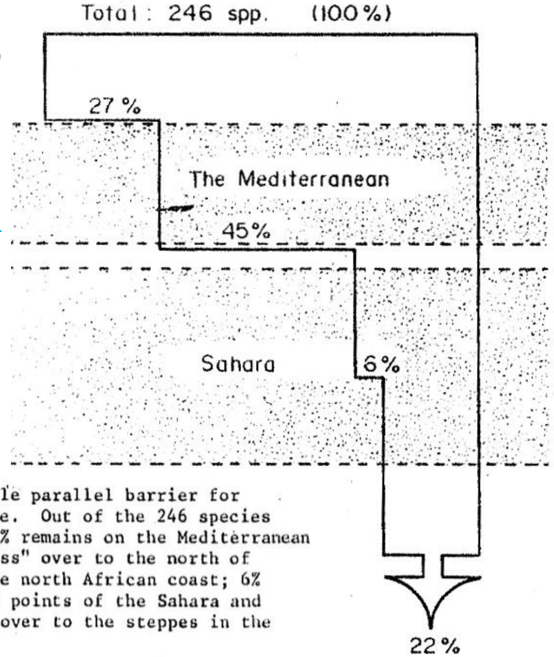
Barreira: ambiente diferente física e/ou biológica

Trópicos = barreira em banda (zona de alta temperatura ao redor do Equador, isolando as áreas temperadas e árticas de cada hemisfério).

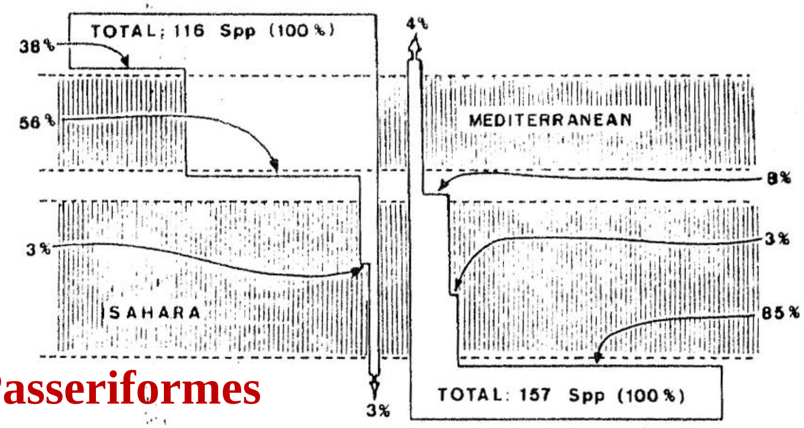
Outros exemplos ?

Rapoport 1982

AVES - total

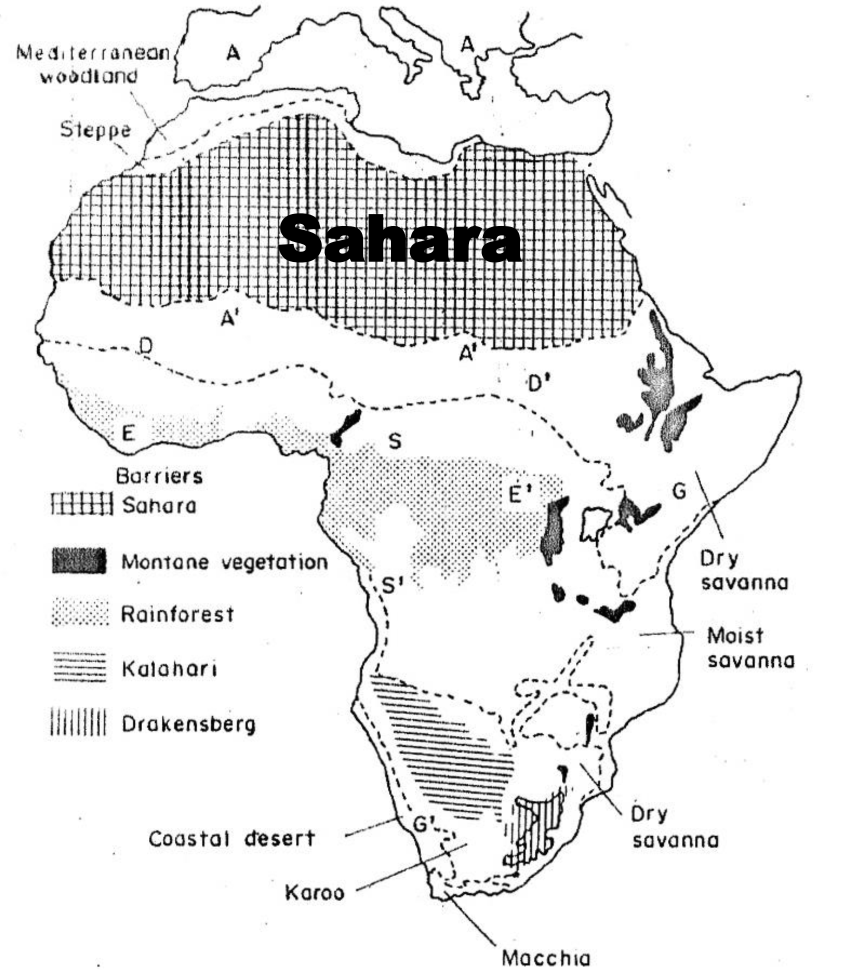


Effectiveness of a double parallel barrier for birds of southern Europe. Out of the 246 species registered by Voous, 27% remains on the Mediterranean coast and does not "cross" over to the north of Africa; 45% stays on the north African coast; 6% "infiltrates" into some points of the Sahara and 22% crosses the desert over to the steppes in the south.



Passeriformes

Fig. 4.15. Same as Fig. 4.14 but restricted to passerine birds. The calculation was made for passerines from the south of Europe that cross the Mediterranean Sea and the Sahara (3%) and for the birds from the south of the Sahara that reach the south of Europe (4%).



4.13. Most conspicuous barriers and possible corridors in Africa. The Mediterranean Sea and the Sahara desert are considered barriers for the dispersal of species between *A*-*A*'. Tropical rainforest is supposed to be a barrier between *S* and *S*'; rain decrease is considered as a barrier between *G* and *G*'. Within the limits of the same biome, the existence of a corridor is expected (*D*-*D*' and *E*-*E*'). The sinuous line inside the Drakensberg indicates the 1500 metres o.s. level.

Haffer 2008

Rios largos como barreiras postuladas X principais rotas de AVES

(baseado em mapas de 360 spp.)

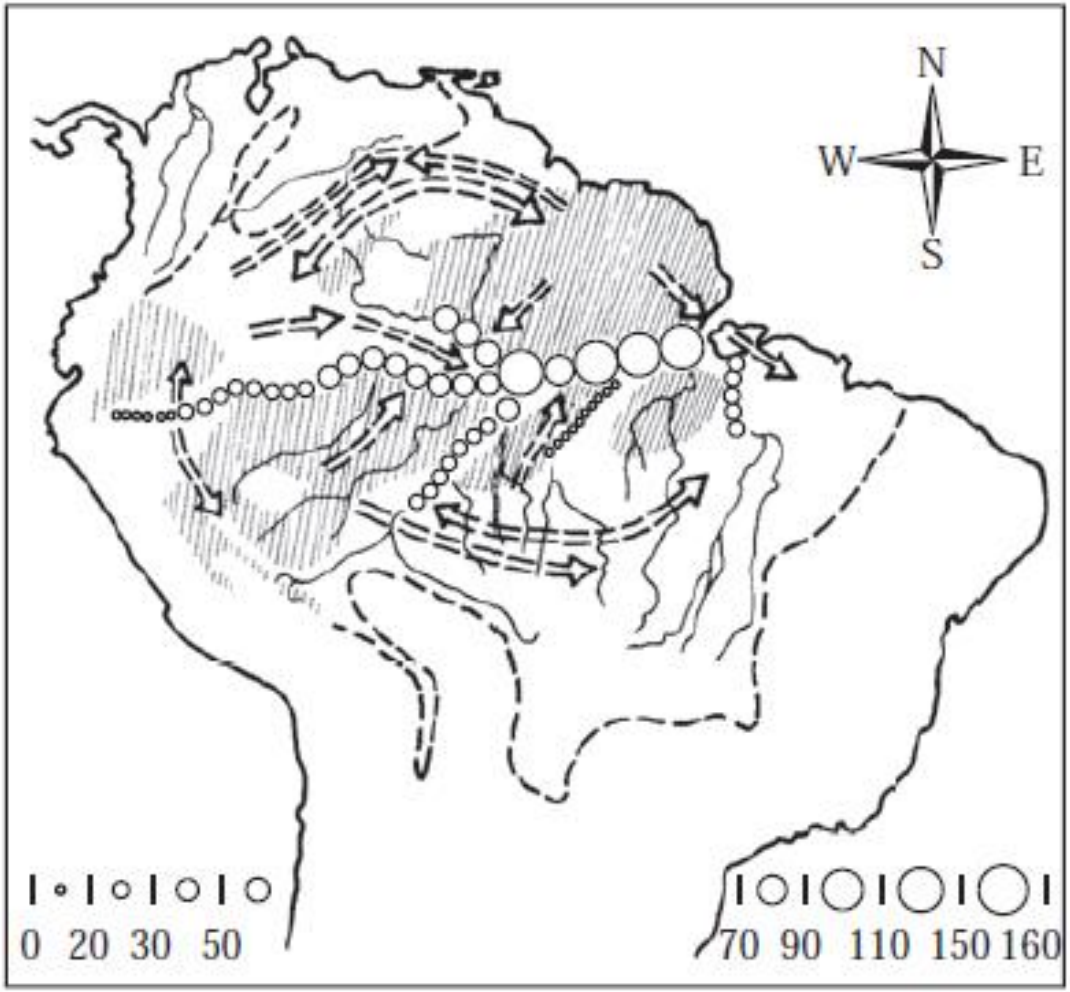


Figure 3. Barrier effect of broad river valleys for birds in Amazonia (open circles) and main avian dispersion routes (Open circles illustrate) in interfluvial regions and in the headwater areas of major rivers, where the latter cease to act as barriers. Solid circles illustrate varying numbers of species range borders along the Solimoes-Amazon River and along the lower portions of its major tributaries (see scale). Data derived from sample of 360 species maps. Shadded areas have less than 10 species range borders per 100 km distance. The increasingly crowded contour lines near the northern and southern limits of the Amazonian-Guianan forest region are not shown. Dashed line follows zero contour of total sample. Insufficient data are available to estimate the (somewhat reduced) barrier effect of the Amazon River near its mouth (Marajó Island). Modified from Haffer (1978).

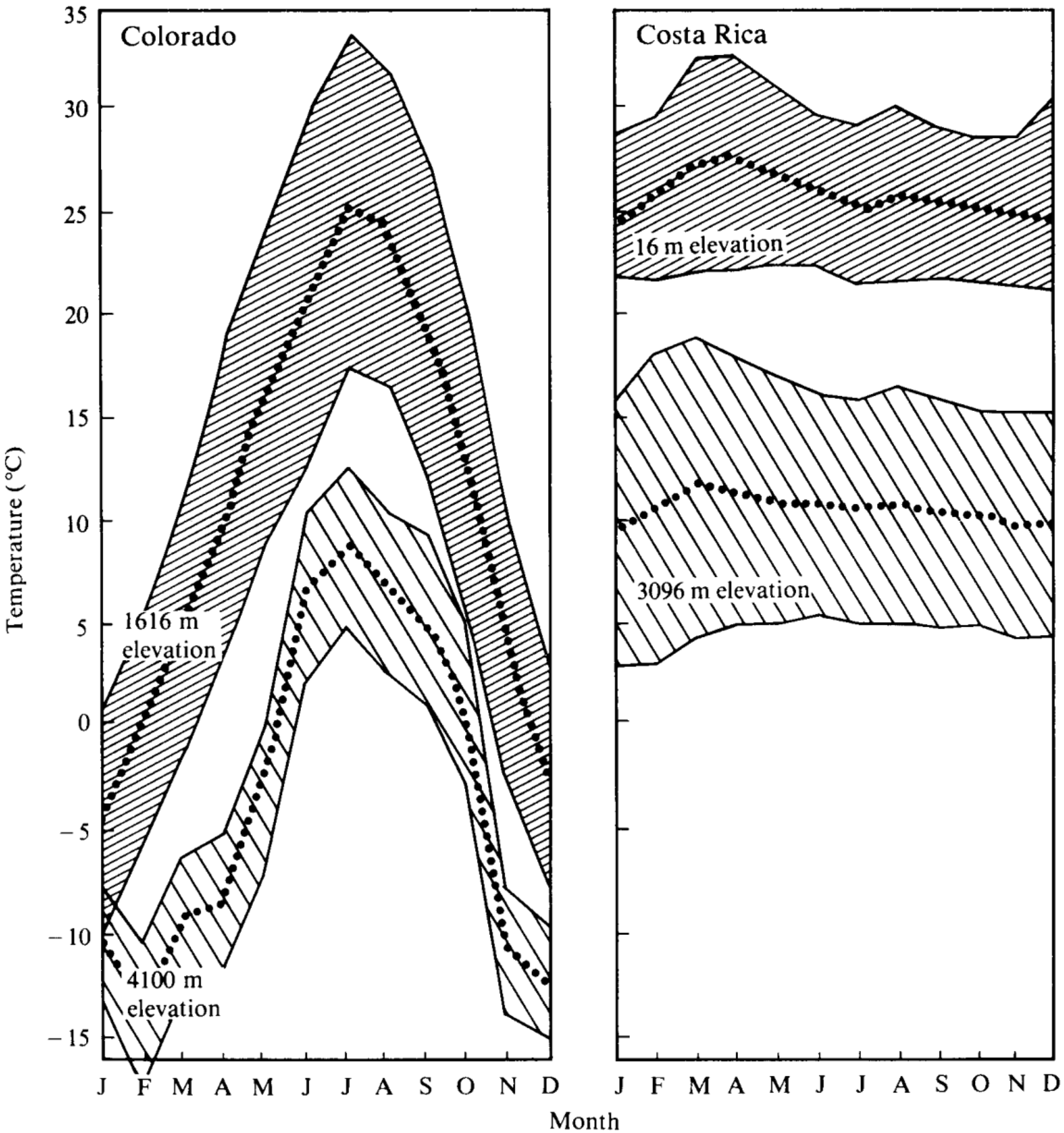
Natureza das barreiras

Efetividade da barreira varia de um grupo taxonômico para outro.
Geralmente organismos de ambientes de condições flutuantes são melhor dispersores, menos limitados por barreiras do que spp. de ambientes estáveis.

Janzen (1967) – distribuição de spp. de montanhas tropicais é mais restrita que a de spp. de montanhas temperadas!

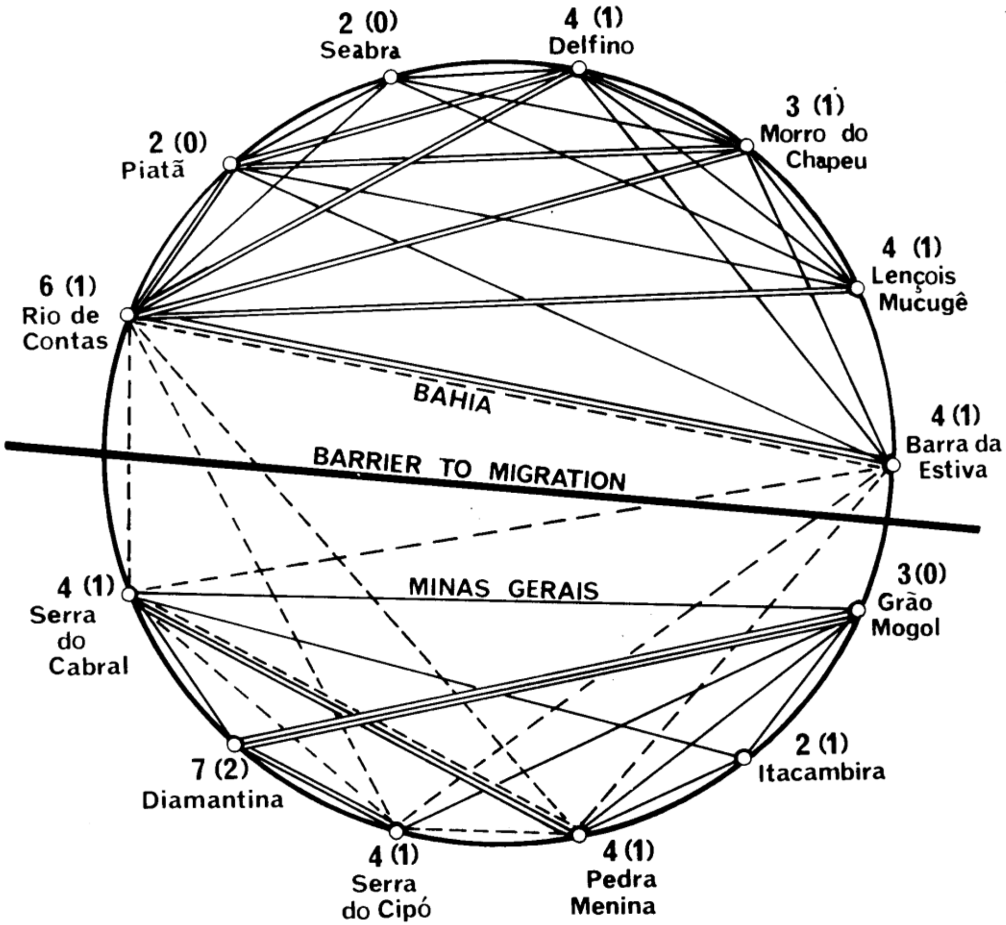
Natureza das barreiras

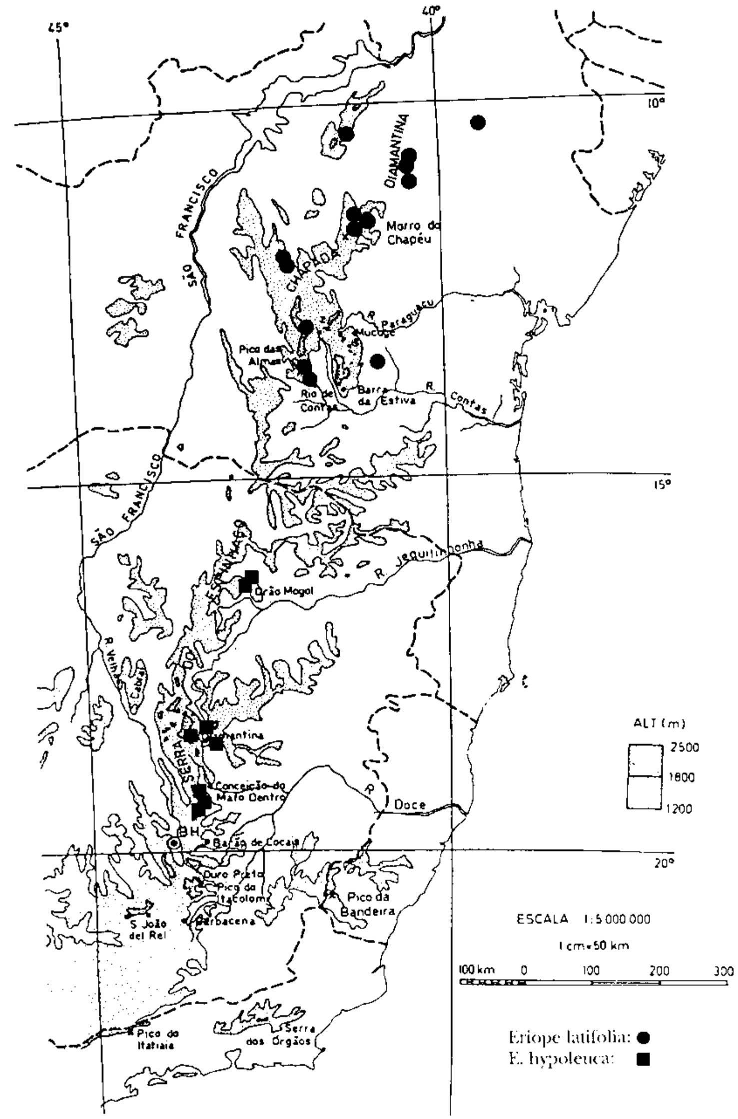
– barreira montanhosa é mais efetiva nos trópicos



A given change in elevation tends to be a greater barrier to dispersal in the tropics than at higher latitudes, for the reason shown in these temperature profiles. In tropical regions sites separated by several thousand meters of elevation usually experience no overlap in temperature, whereas in the temperate zones winter temperatures at low elevations broadly overlap summer temperatures at much higher sites. (Reprinted from "Why mountain passes are higher in the tropics," *American Naturalist* 101:233-2+9, by D.H. Janzen, 1967)

Brown & Gibson 1983





Harley 1988

Distribution of ***Eriope*** species within campos rupestres of Minas Cerais and Bahia. Each line represents 1 species common to the two areas which it links. *E. macrostachya* is represented by broken lines. Numbers represent number of *Eriope* species with number of special endemic to the area in parentheses. Only *E. macrostachya* crosses the "barrier".

Estabelecimento da nova colônia

Carlquist 1965: “getting there is half the problem”

PROPÁGULO (MacArthur & Wilson 1967) =
unidade necessária para fundar uma nova colônia

Orchidaceae
Plantas xenógamas obrigatórias
Plantas com reprodução assexuada
} **qual o mais limitado?**

Fruto multisseminado = propágulo eficiente
Uma só semente pode atuar como propágulo
no caso de grupos apomíticos

Rotas de dispersão: corredores e filtros

Corredor (Simpson 1936):

Rota que permite expansão de muitos ou da maioria dos taxa de uma região a outra.

Biomas contínuos nos continentes facilitam difusão livre entre regiões:

- Floresta transcontinental temperada decídua – estendia-se do oeste da Europa até o leste da China no Cenozóico. Hoje corredor truncado, mas muitas spp de plantas e aves são ainda comuns à França e China!

- Estreito de Bering = corredor de clima ameno entre Alasca e Sibéria na primeira metade do Cenozóico (conexão em ponte durou até o Pleistoceno) .

Rotas de dispersão: corredores e filtros

Filtro (Brown & Gibson 1983):

Rota mais restritiva a certas formas, permitindo outras (as capazes de tolerar as condições da barreira).

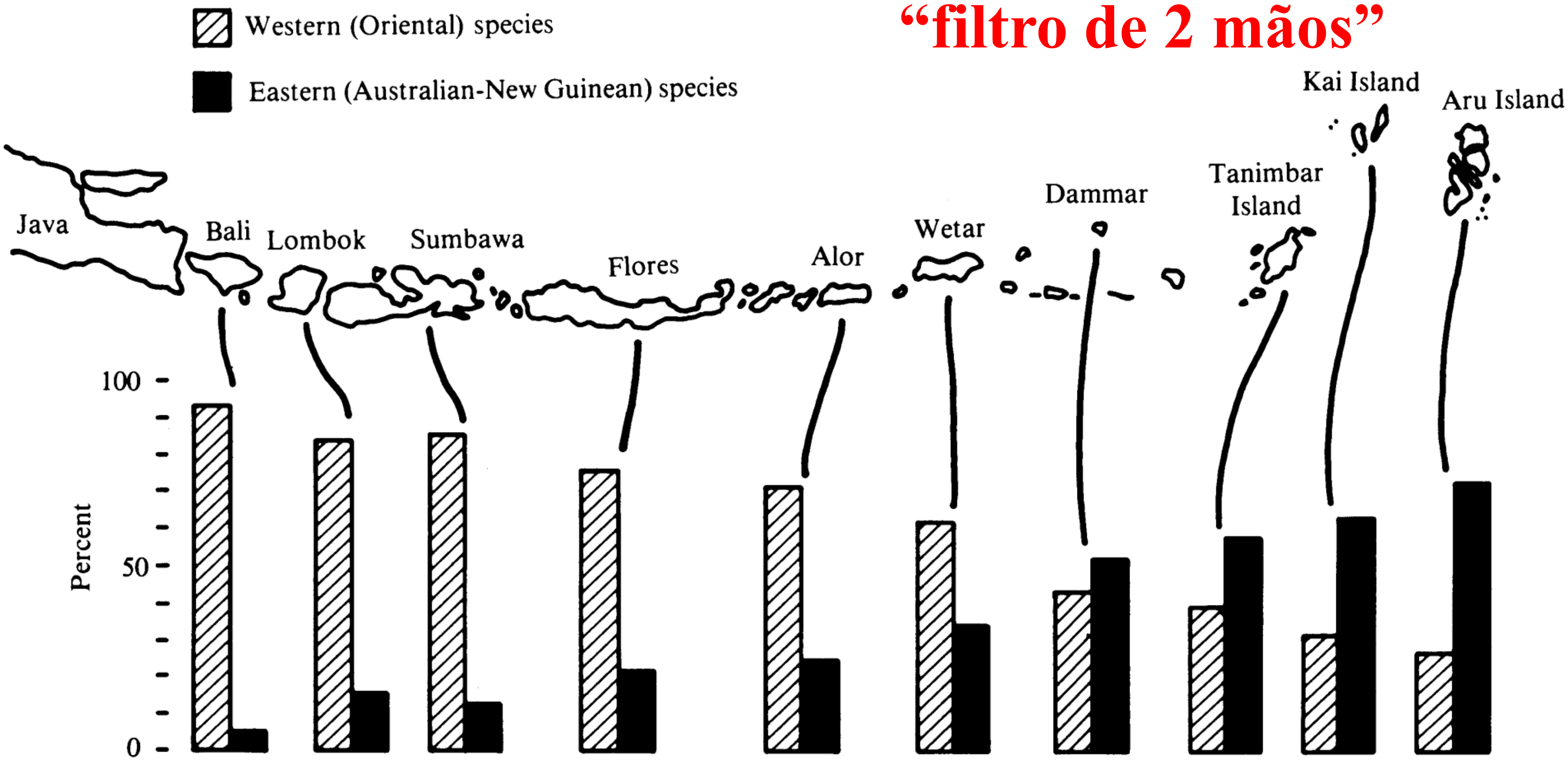
-Biotas de cada extremidade do filtro compartilham muitos táxons, mas alguns são conspicuamente ausentes numa ou noutra.

Freqüentemente exibem descontinuidade de habitats.

-Subcontinente árabe: eficiente filtro (xerófitas, certos mamíferos, répteis e aves não-passeriformes mantêm distribuição mais ou menos contínua entre África N e Ásia Central; mas organismos mais dependentes de água são barrados pelo deserto).

"Filtro Arábia" hoje deve ter sido um "corredor Arábia" contactando o Irã no Mioceno (antes separado pelo Mar de Tethys) e muitas spp. africanas aparecem na Ásia pela primeira vez!

Rotas de dispersão: filtros – arco de ilhas "filtro de 2 mãos"



Lesser Sunda Islands between Java and New Guinea serve as a two-way filter for the reptilian faunas of southeastern Asia and Australia. This diagram quantifies the decline in Oriental species and the increase in Australian species going from west to east down the island chain. (After Carlquist, 1965.)

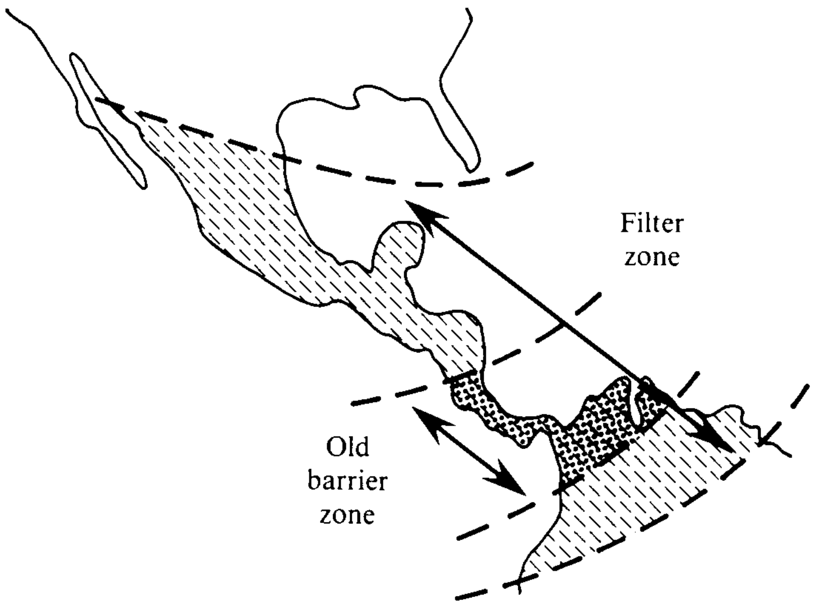
Brown & Gibson 1983

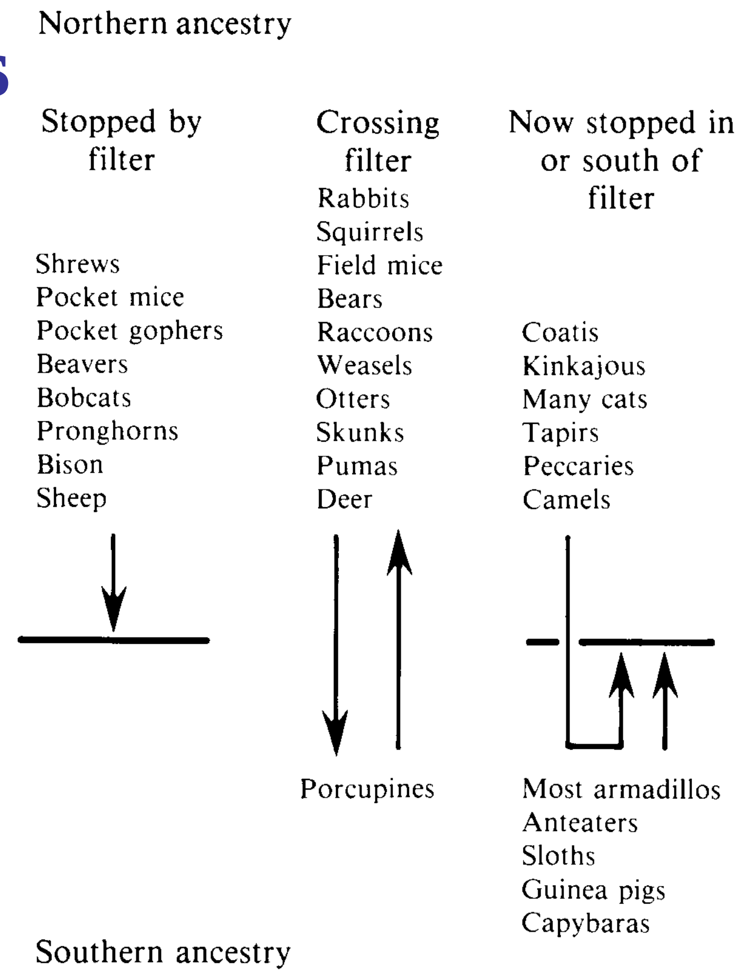
Figura 34.7 O Arquipélago Malai durante o máximo glacial mais recente A linha de Wallace, que divide duas regiões geográficas dist tas, corresponde ao canal de águas profundas entre as ilhas de Bali e Lombok. Este canal é suficientemer profundo para ter bloqueado o mov mento de seres vivos terrestres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

Sadava et al. 2009

Rotas de dispersão: filtros

– istmo do Panamá





Central America has acted as a filter, allowing extensive interchange of some mammalian groups between North and South America but preventing the passage of other taxa. This diagram shows those groups of northern ancestry that both were stopped by and passed through the filter, the same groups for taxa of southern ancestry, and a final group, originally of northern ancestry, that invaded and survived in South America but became extinct in North America. (From *The Geography of Evolution* by G.G. Simpson. Copyright © 1965 by Chilton Book Co., Radnor, Pennsylvania.)

Brown & Gibson 1983

Figura 34.13 A fauna de mamíferos trocada entre a américa do norte e do sul (A) O tatu-galinha e o porco-espinho estão entre as poucas espécies da América do Sul que colonizaram a América do Norte. (B) Algumas das espécies que atualmente existem apenas na América do Sul descendem de ancestrais que migraram da América do Norte, incluindo a raposa-da-Patagônia, o "*chacoan peccary*" (um porco-do-mato) e a vicunha (um membro da família dos camelos).

(A)

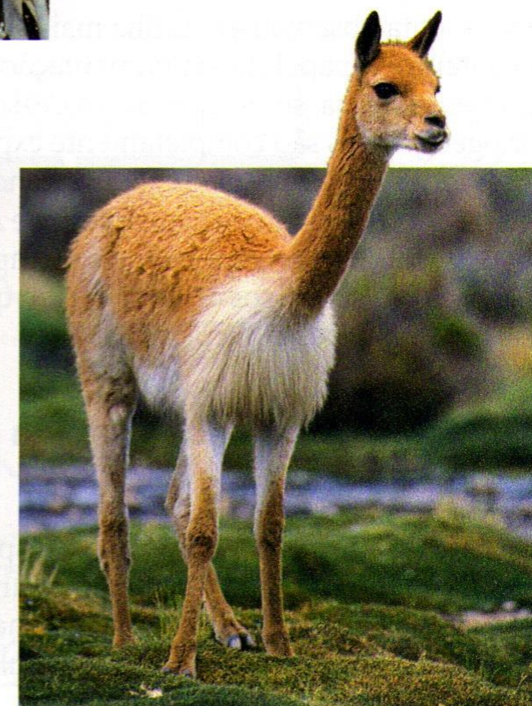
Dasypus novemcinctus

Erethizon dorsatum

(B)

Pseudalopex griseus

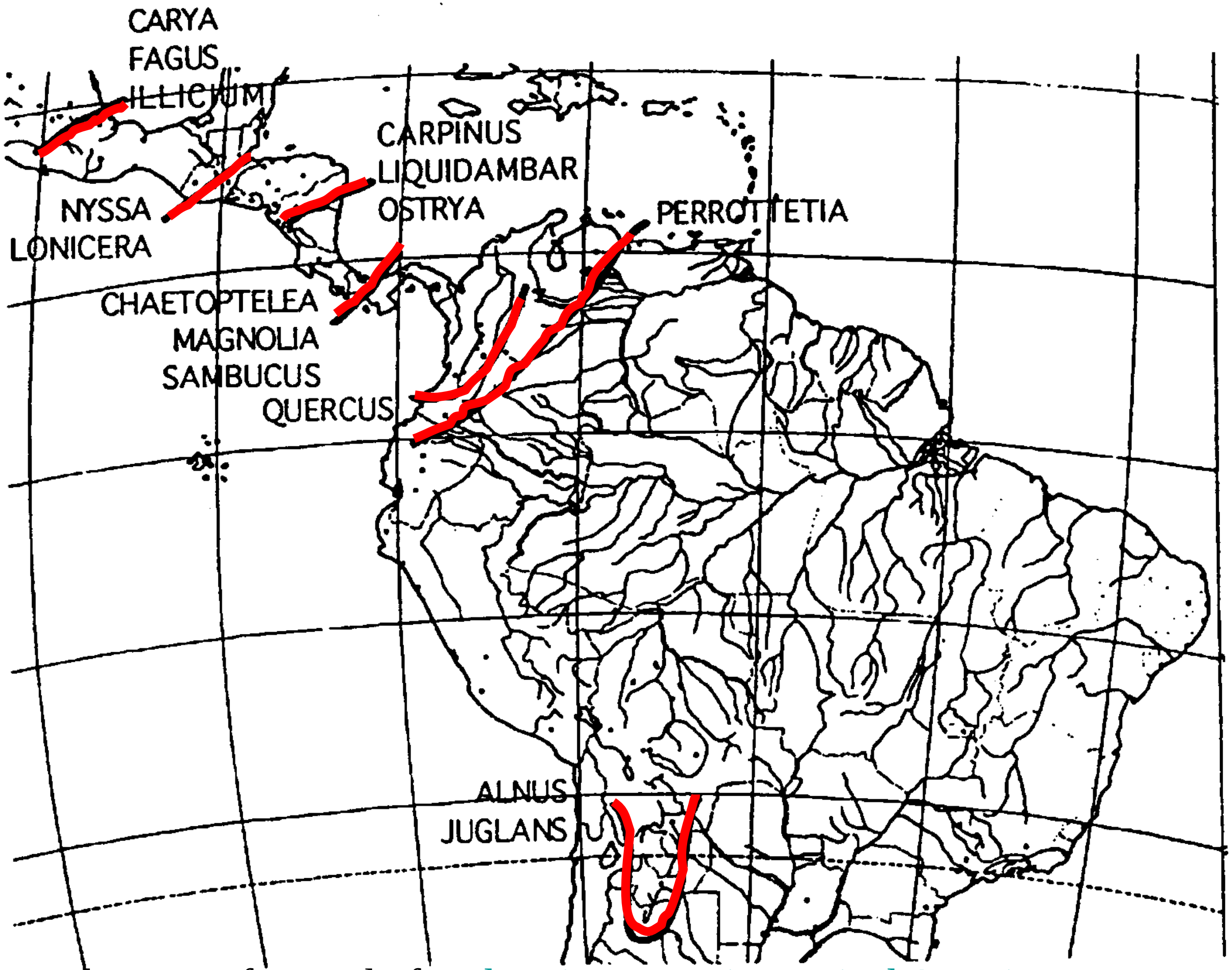
Catagonus wagneri



Vicugna vicugna

Sadava et al. 2009

Rotas de dispersão: filtros – istmo do Panamá



Southward extent of spread of Holarctic genera in tropical America

Churchil *et al.* 1995

Rotas de dispersão: filtros – istmo do Panamá

América Central é vulcânica
= rios correm para o mar
e não ao longo do istmo:
não há caminho de água doce
da Nicarágua até a Colômbia!

Northward extent of spread of
Gondwana genera in tropical America

Churchil *et al.* 1995

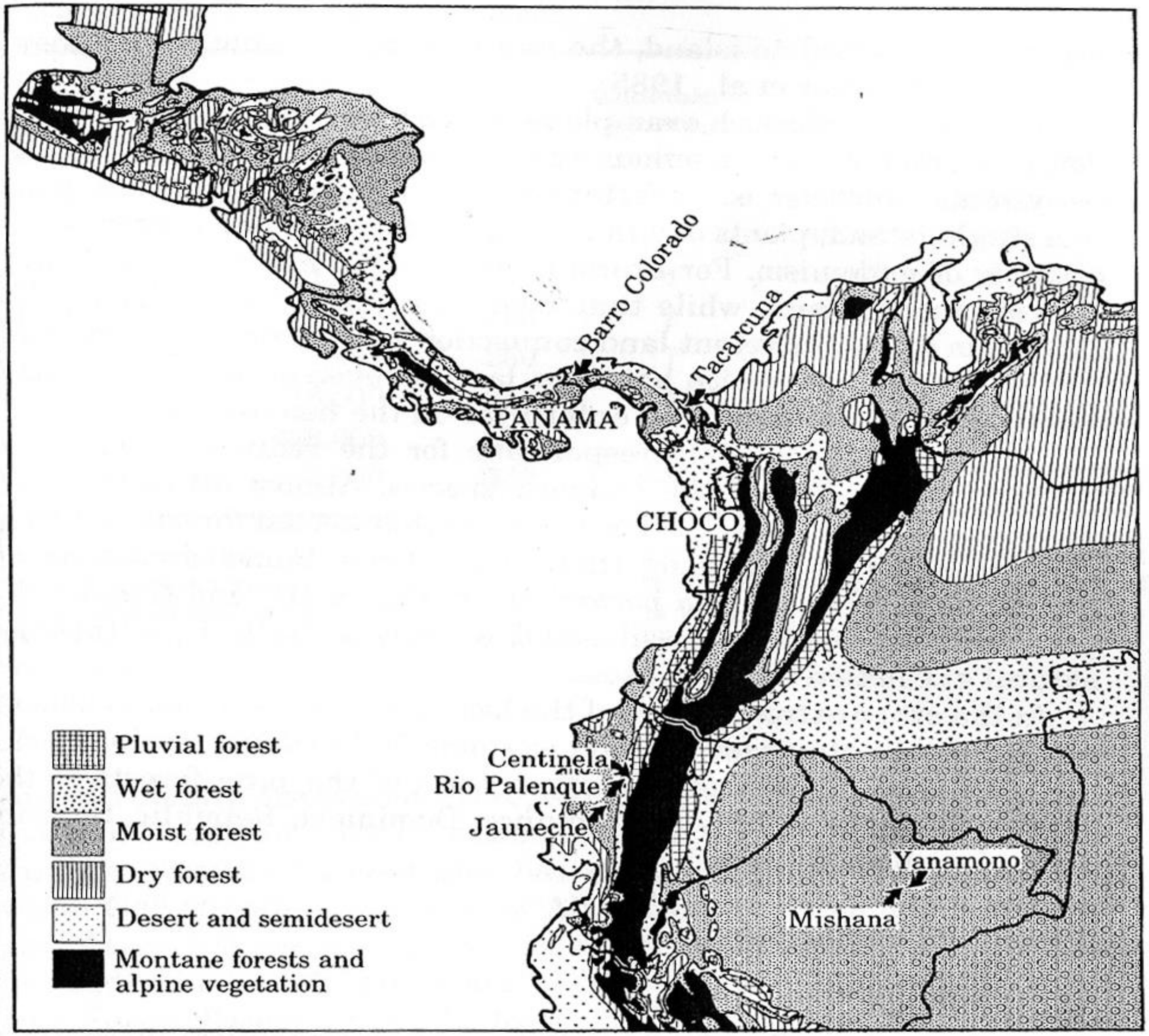
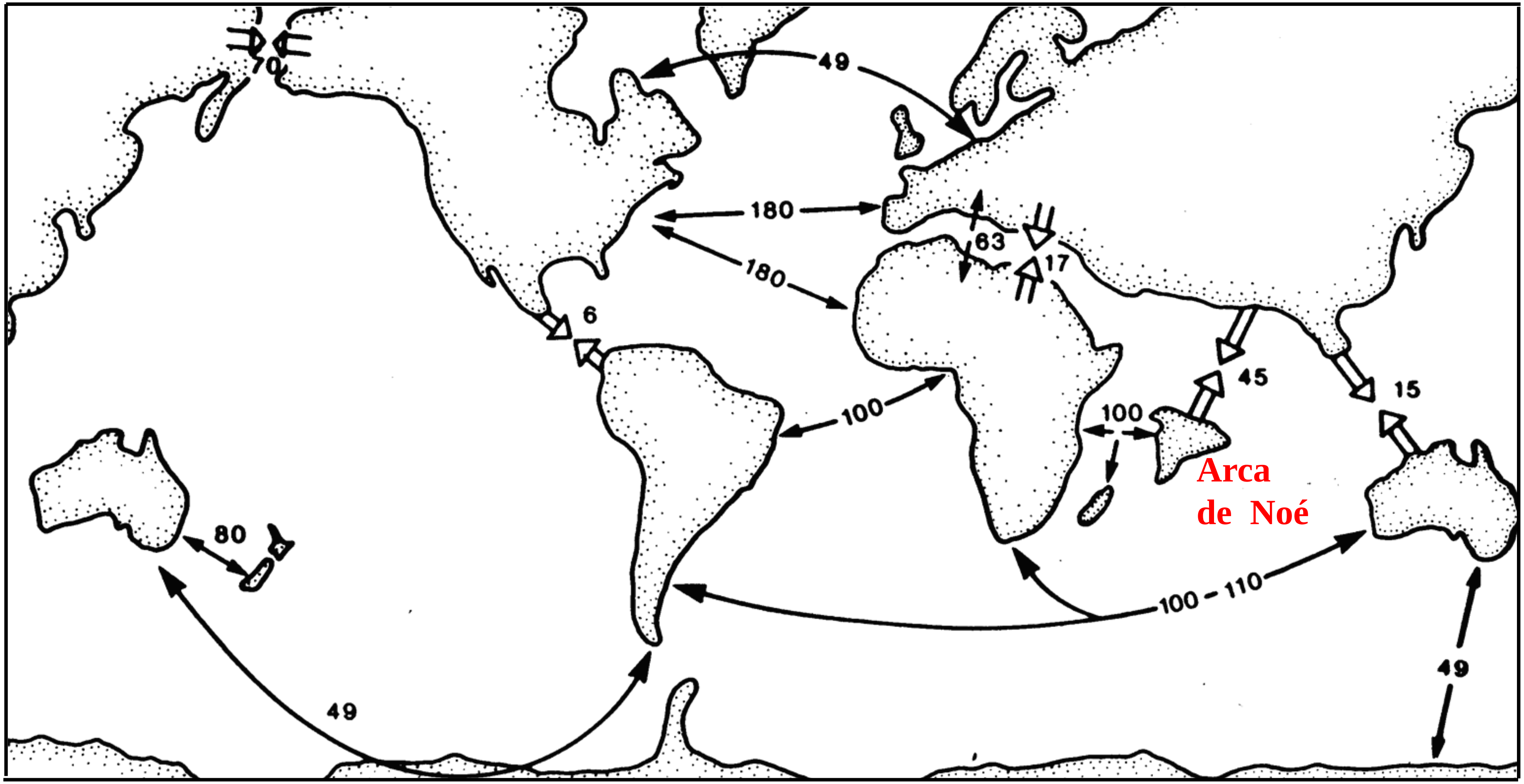


FIGURE 3. Ecological map of Central America and northwest South America showing localities emphasized in the text. Choco Department, Colombia, is outlined in black, as are international borders. (From Gentry, 1978.)

Gentry 1986



Estimates of the times (in millions of years BP) at which direct dispersal routes between land masses were made or broken. Hollow converging arrows show joins (the "join" between Australia and Asia refers to the narrowing of a gap and the appearance of stepping stone islands). Black diverging arrows show separations. (Based on Raven and Axelrod, 1974.)

Pielou 1979

Em suma:

Grande n° de pontes de terra transoceânicas (agora submersas) foram propostas *ad hoc* para explicar distribuições disjuntas de muitos táxons.
Alguns usaram exclusivamente pontes holárticas.

Biogeógrafos foram muito conservadores e ajudaram menos do que poderiam a evidenciar barreiras e conexões terrestres antigas.
Mas agora podemos fazer reconstruções com background mais realístico da história geológica da Terra.