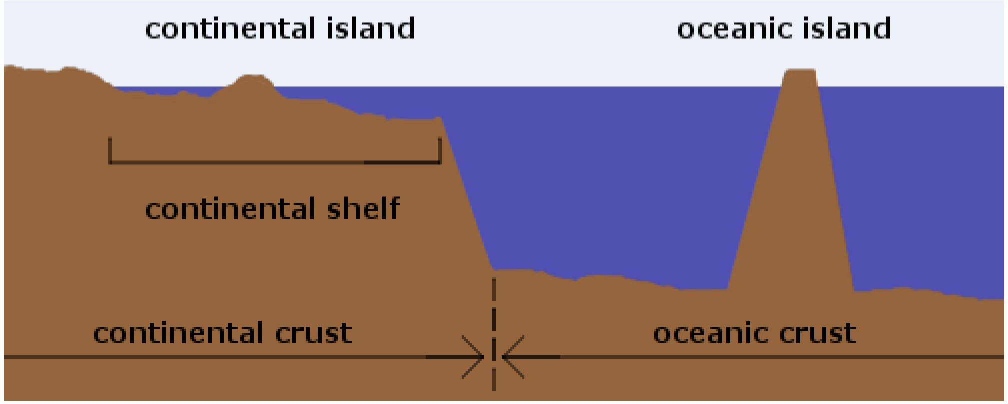
ISLANDS

ISLANDS

Types of islands:

- Geological
  - Oceanic
  - Continental



ISLANDS

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  - Oceanic
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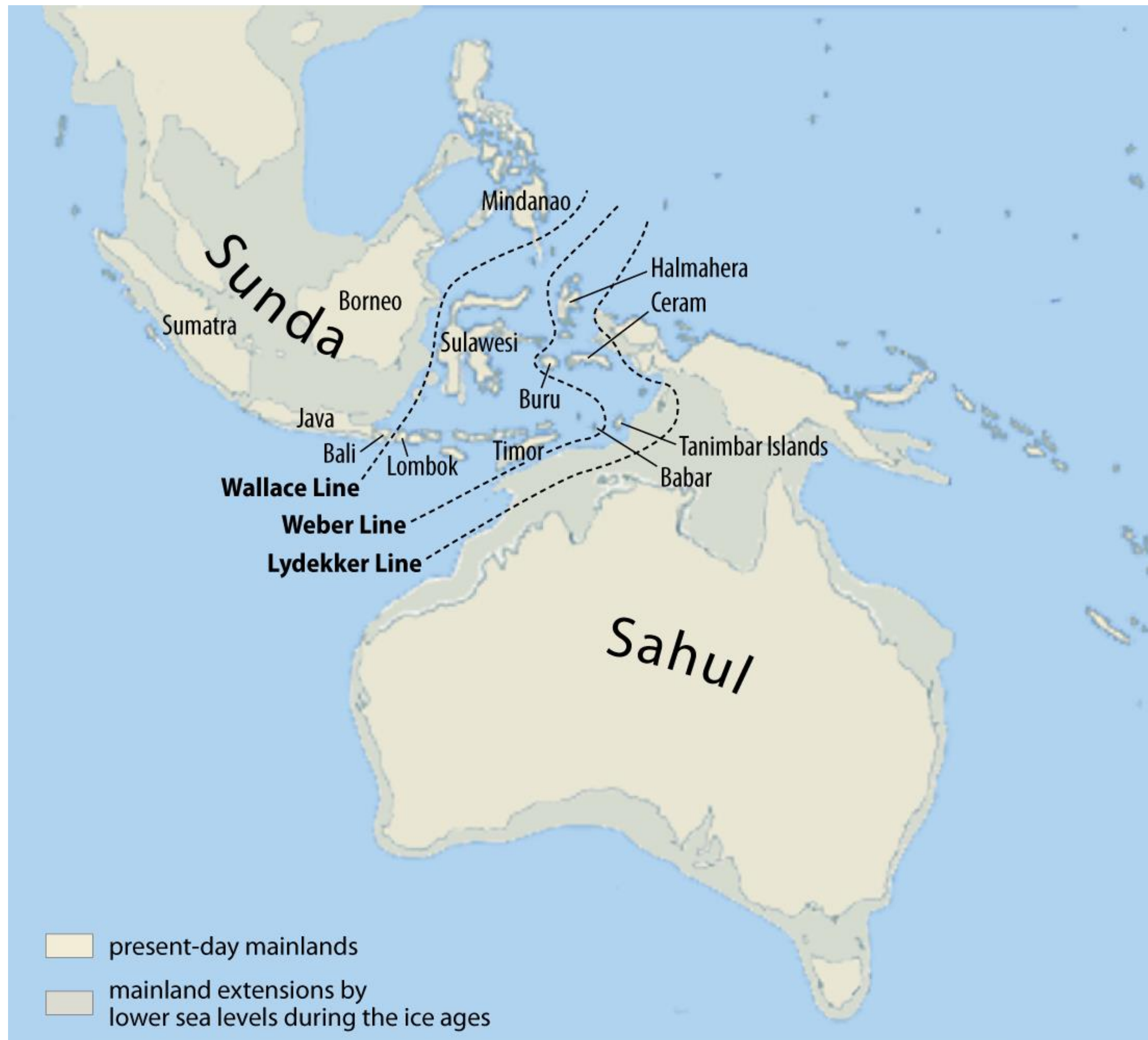

ISLANDS

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  - Oceanic
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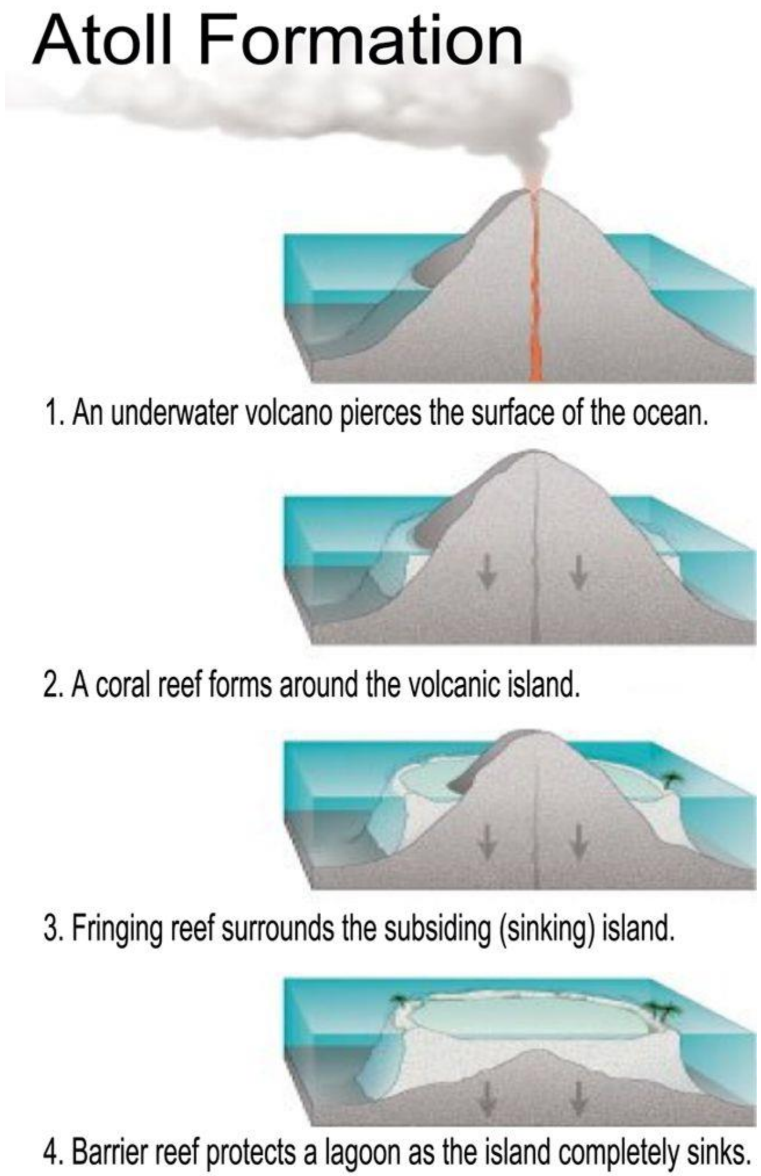
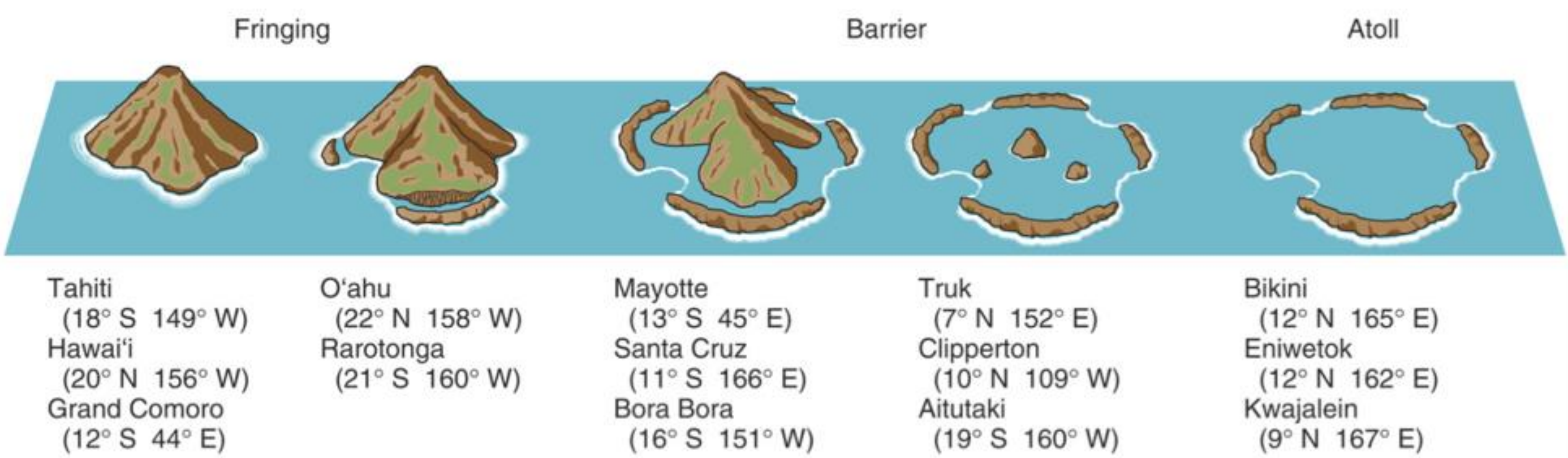


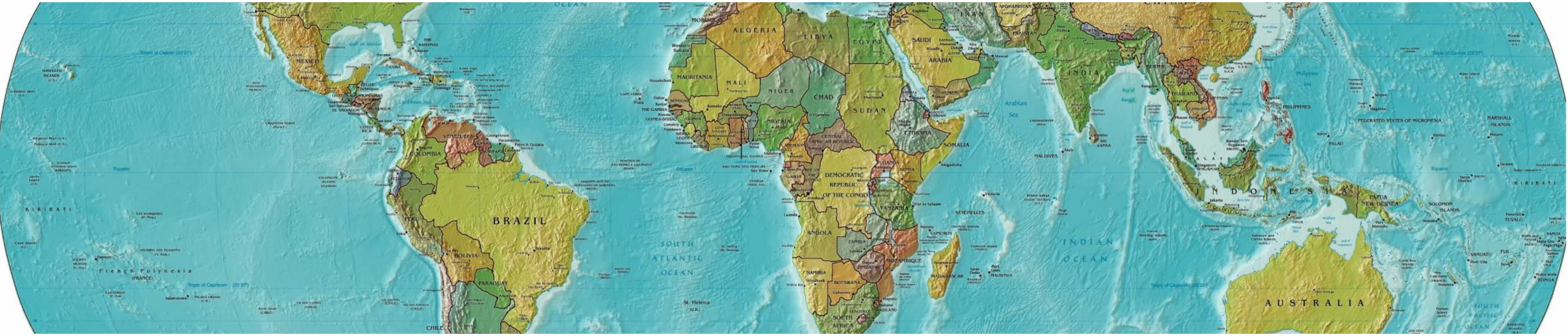
ISLANDS

Types of islands:

- Geological
  - Oceanic
  - Continental



ISLANDS


ALGERIA
LIBYA
EGYPT
SAUDI ARABIA
IRAN
INDIA
MEXICO
MAURITANIA
MALI
NIGER
CHAD
SUDAN
NIGERIA
ETHIOPIA
SOMALIA
DEMOCRATIC REPUBLIC OF THE CONGO
ANGOLA
NAMIBIA
BOTSWANA
SOUTH AFRICA
MADAGASCAR
BRAZIL
BOLIVIA
PARAGUAY
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
INDONESIA
PAPUA NEW GUINEA
AUSTRALIA
KIRIBATI
French Polynesia

ISLANDS

Patterns associated to islands

ISLANDS

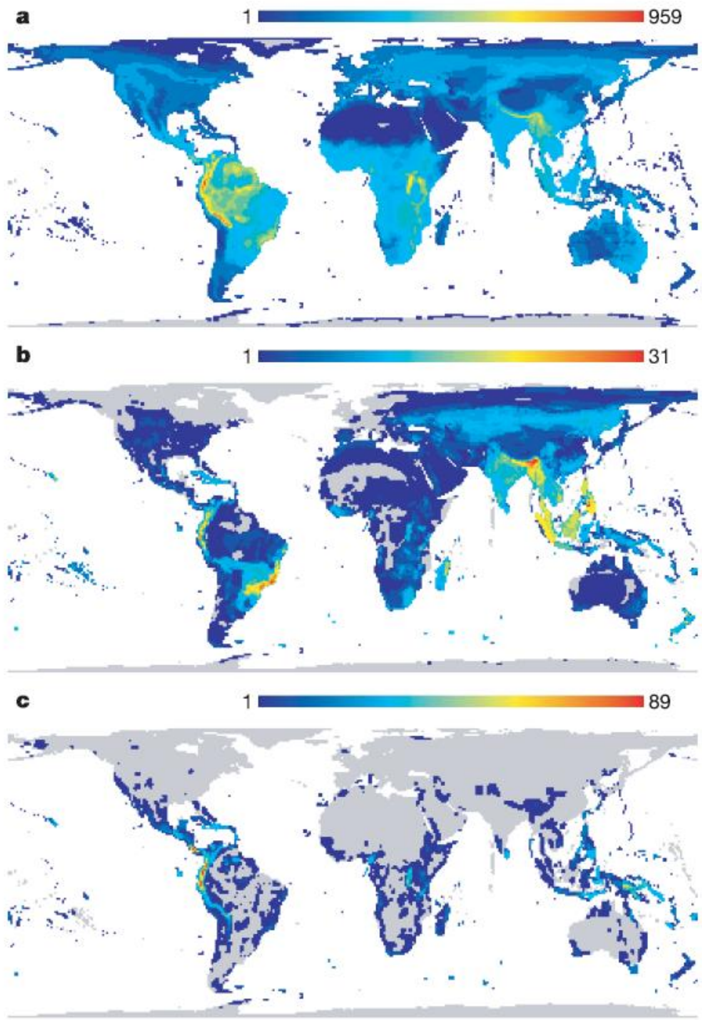


Figure 1 | Geographical distribution of three aspects of diversity. **a**, Total species richness. **b**, Threatened species richness. **c**, Endemic species richness. The bars above the maps show the corresponding colour scale, which is linear in terms of numbers of species.

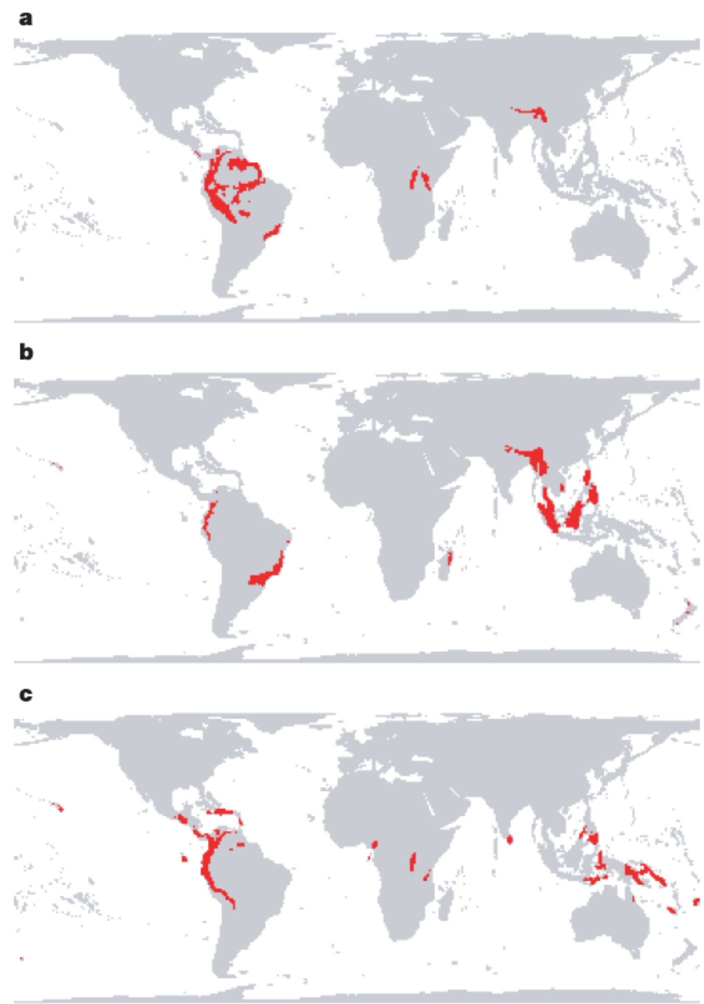


Figure 2 | Biodiversity hotspots for three aspects of diversity. **a**, Hotspots of species richness. **b**, Hotspots of threatened species. **c**, Hotspots of endemic species. For each measure of diversity, hotspots are defined as the richest 2.5% of grid cells. Hotspots are shown in red.

Low species richness

Prone to threats

Endemic rich

ISLANDS

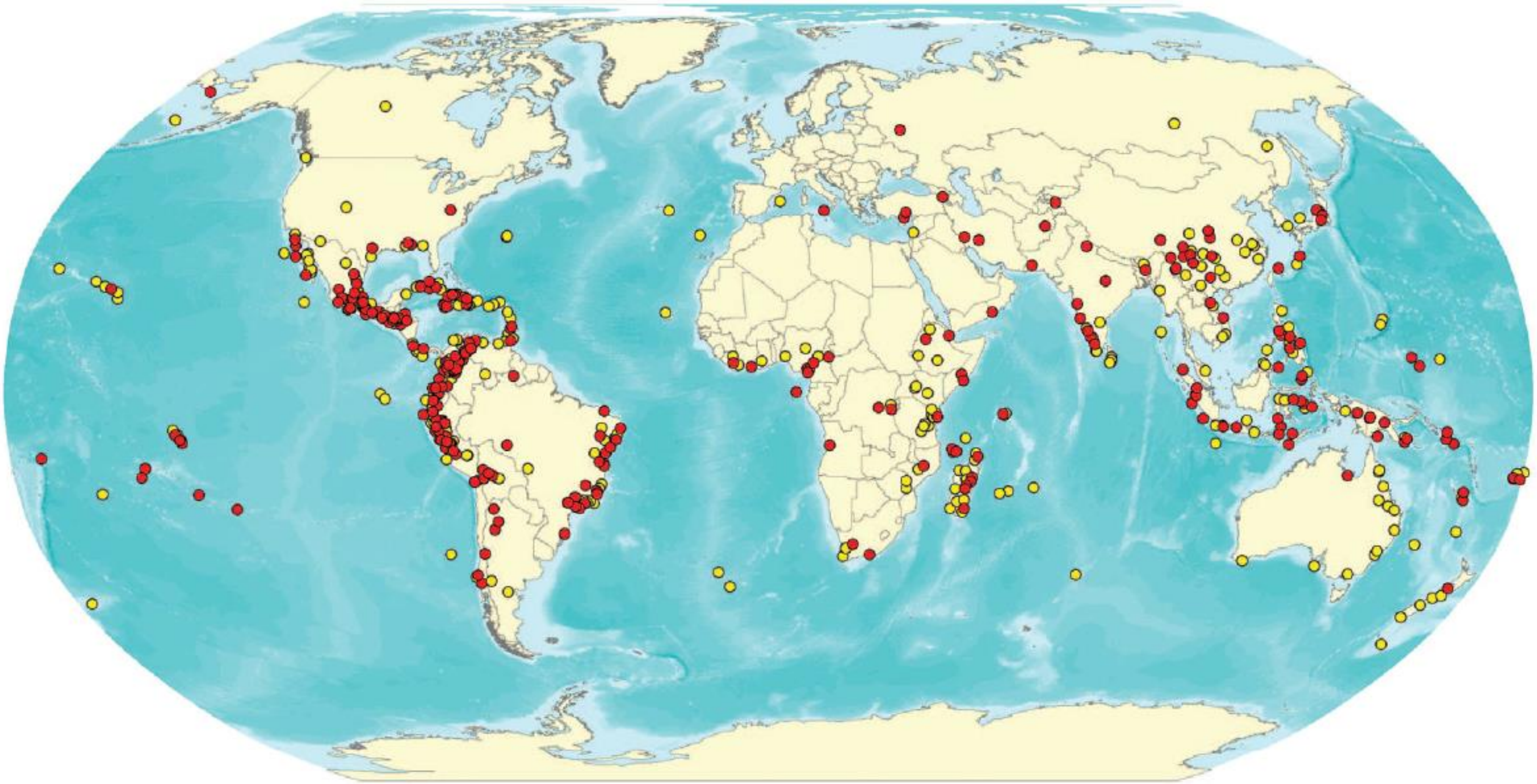


Fig. 1. Map of 595 sites of imminent species extinction. Yellow sites are either fully or partially contained within declared protected areas (n = 203 and 87, respectively), and red sites are completely unprotected or have unknown protection status (n = 257 and 48, respectively; see *Methods*). In areas of overlap, unprotected (red) sites are mapped above protected (yellow) sites to highlight the more urgent conservation priorities.

Prone to threats

ISLANDS

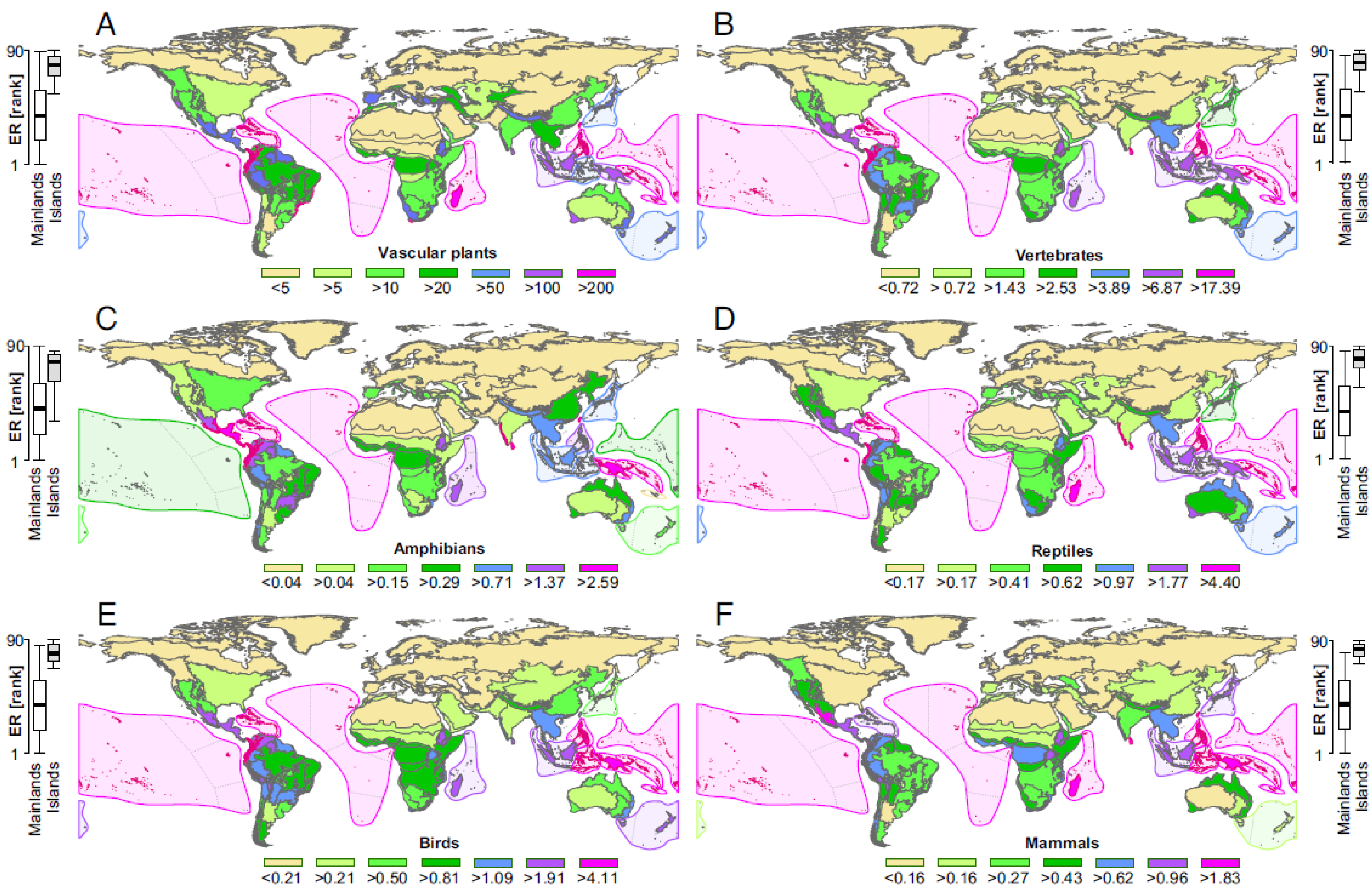


Fig. 1. Global patterns of endemism richness (ER; range equivalents per 10,000 km^2) for (*A*) vascular plants, (*B*) terrestrial vertebrates, (*C*) amphibians, (*D*) reptiles, (*E*) birds, and (*F*) mammals across 90 biogeographic regions. Map legends were classified using quantiles, i.e., each color class contains a comparable number of regions. Box-and-whisker plots illustrate rank-based differences in endemism richness between mainland (n = 76; white boxes) and island regions (n = 14; gray boxes). Boxes mark second and third quartiles; whiskers mark the range of the data.

ISLANDS

High population density

ISLANDS

Extreme adaptations:

- Brachyptery
- Reduced/loss of flight ability

ISLANDS

Intraspecific

variability

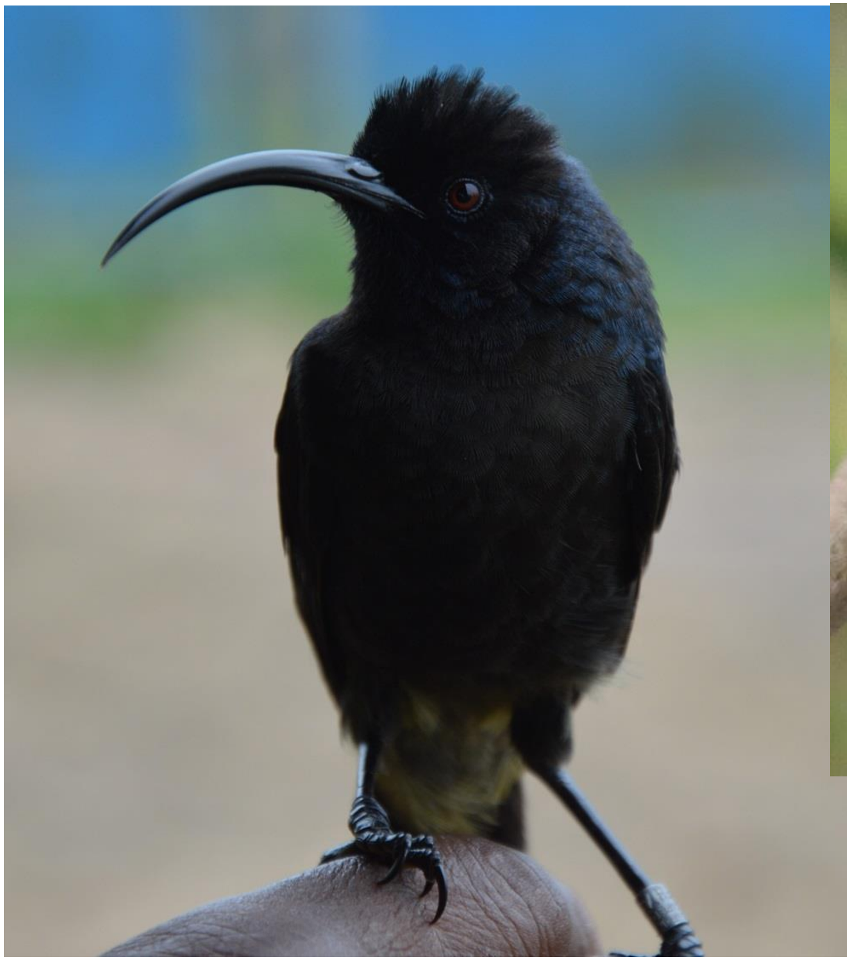
(Sexual dimorphism)

ISLANDS

Gigantism

Nanism

ISLANDS



Gigantism / Nanism

Loss of sexual ornaments

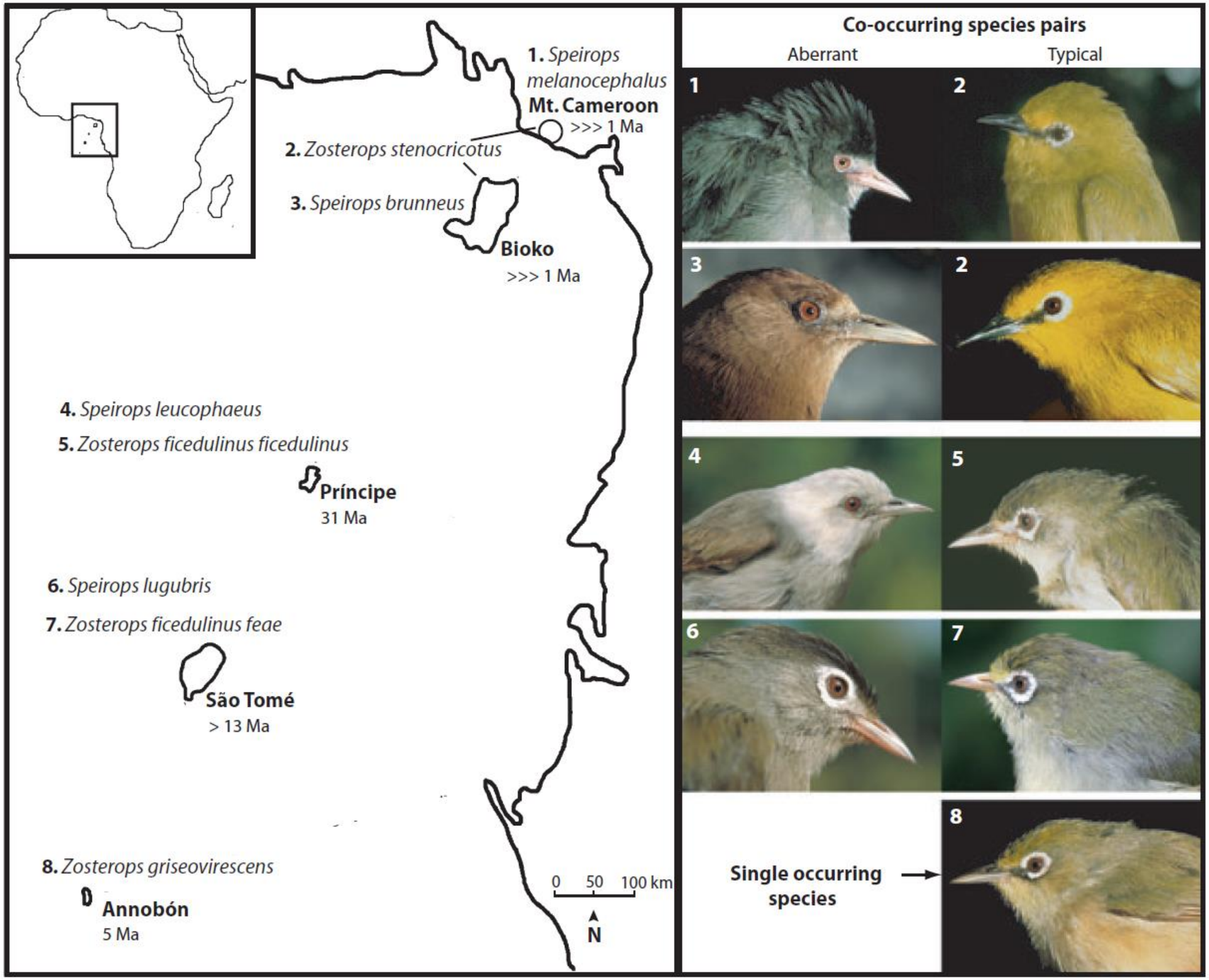
Ecological displacement

ISLANDS

Reduced sexual ornaments

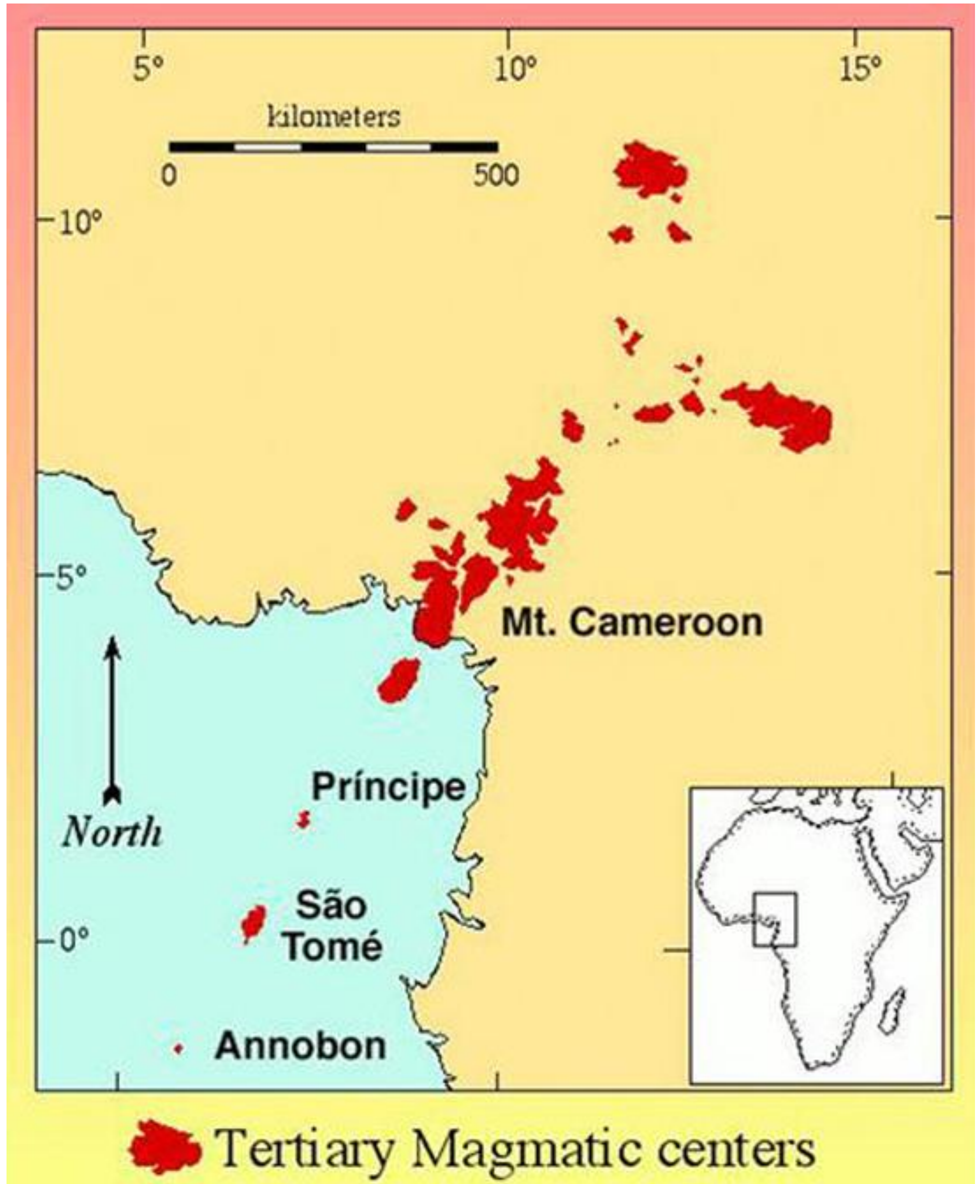
Gigantism

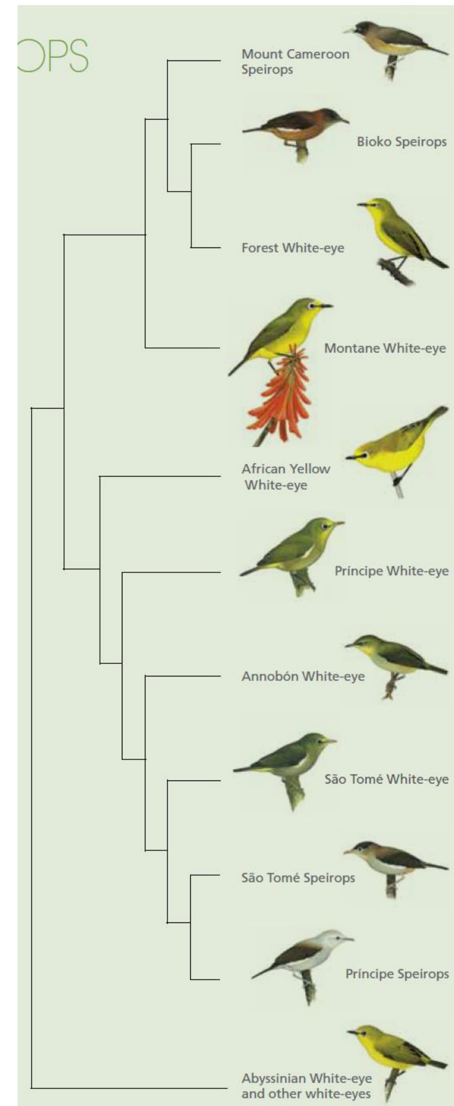
Ecological displacement



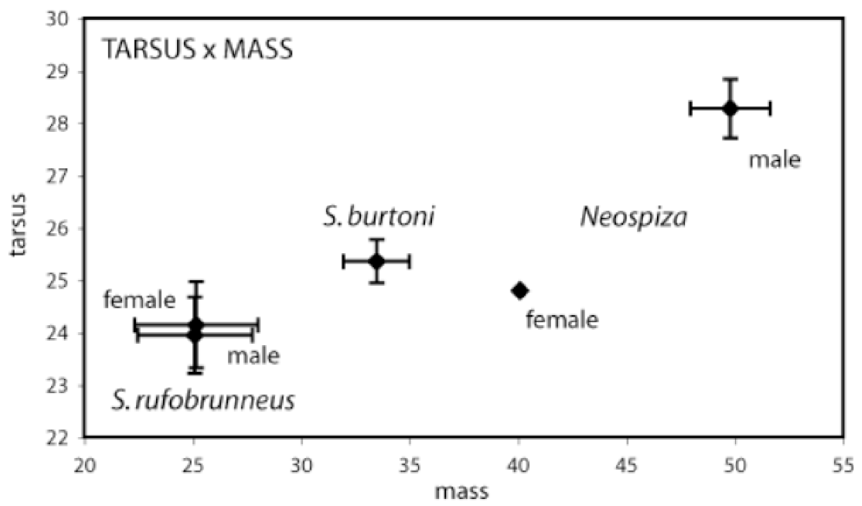
ISLANDS

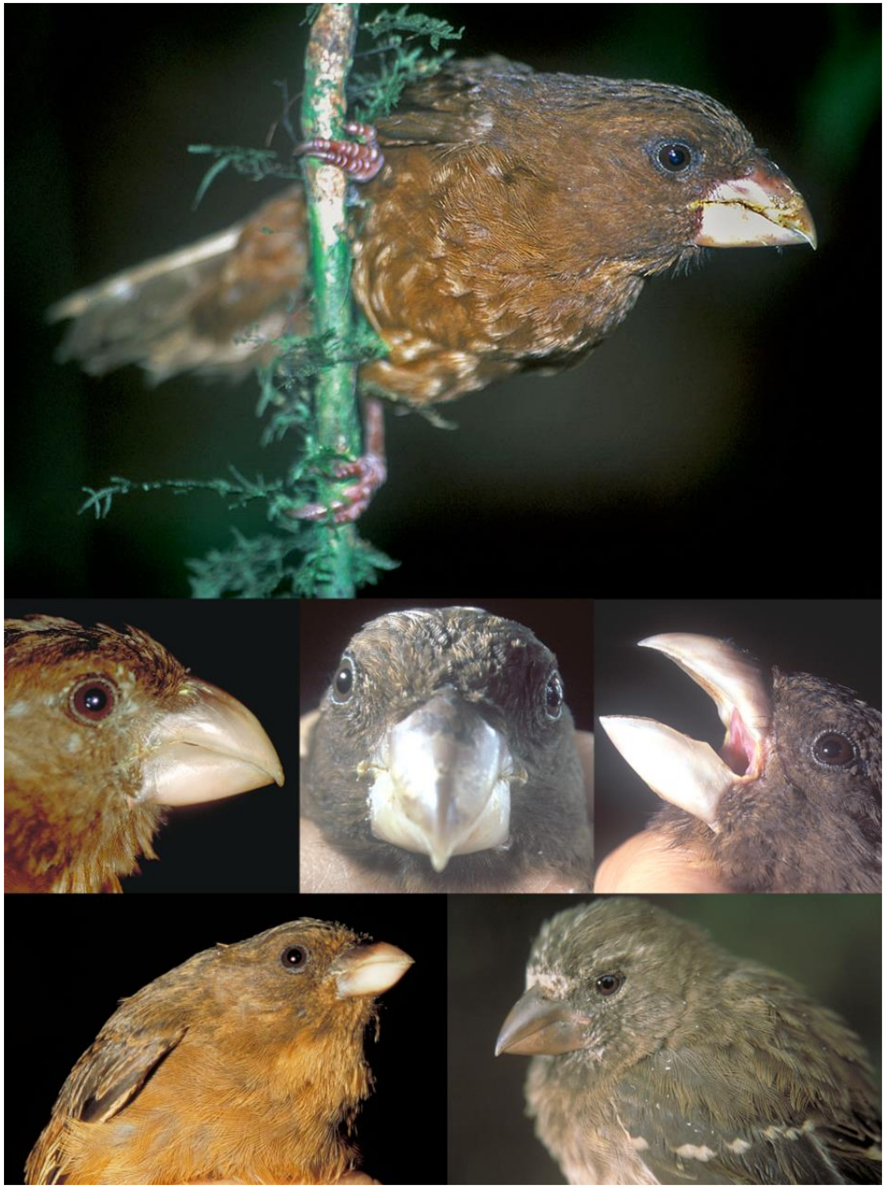
Reduced sexual ornaments





ISLANDS





Gigantism

Sexual dimorphism

Ecological displacement

ISLANDS

Reduced fecundity

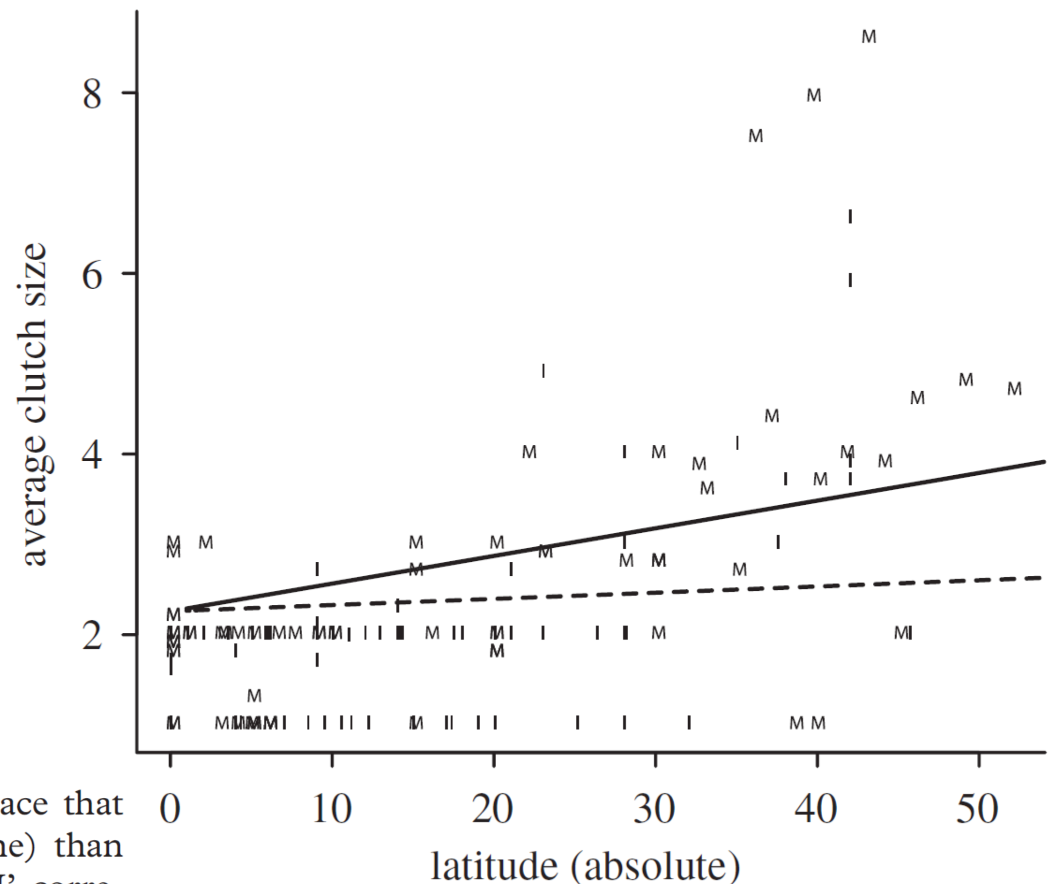
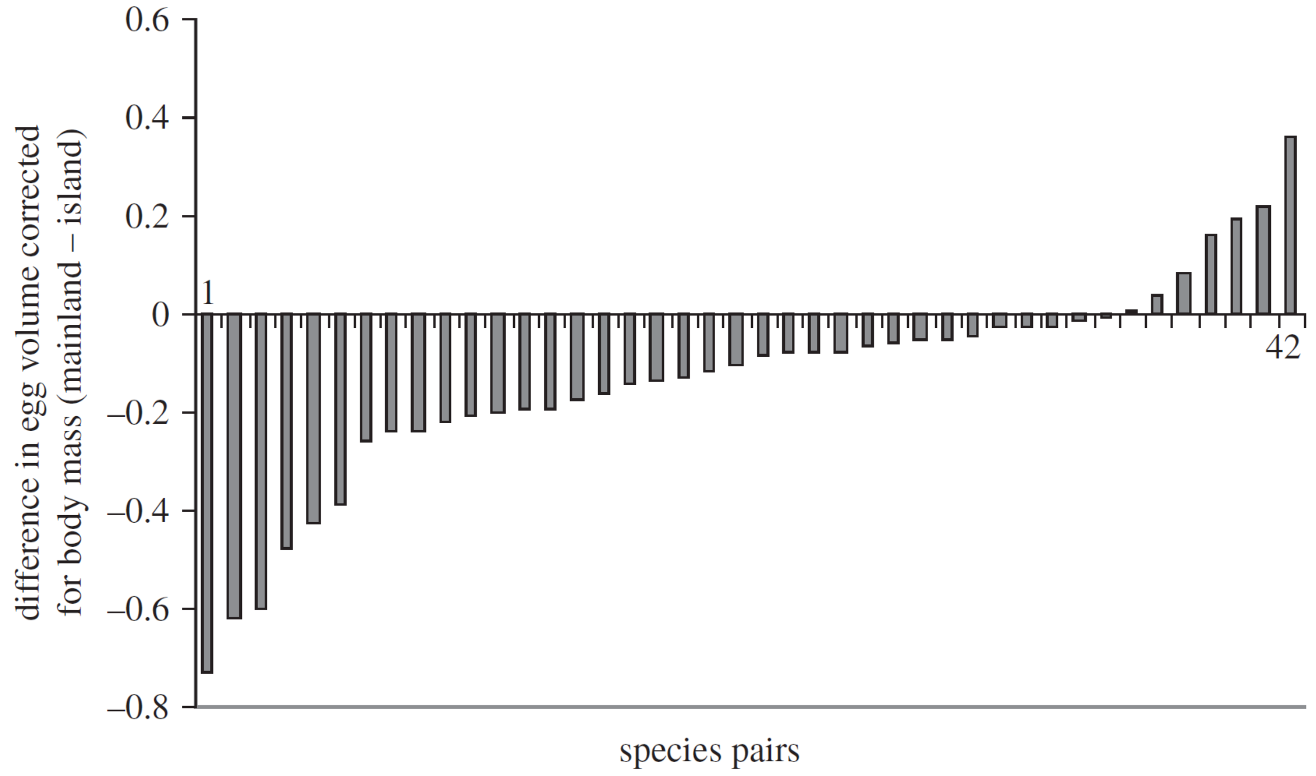


Figure 1. Clutch size increased with latitude at a pace that was *ca* 4.5 times higher on the mainland (solid line) than on the islands (dashed line). The letters 'M' and 'I' correspond to the data points for the mainland and island species used ($n = 148$ species). The effect of the interaction remains significant if the three outliers (and their island counterparts) are removed from the analysis ($F_{1,68} = 6.42$, $p = 0.014$).

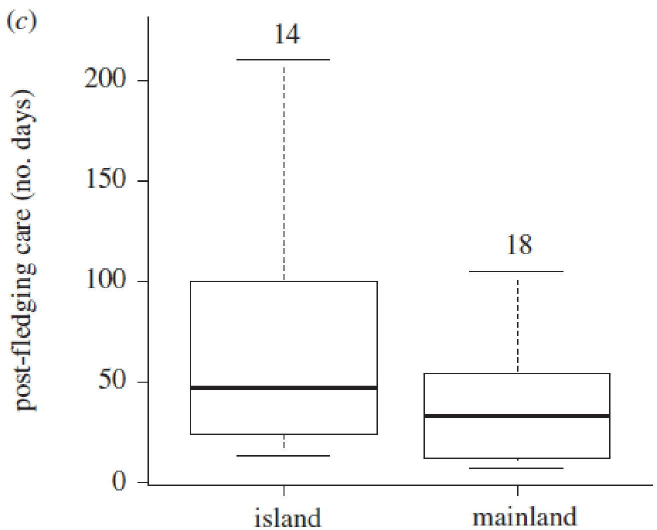
ISLANDS

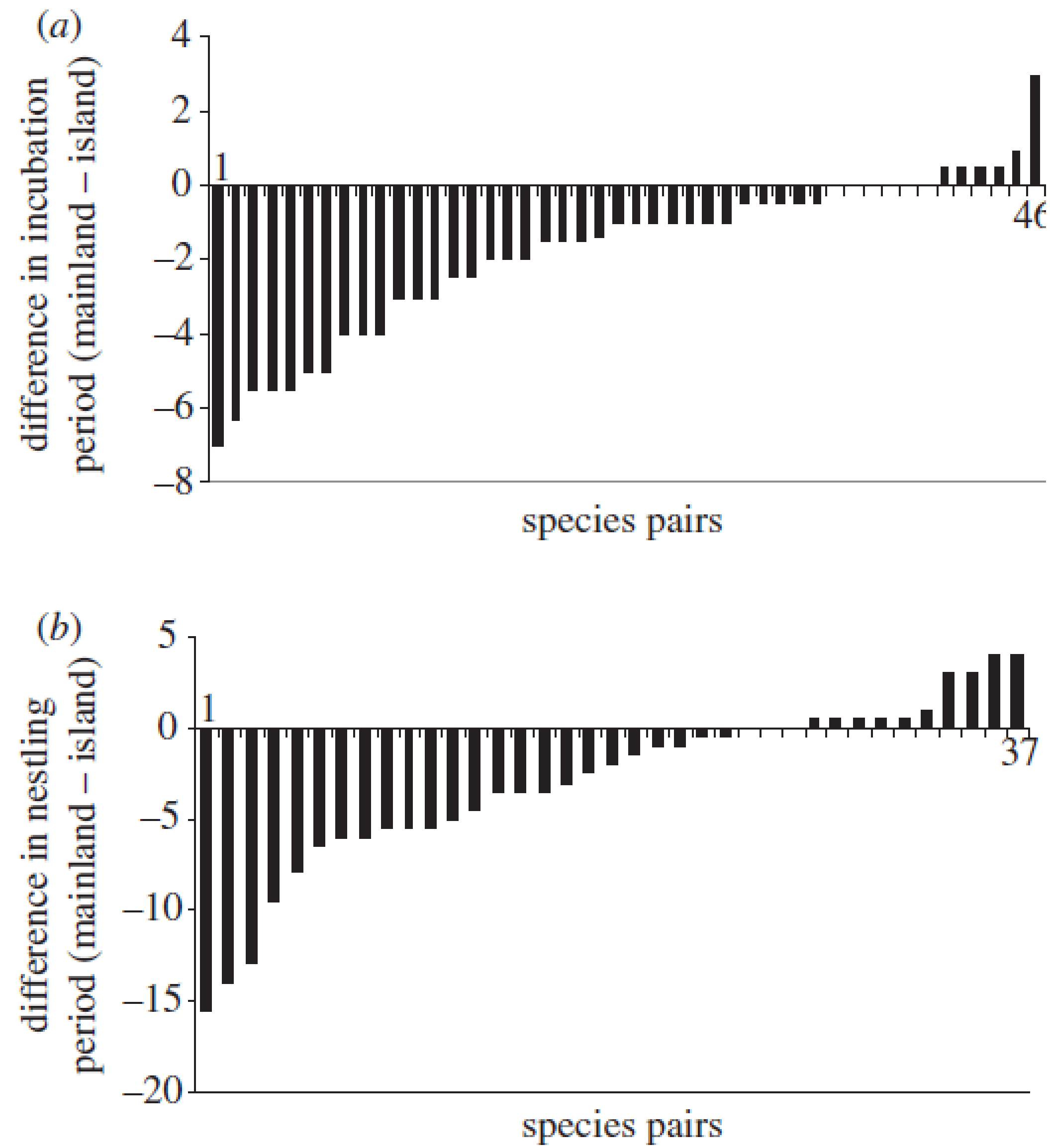
Figure 2. The egg volume of islands species was generally larger than that of the mainland counterparts. This graph represents the difference between the mainland value and the island value for the pairs used in the analyses (hence negative values correspond to a larger egg volume of the insular species). To account for body size, the figure was based on the residuals of a regression of egg volume against body mass (but not the analyses—see text).

High progeny investment



ISLANDS





High progeny investment

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Wider ecological niches

Simpler trophic networks

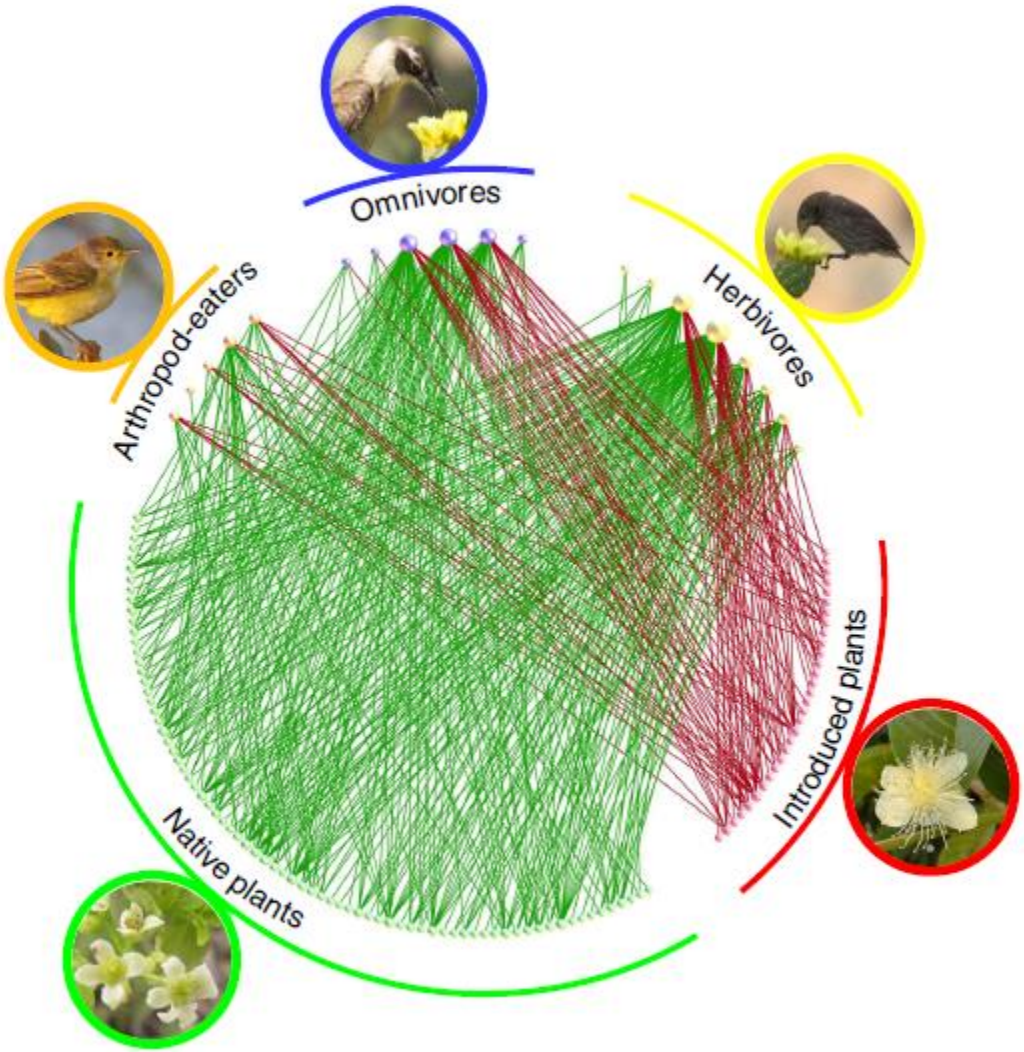


Figure 1 | Archipelago network in which all interactions observed on the 12 largest Galápagos islands were pooled. This network consisted of 19

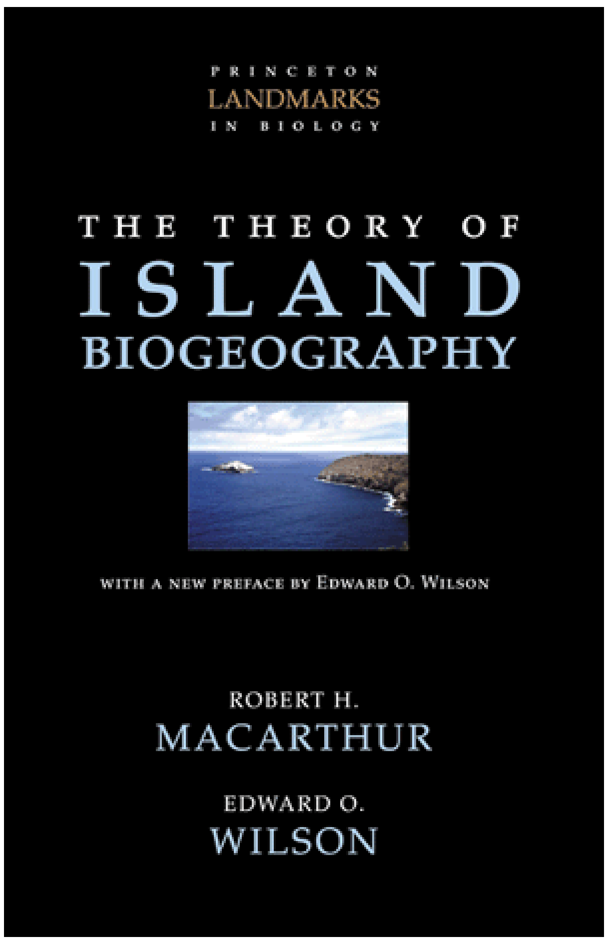
ISLANDS

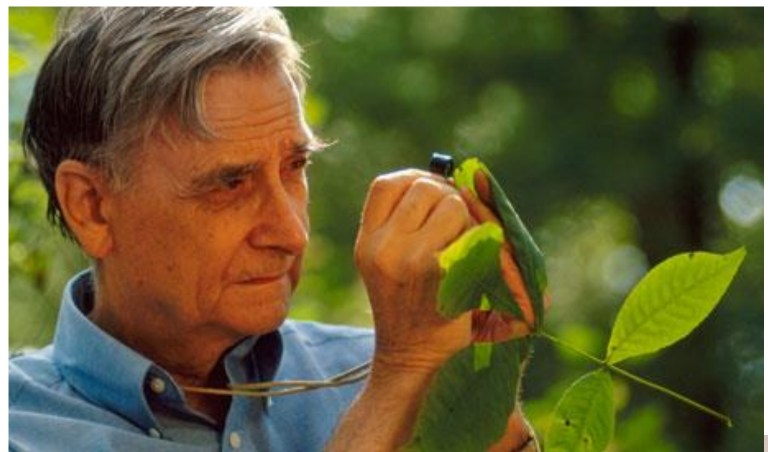
Island syndromes:

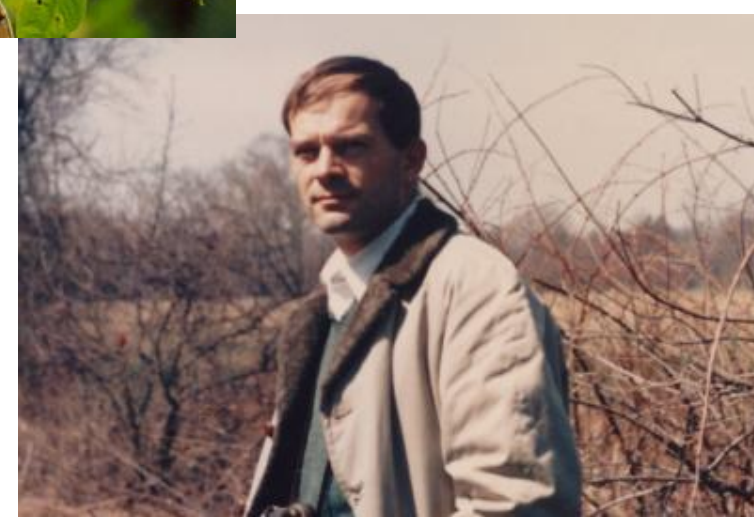
- Reduced species richness
- Endemic-rich
- High population densities
- K-strategies
- Gigantism and nanism
- Reduced mobility (apterism)
- Reduced aggressiveness
- Predator naivity
- Reduced sexual ornaments
- Simplified ecological interactions
- Wider ecological niches
- ...

ISLANDS

Theory of Island Biogeography

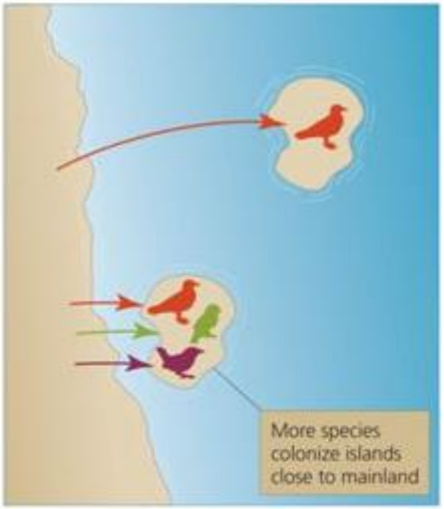






ISLANDS

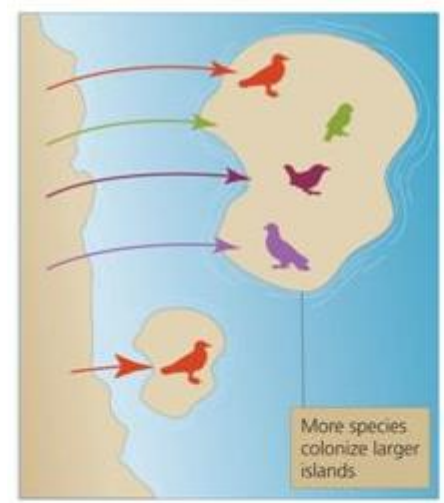
- *Distance effect*: the farther an island is from the continent, the fewer species find and colonize it



(a) Distance effect

ISLANDS

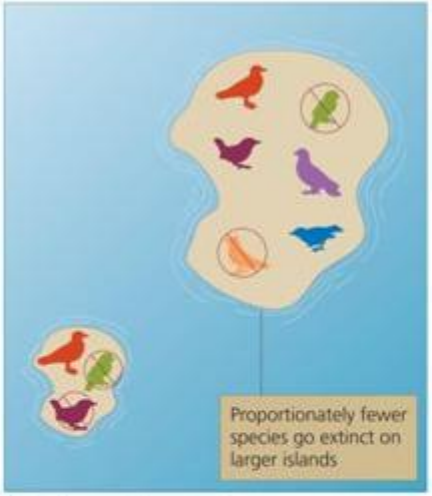
- Larger islands have higher immigration rates – they are fatter targets



(b) Target size

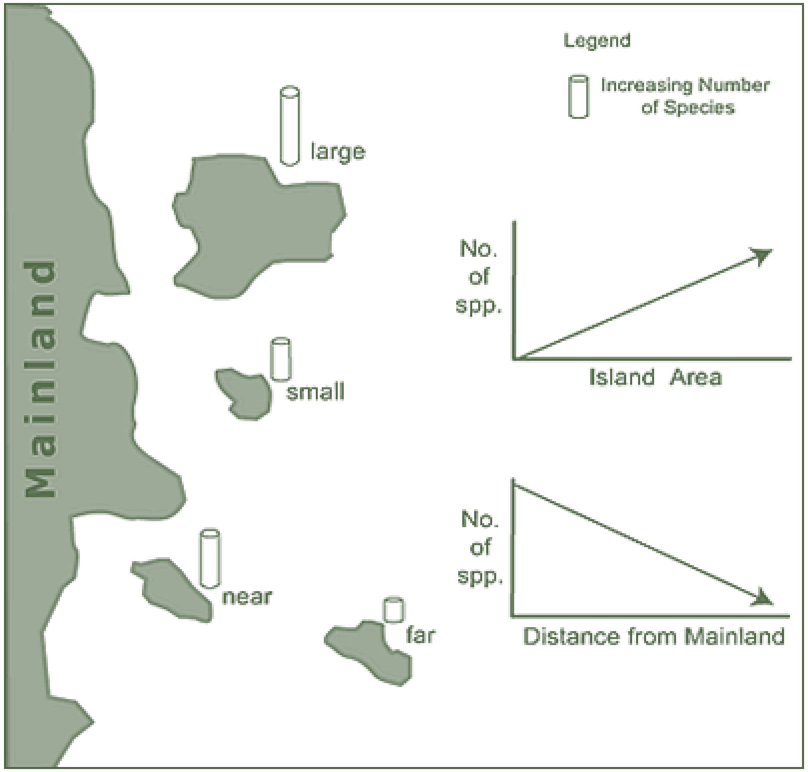
ISLANDS

- Larger islands have lower extinction rates – more space allows for larger populations



(c) Differential extinction

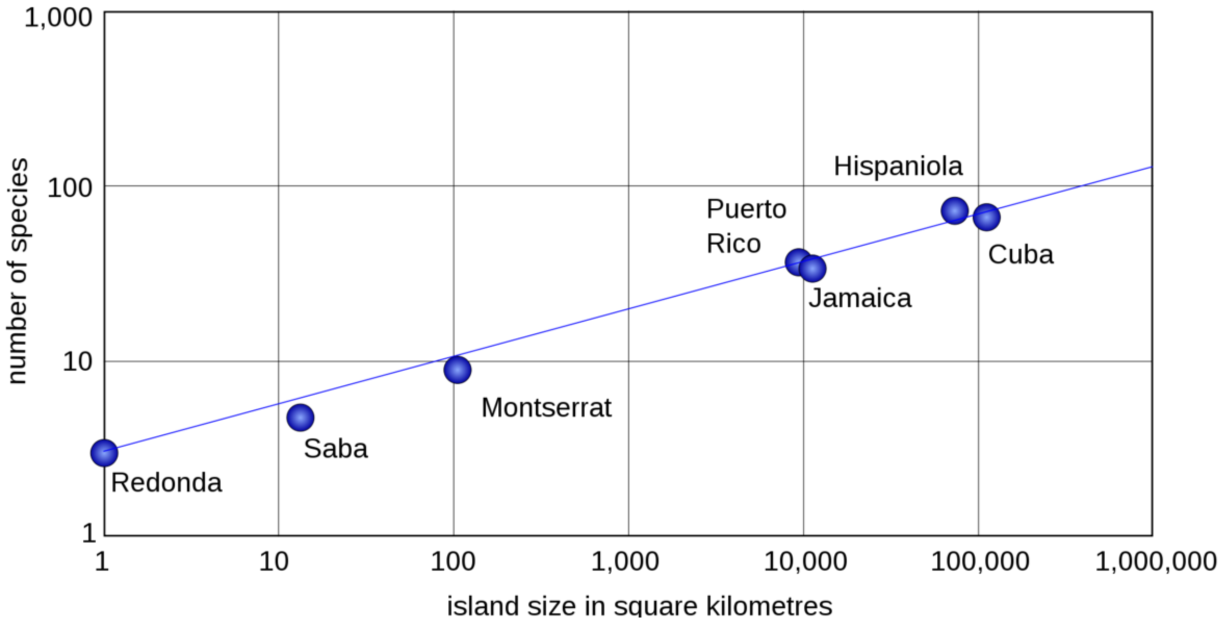
ISLANDS



Species richness:

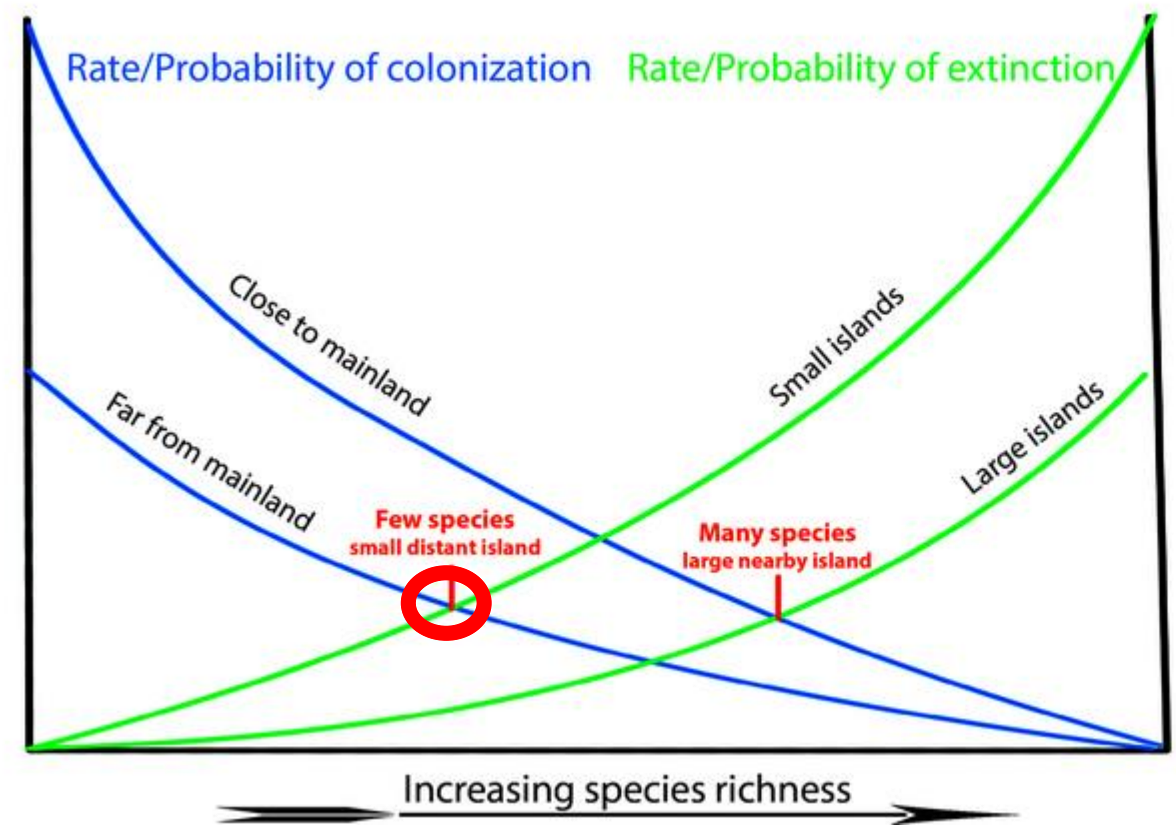
- Increases with island area

- Decreases with distance to source



ISLANDS

Dynamic balance



Tiny species richness

High proportion of endemics

Reduced turnover

Brachyptery and other extreme adaptations

Colonized by island specialists

ISLANDS

Fatu Hiva (Marquesas, French Polynesia)

85 km²

5.000 km to Mexico

ISLANDS

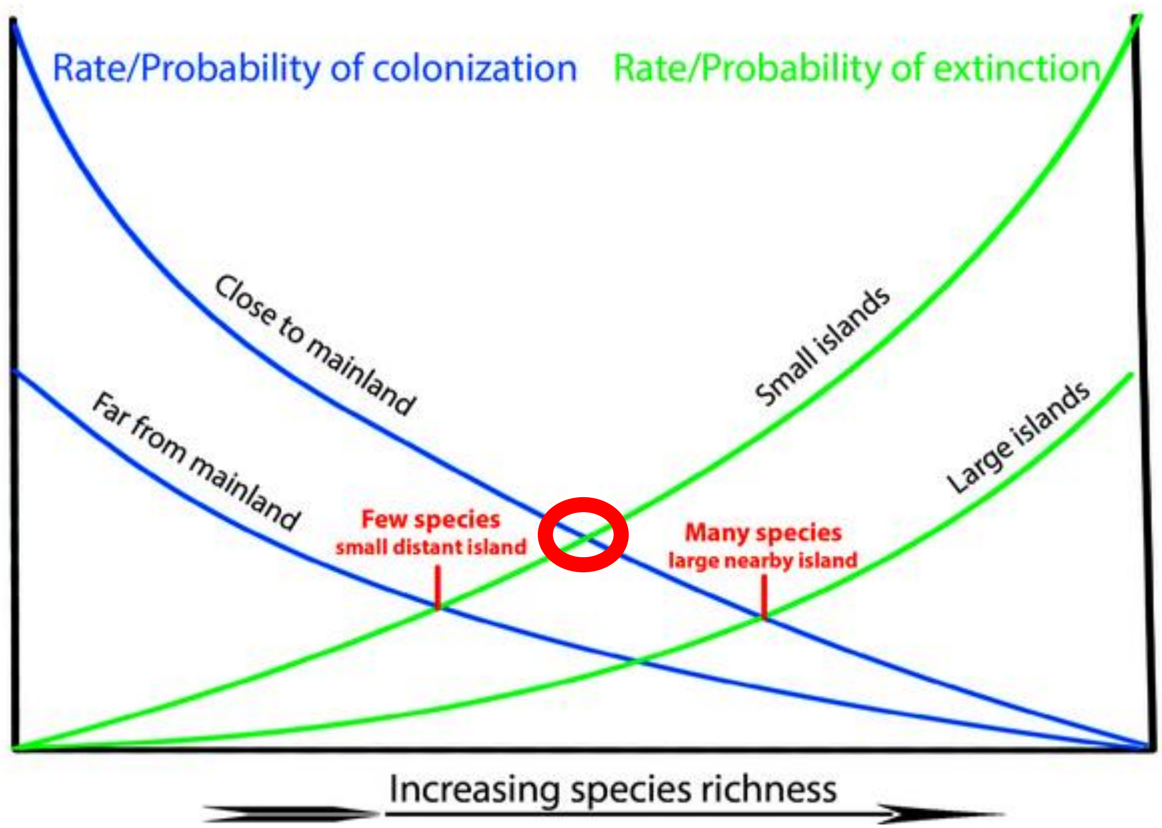
Fatu Hiva (Marquesas, French Polynesia)

3 terrestrial bird species

All endemic

ISLANDS

Dynamic balance



Reduced species richness

Few endemics

High turnover

Attenuated island syndrome

Colonized by multiple groups

ISLANDS

Curaçao (the Netherlands, Caribbean)

444 km²

65 km to Venezuela

ISLANDS

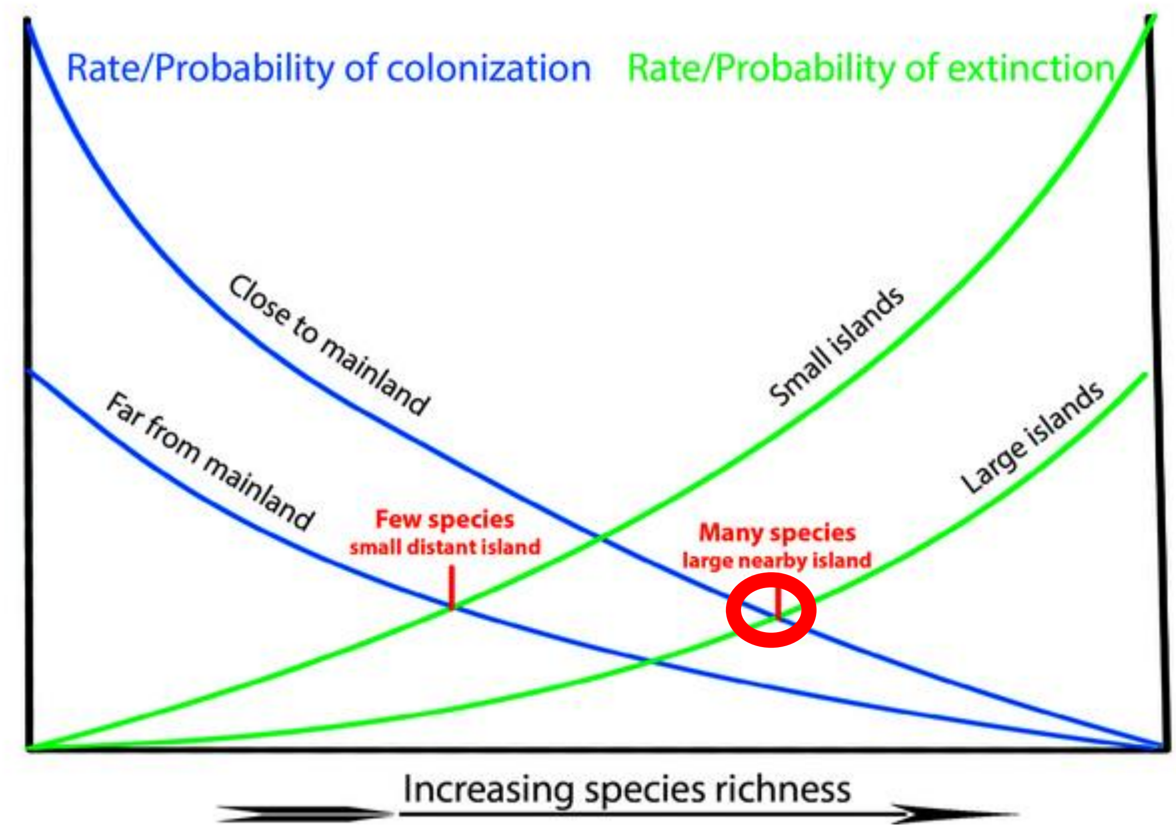
Curaçao (the Netherlands, Caribbean)

63 terrestrial bird species

No endemic

ISLANDS

Dynamic balance



High species richness

Small proportion of endemics

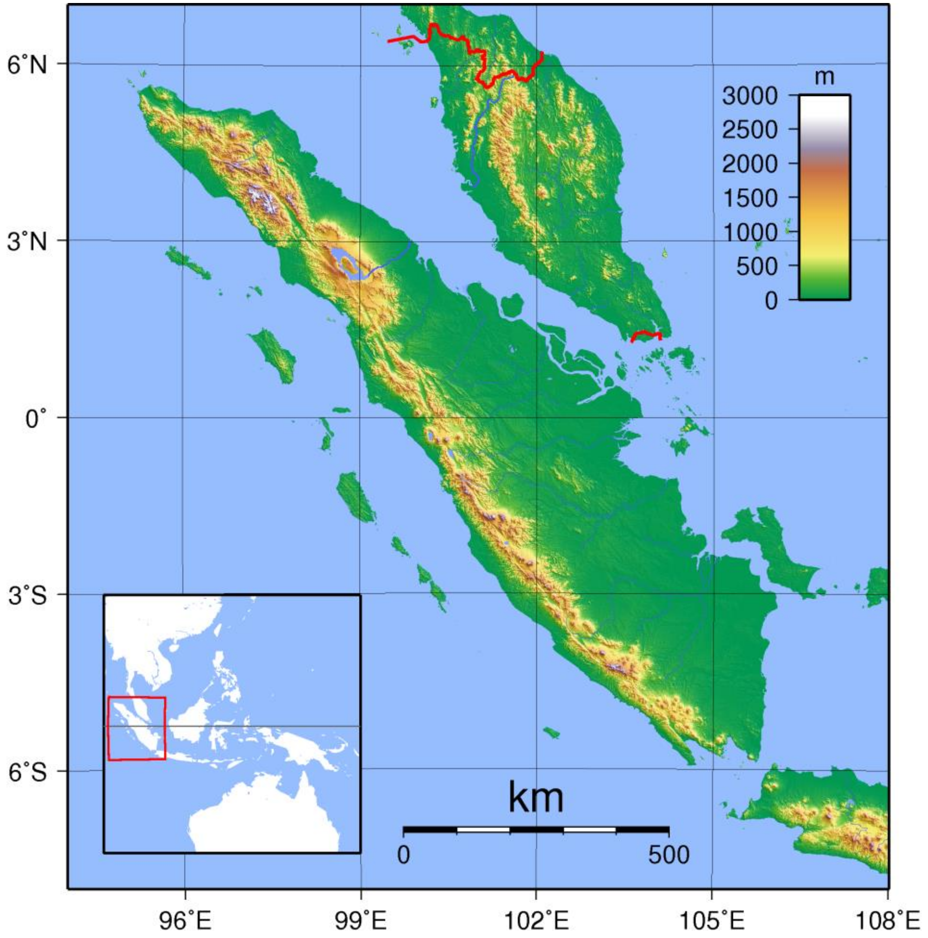
Intermediate turnover

Attenuated island syndrome

Colonized by many *taxa*

ISLANDS

Sumatra (Indonesia, Southeast Asia)

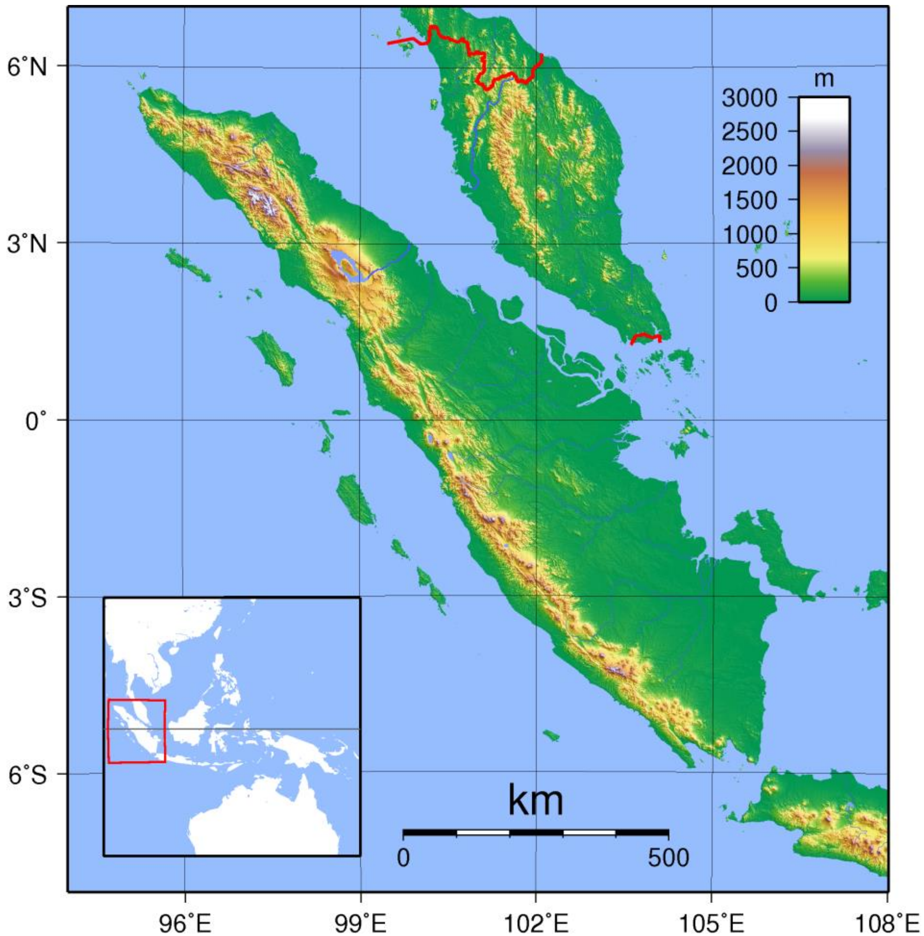


473 481 km²

c. 80 km to continental Malaysia

ISLANDS

Sumatra (Indonesia, Southeast Asia)

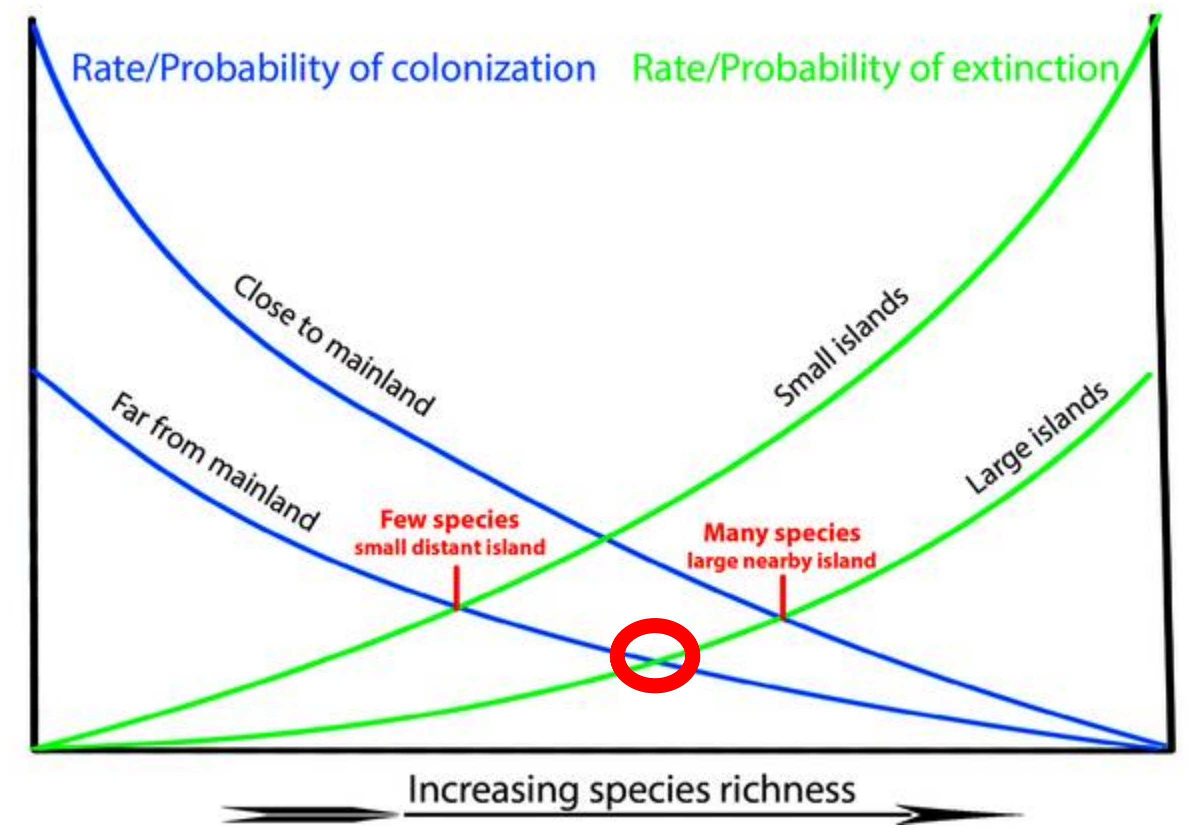


> 550 terrestrial birds

29 endemics

ISLANDS

Dynamic balance



Intermediate species richness

Many endemics (old)

Tiny turnover

Adaptive radiation

Intermediate island syndrome

Colonized by specialized *taxa*

ISLANDS

Madagascar

587 713 km²

400 km to Mozambique

ISLANDS

Madagascar

c. 250 terrestrial bird species

105 endemics

ISLANDS

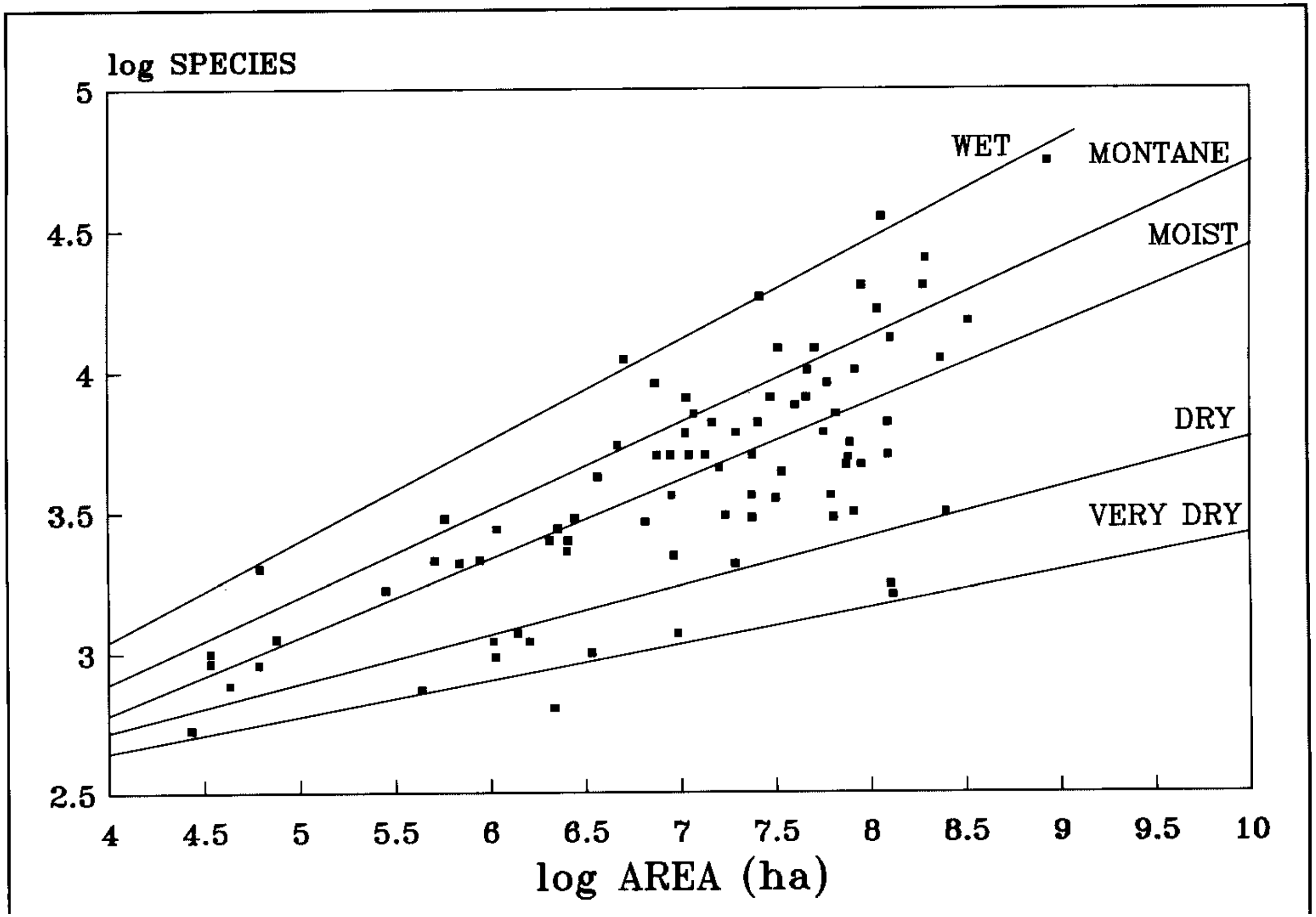
Other factors affecting island biodiversity

- Topography
- Island age
- Geology
- Climate
- Oceanic currents
- Winds
- Human presence
- Latitude
- Effective isolation (stepping stones / archipelagos)
- ….

ISLANDS

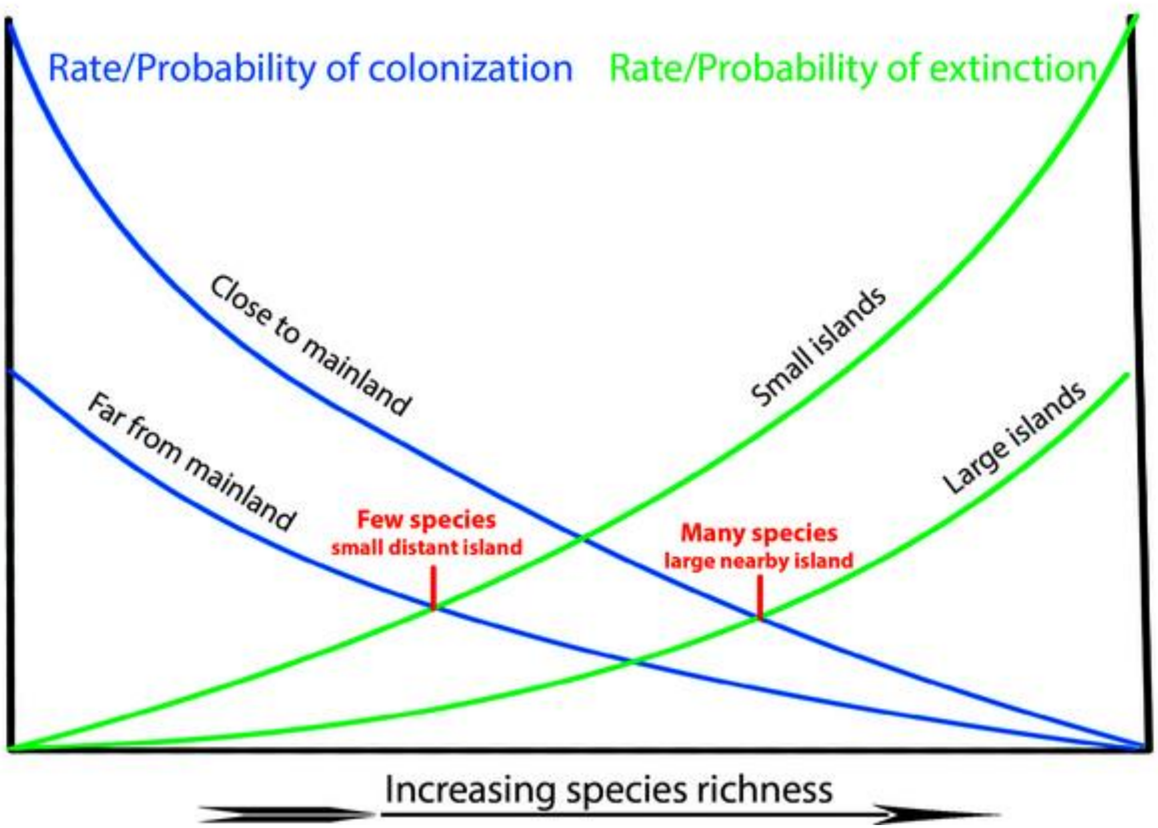
Figure 9

Species/area relationships, plant species - 86 countries



ISLANDS

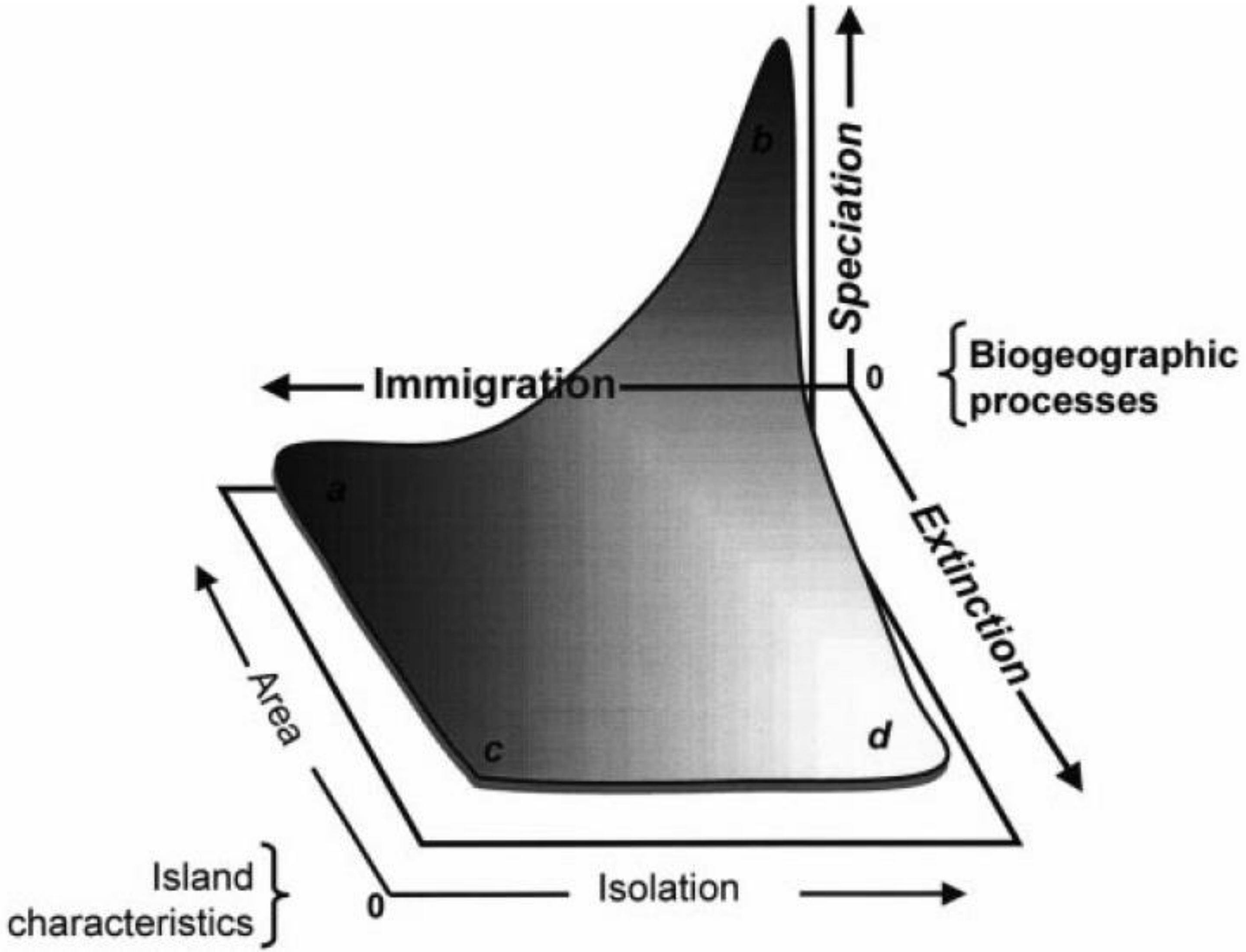
Dynamic balance



Essentially, all models are wrong, but some are useful.

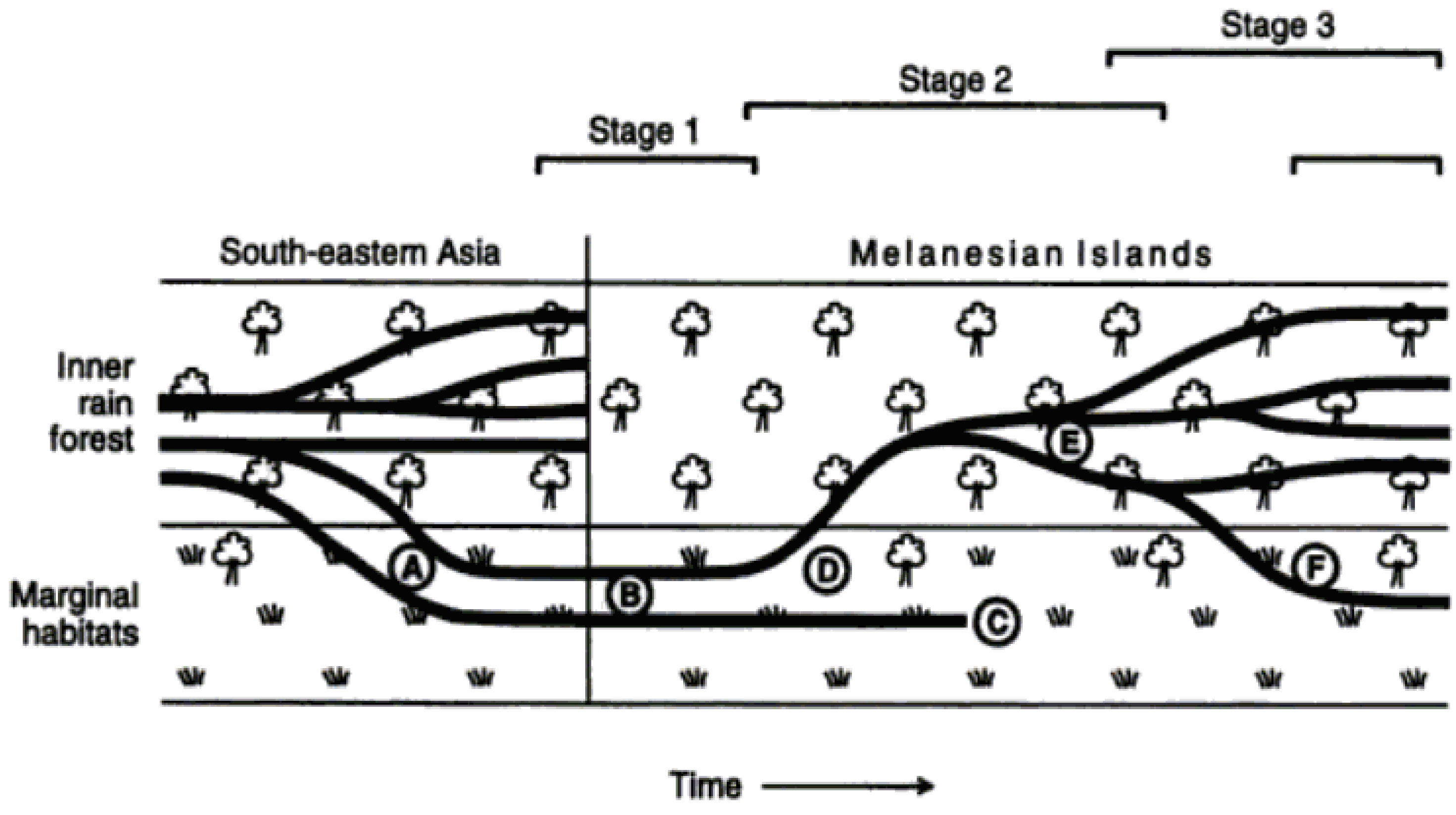
(George E. P. Box)

ISLANDS


Speciation
Biogeographic processes
0
Immigration
Extinction
b
a
c
d
Area
Island characteristics
0
Isolation

ISLANDS

Taxa cycling



ISLANDS

Taxa cycling

(a) *Characteristics of distribution of birds in the four stages of the taxon cycle*

Stage of cycle	Distribution among islands	Differentiation between island populations
I	Expanding or widespread	Island populations similar to each other
II	Widespread over many neighbouring islands	Widespread differentiation of populations on different islands
III	Range fragmented due to extinction	Widespread differentiation
IV	Endemic to one island	N/A

ISLANDS

Taxa cycling

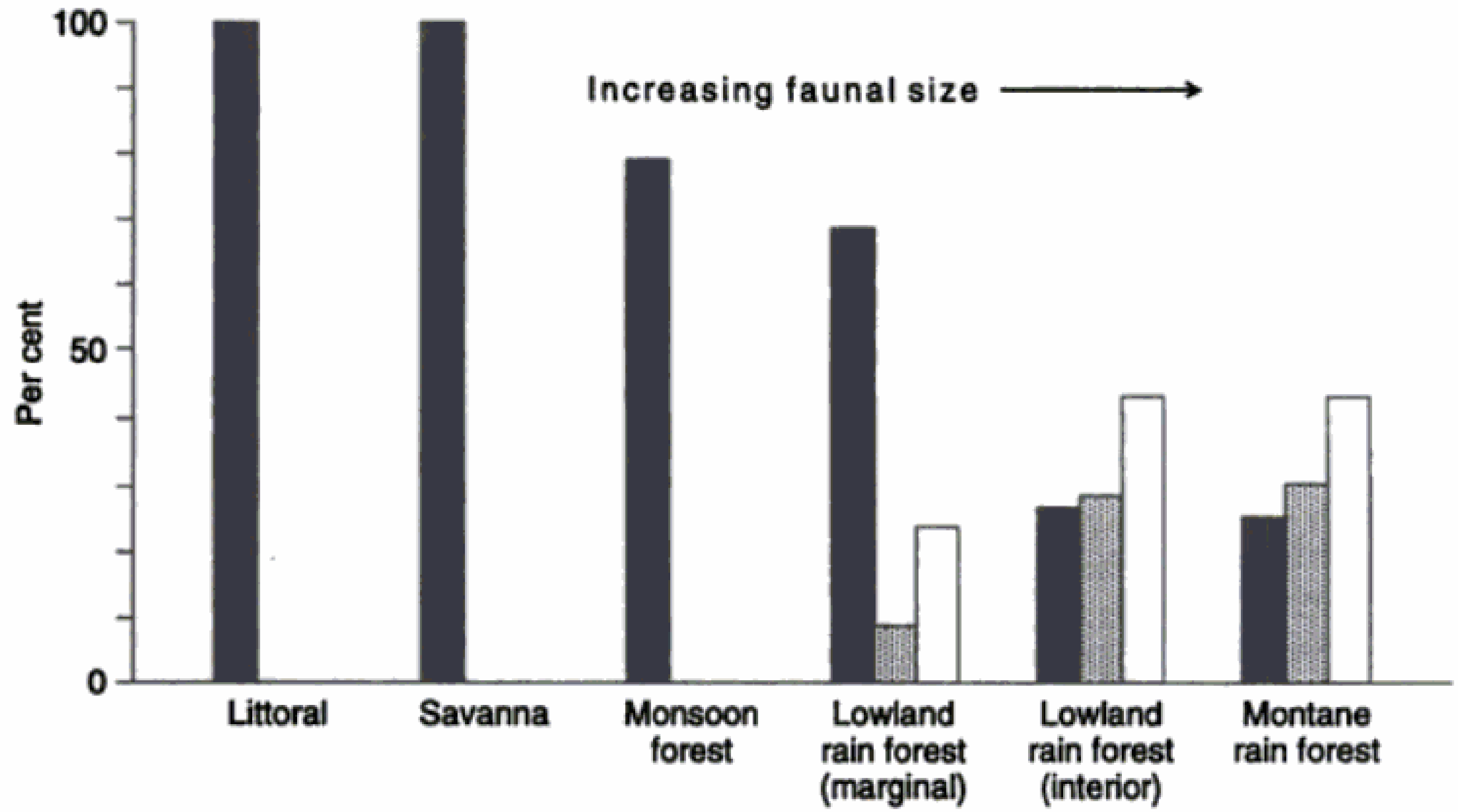
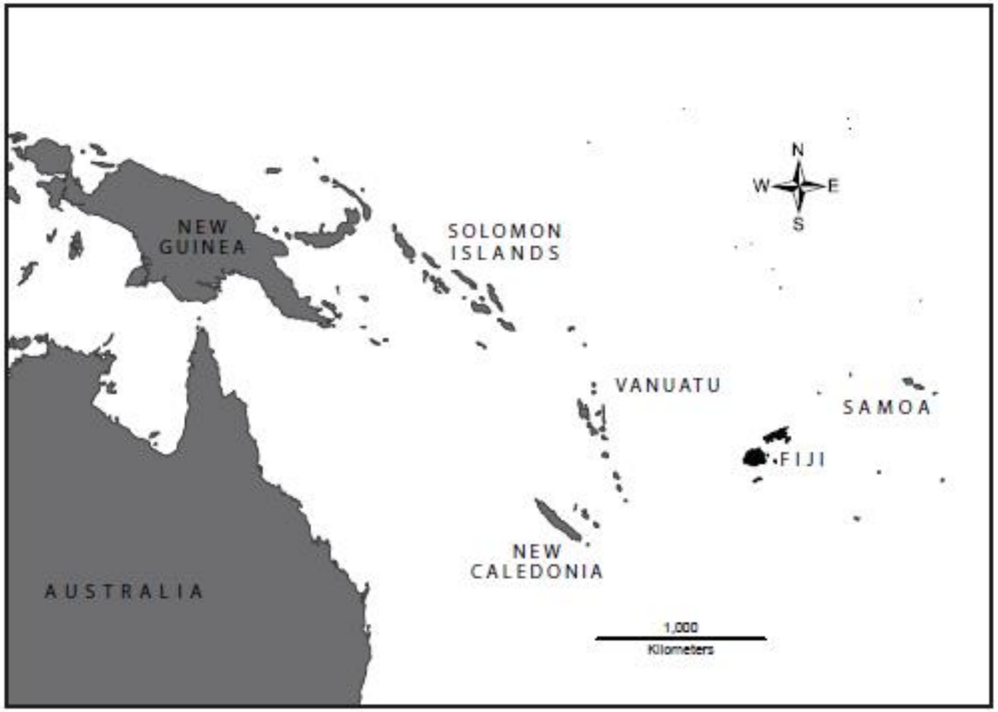
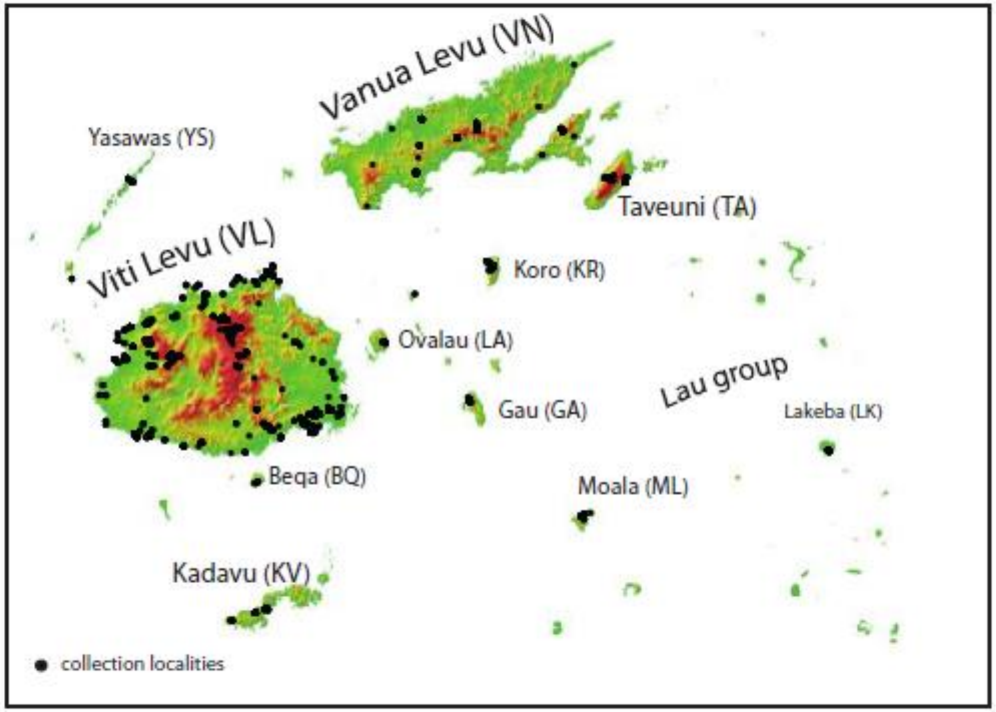


Fig. 6.1. Proportions of ponerine ant species in different habitats, as a function of their geographical distribution. The marginal habitats, to the left, contain both smaller absolute numbers of species and higher percentages of widespread species. Dark columns, species widespread in Melanesia; stippled columns, species restricted to single archipelagos in Melanesia but belonging to groups centred in Asia or Australia; blank columns, species restricted to single archipelagos and belonging to Melanesia-centred species groups. (Redrawn from Wilson 1959.)

ISLANDS

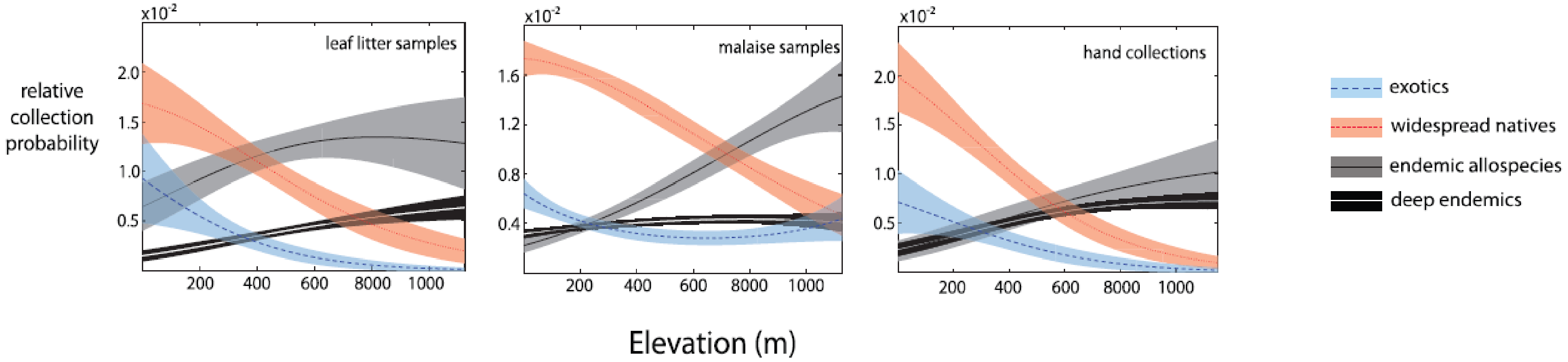
Taxa cycling



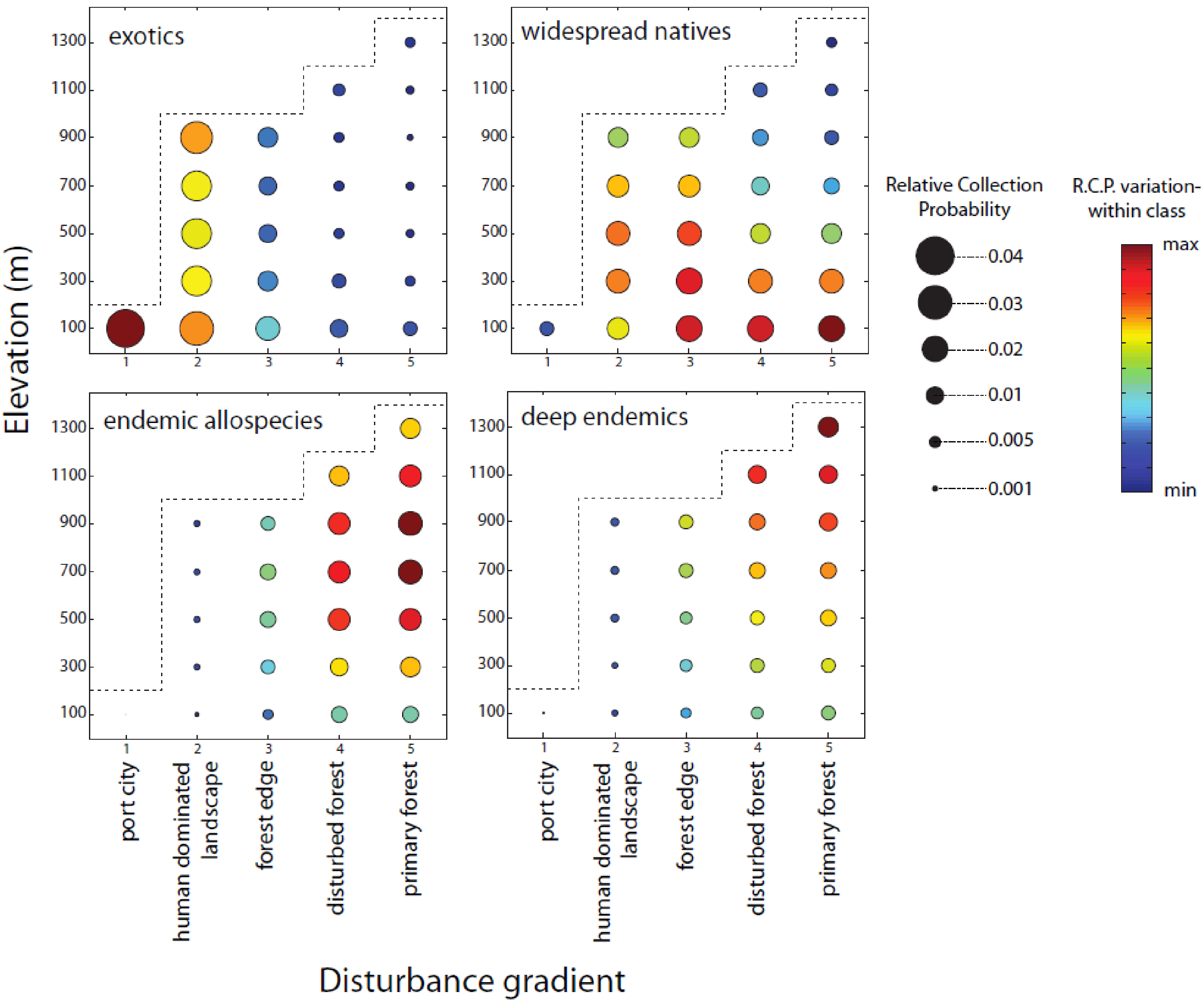


ISLANDS

Taxa cycling



ISLANDS


exotics
widespread natives
endemic allospecies
deep endemics
Elevation (m)
1300
1100
900
700
500
300
100
1
2
3
4
5
port city
human dominated landscape
forest edge
disturbed forest
primary forest
Disturbance gradient
Relative Collection Probability
0.04
0.03
0.02
0.01
0.005
0.001
R.C.P. variation-within class
max
min

ISLANDS

Wider ecological niche

Population density compensation

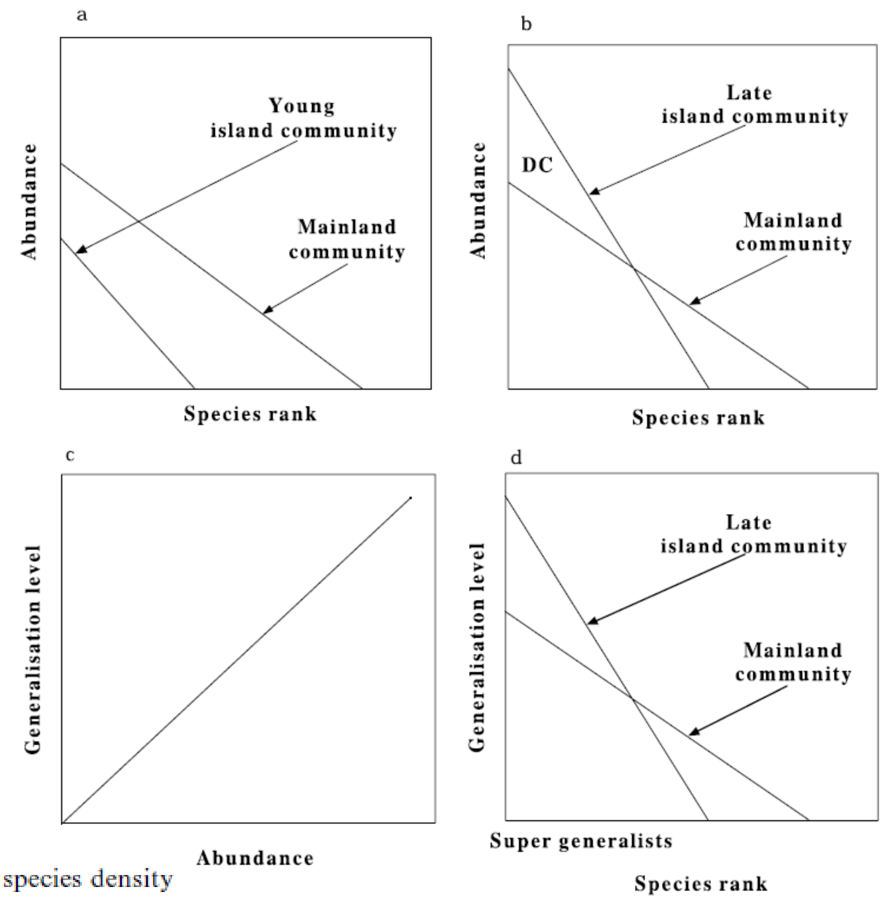


Fig. 1 Sequence of events leading to super generalization. (a) Island communities have a lower species density than an the adjacent mainland and island population density is initially also lower. (b) Low species density leads to low interspecific competition and, in some taxonomic and trophic groups, to density compensation (DC, e.g. Case, 1982). We have complete DC when the areas of the two triangles become equal in size. (c) Generalization level and abundance are expected to be positively correlated in pollination networks (J.M. Olesen, unpublished data; and this study). (d) Because of (b) and (c), a rank-generalization diagram mirrors a rank-abundance diagram, as seen in (b). Species being super generalists will thus to some extent also be density-compensating species.

ISLANDS

Foster´s rule

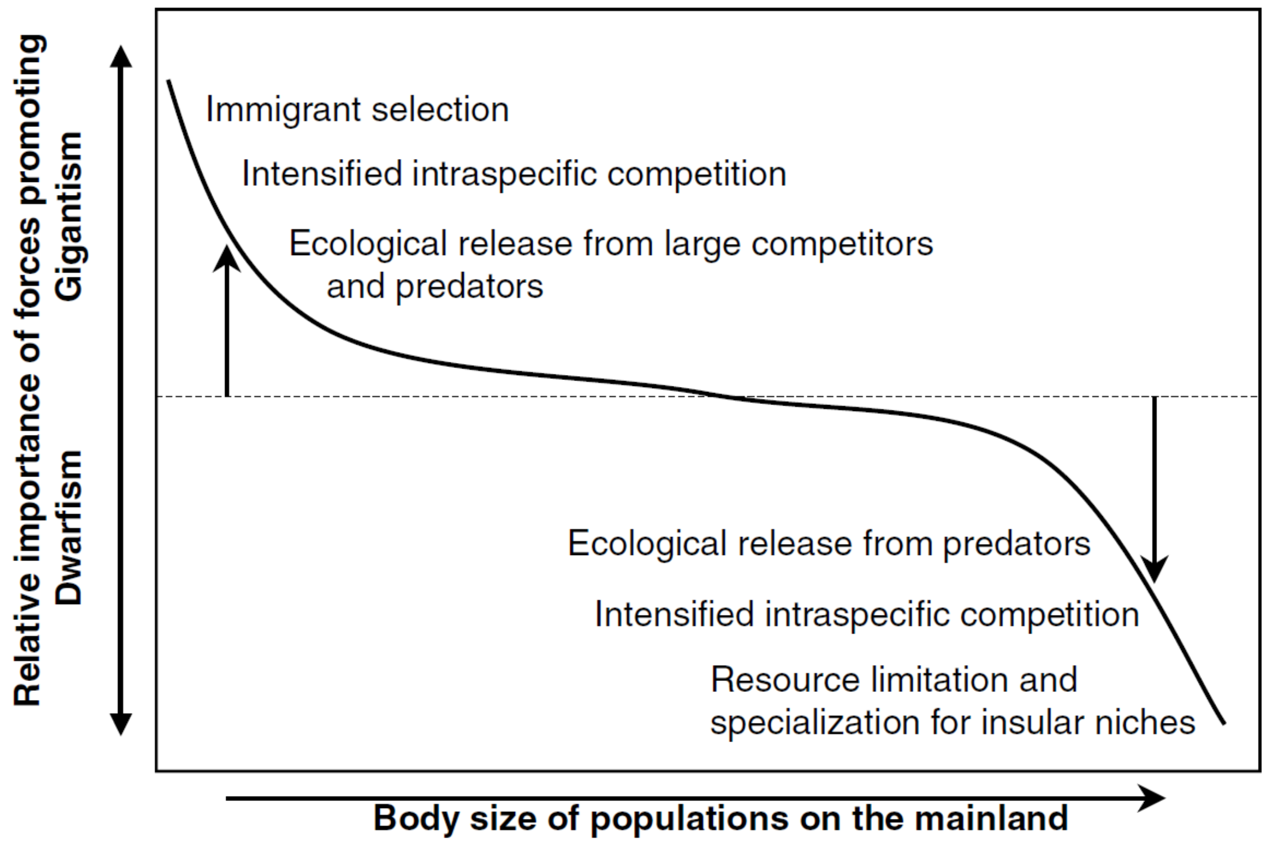
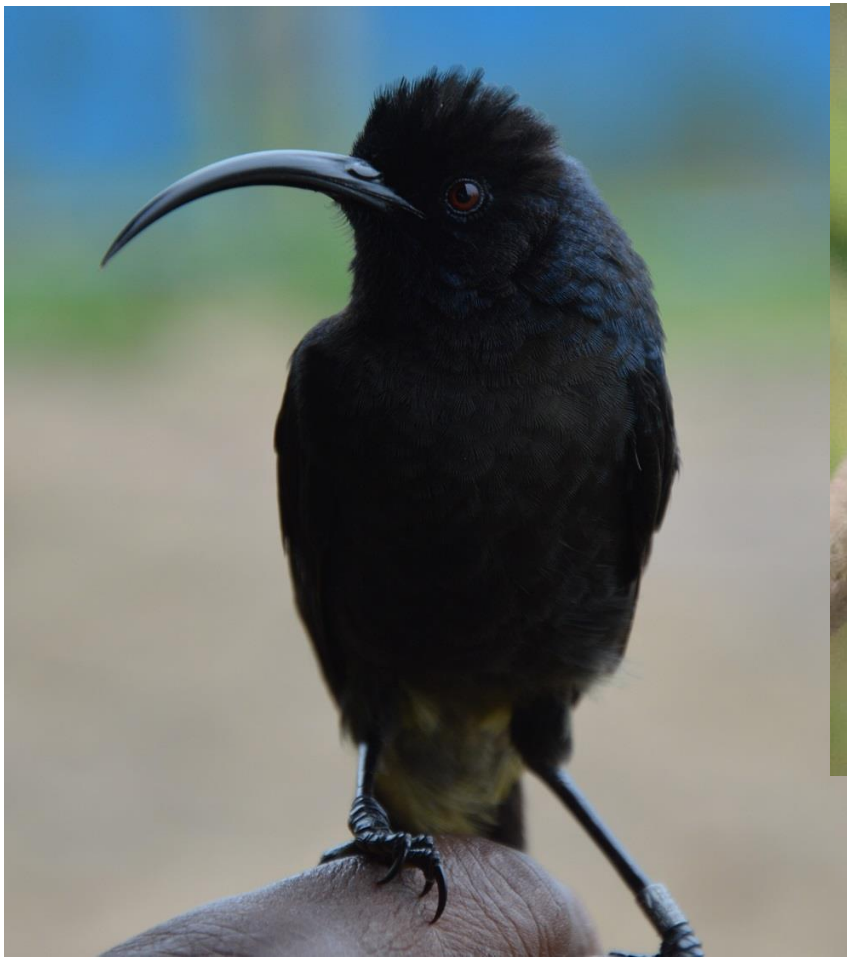


Figure 9 The island rule is an emergent pattern resulting from a combination of selective pressures whose importance and influence on insular populations change in a predictable manner along a gradient from relatively small to relatively large species.

ISLANDS

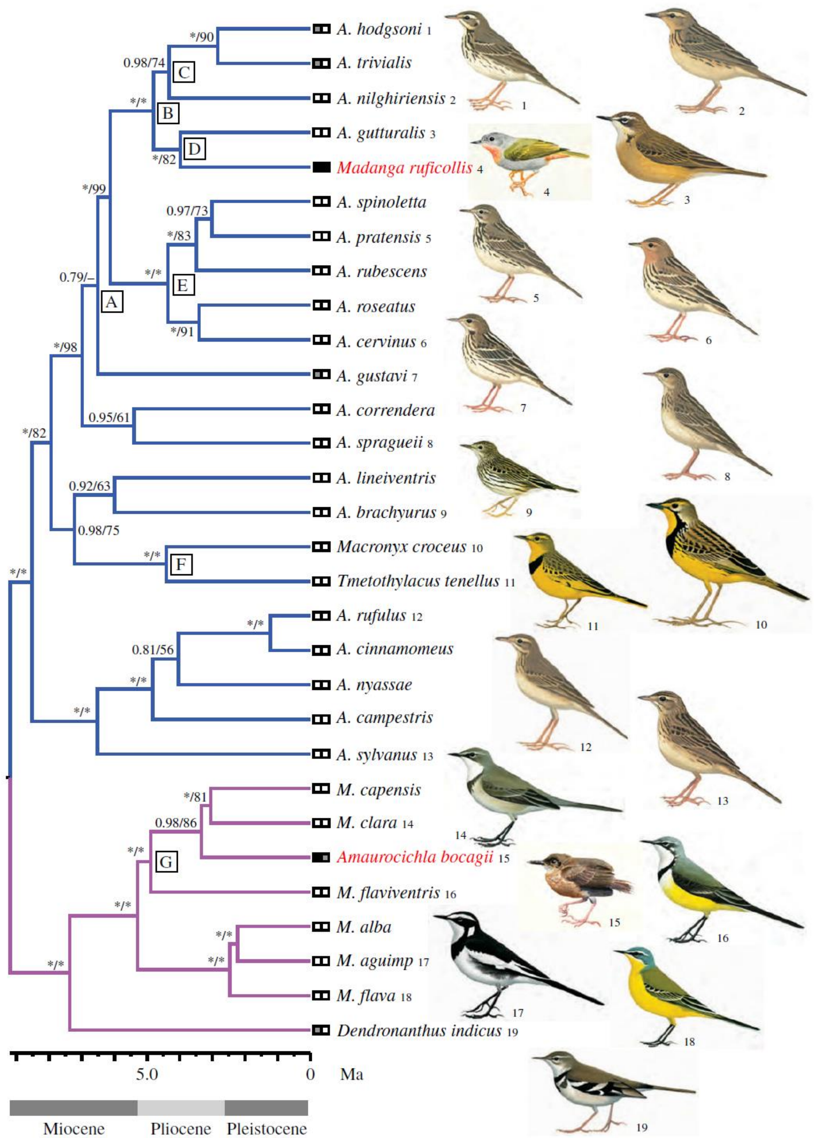


Gigantism / Nanism

Reduced sexual ornaments

Ecological displacement

ISLANDS

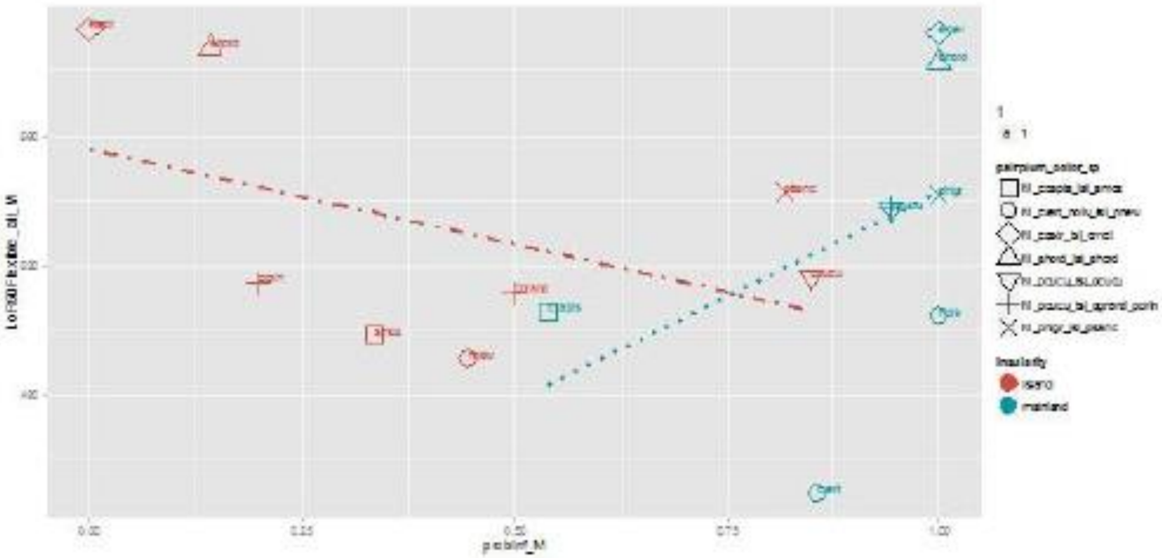


Nanism

Reduced sexual ornaments

Ecological displacement

ISLANDS



More colourful species have higher parasite levels on the mainland, but positive relationship does not hold on the islands

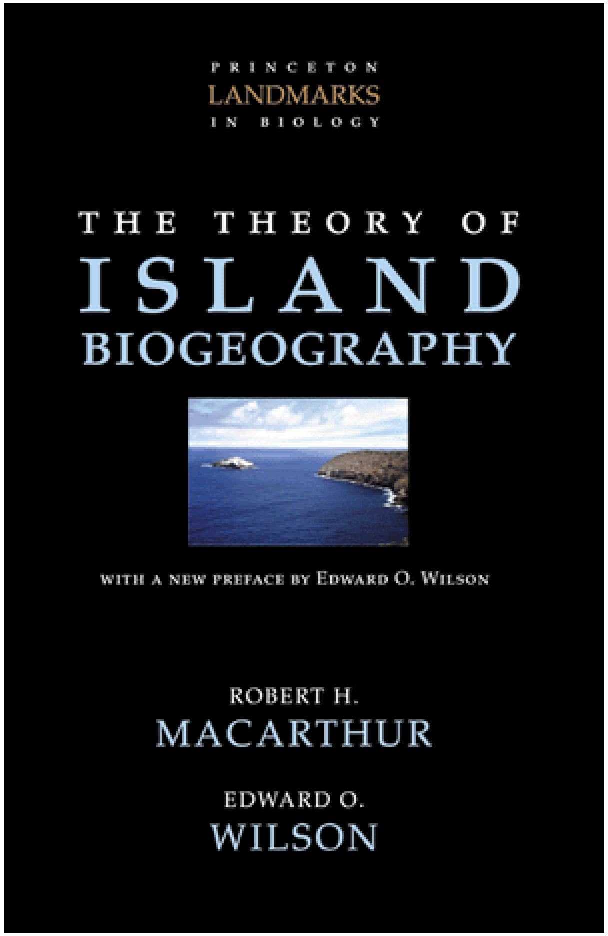
Ploceus princeps, Principe il

Ploceus cucullatus, Gabon

Hamilton-Zuk hypothesis

ISLANDS

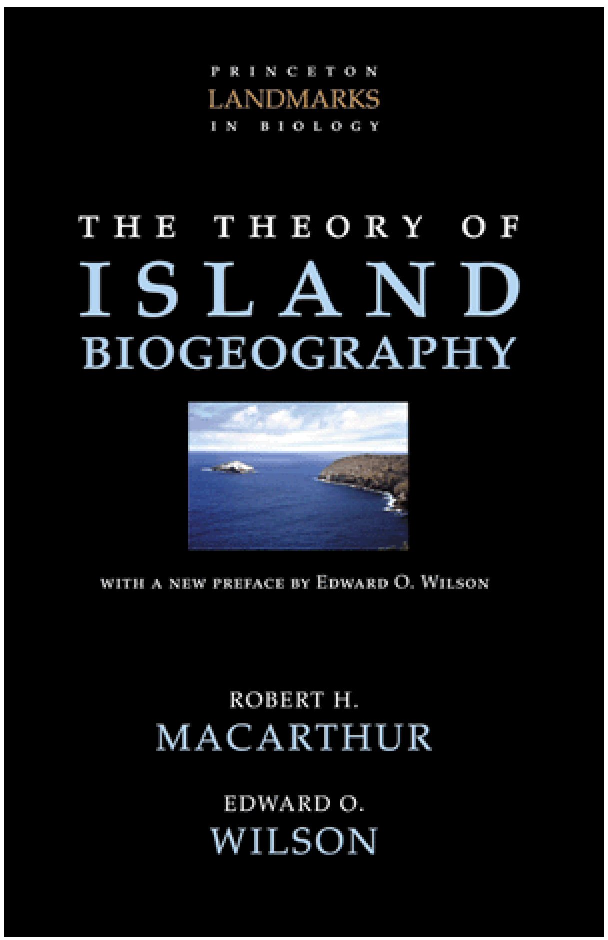
Theory of Island Biogeography

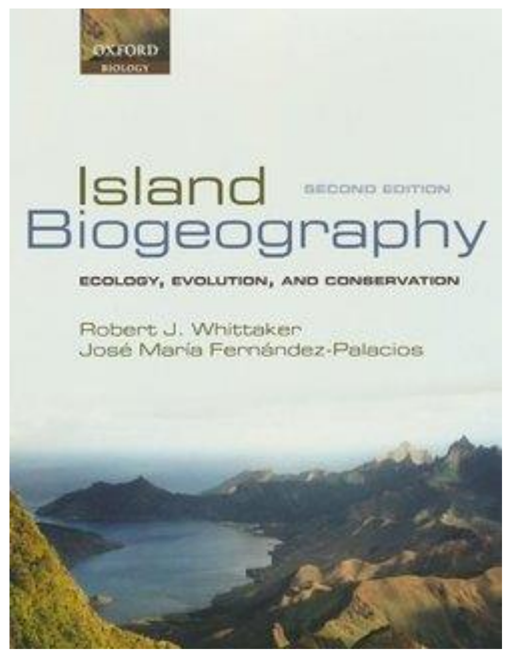


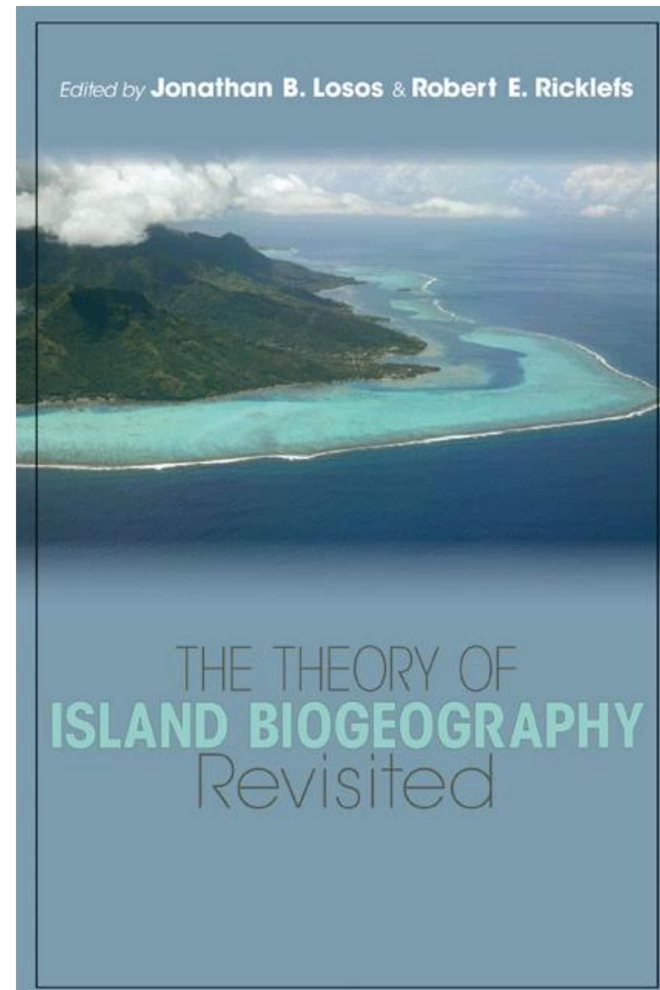
1. The Importance of Islands
2. Area and Number of Speicies
3. Further Explanations of the Area-Diversity Pattern
4. The Strategy of Colonization
5. Invasibility and the Variable Niche
6. Stepping Stones and Biotic Exchange
7. Evolutionary Changes Following Colonization
8. Prospect

ISLANDS

Theory of Island Biogeography

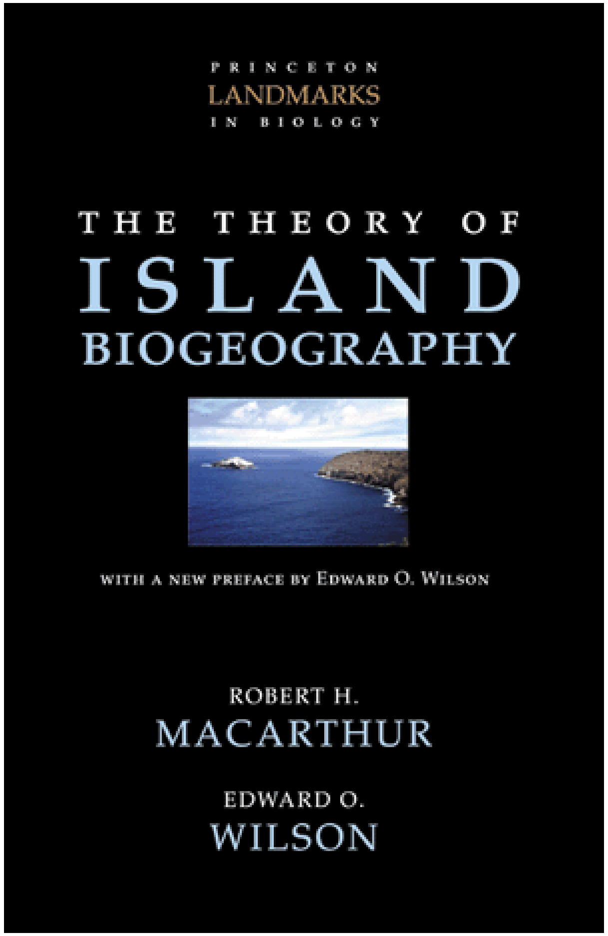


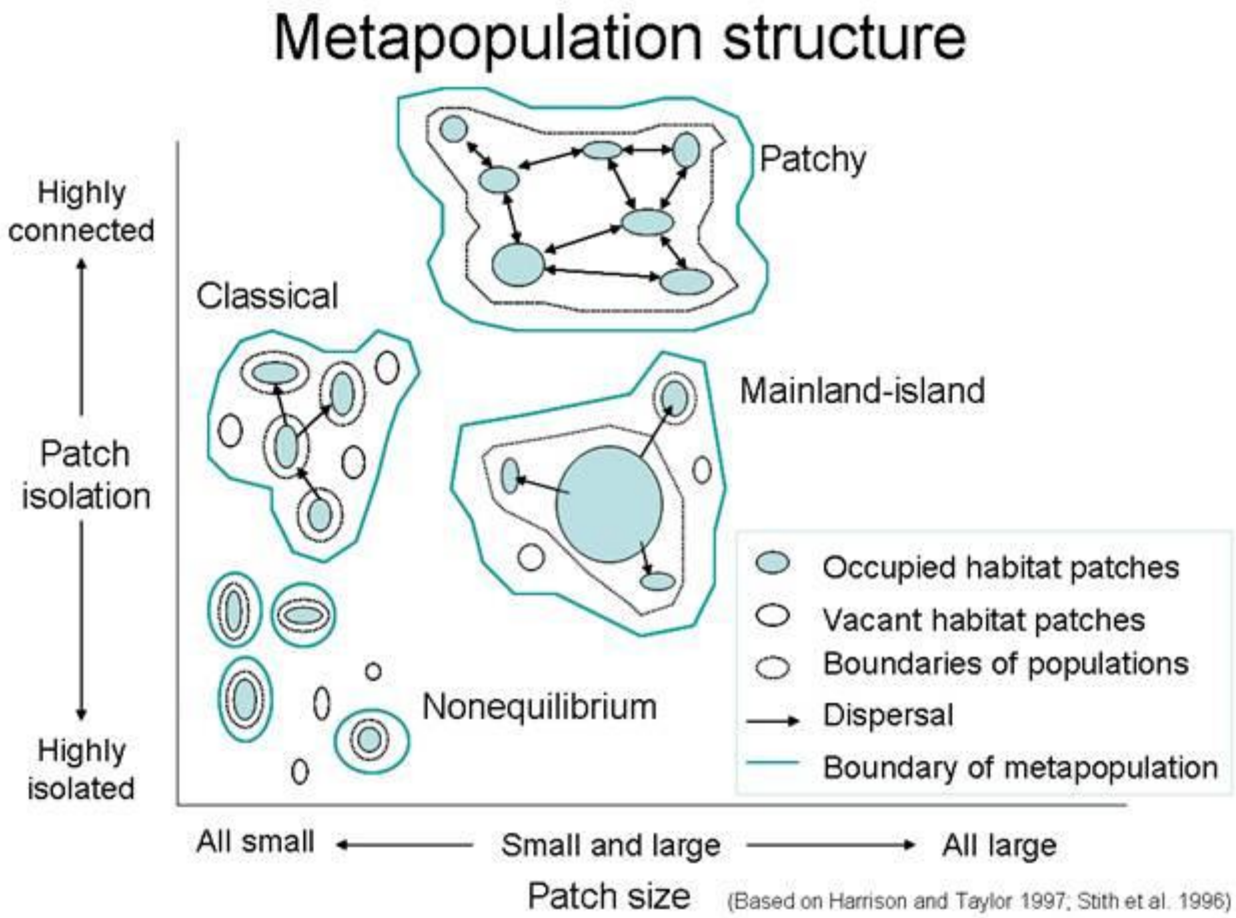




ISLANDS

Theory of Island Biogeography





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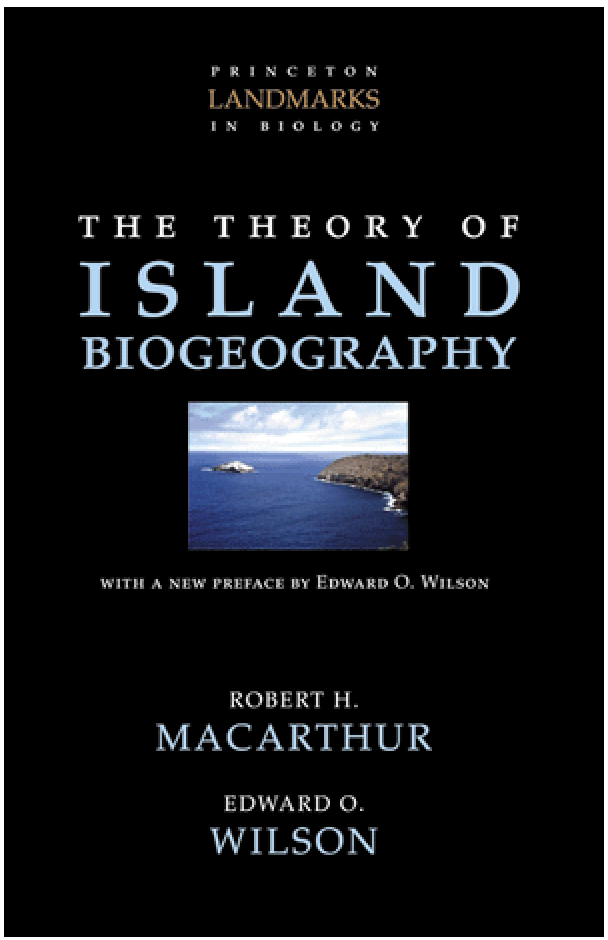

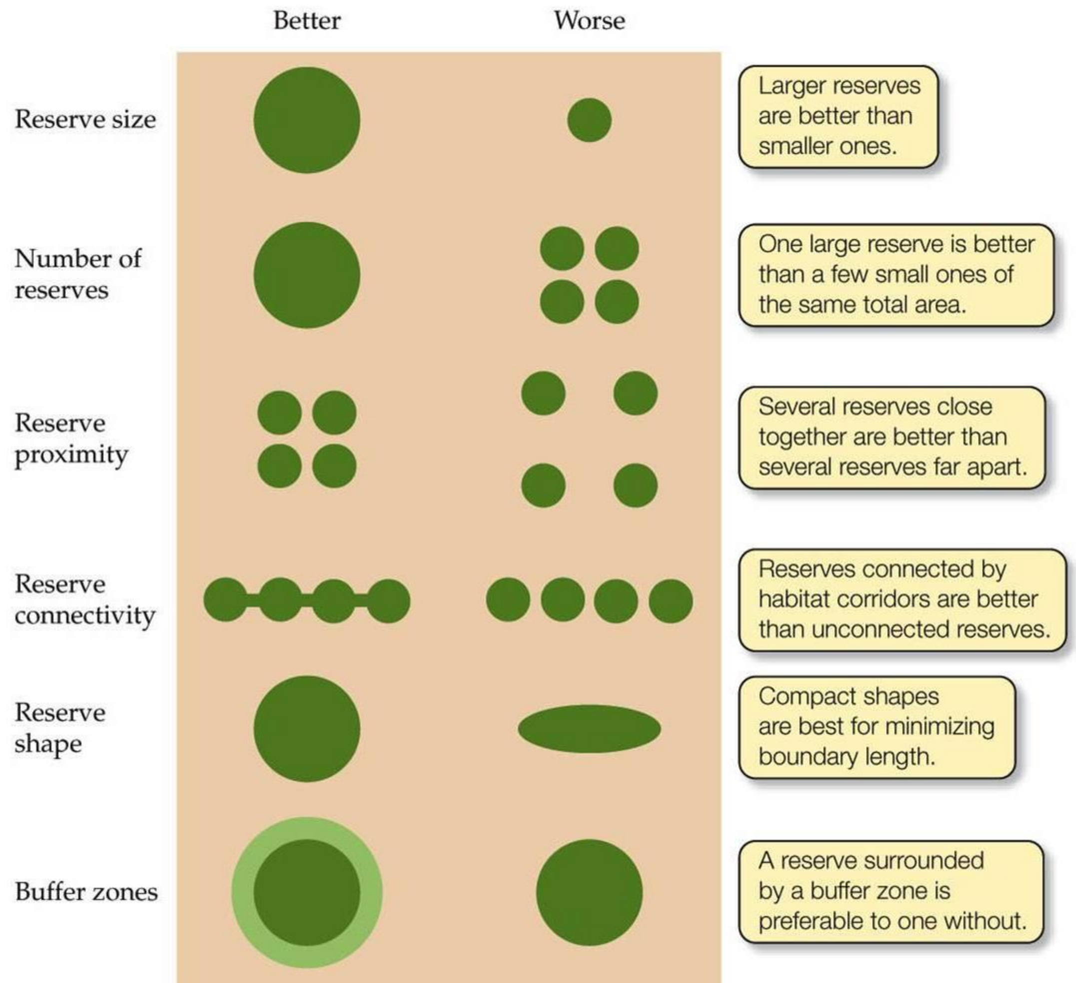

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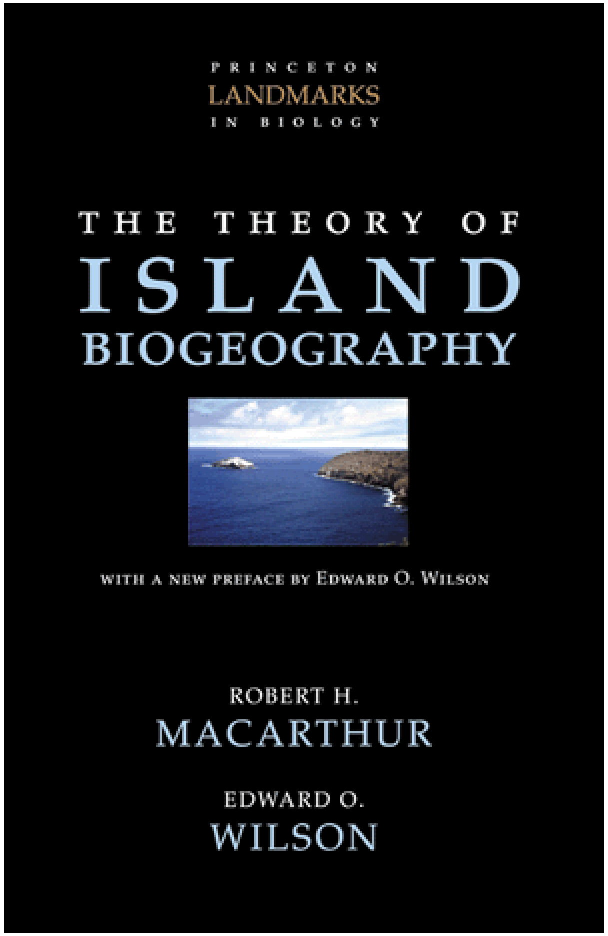

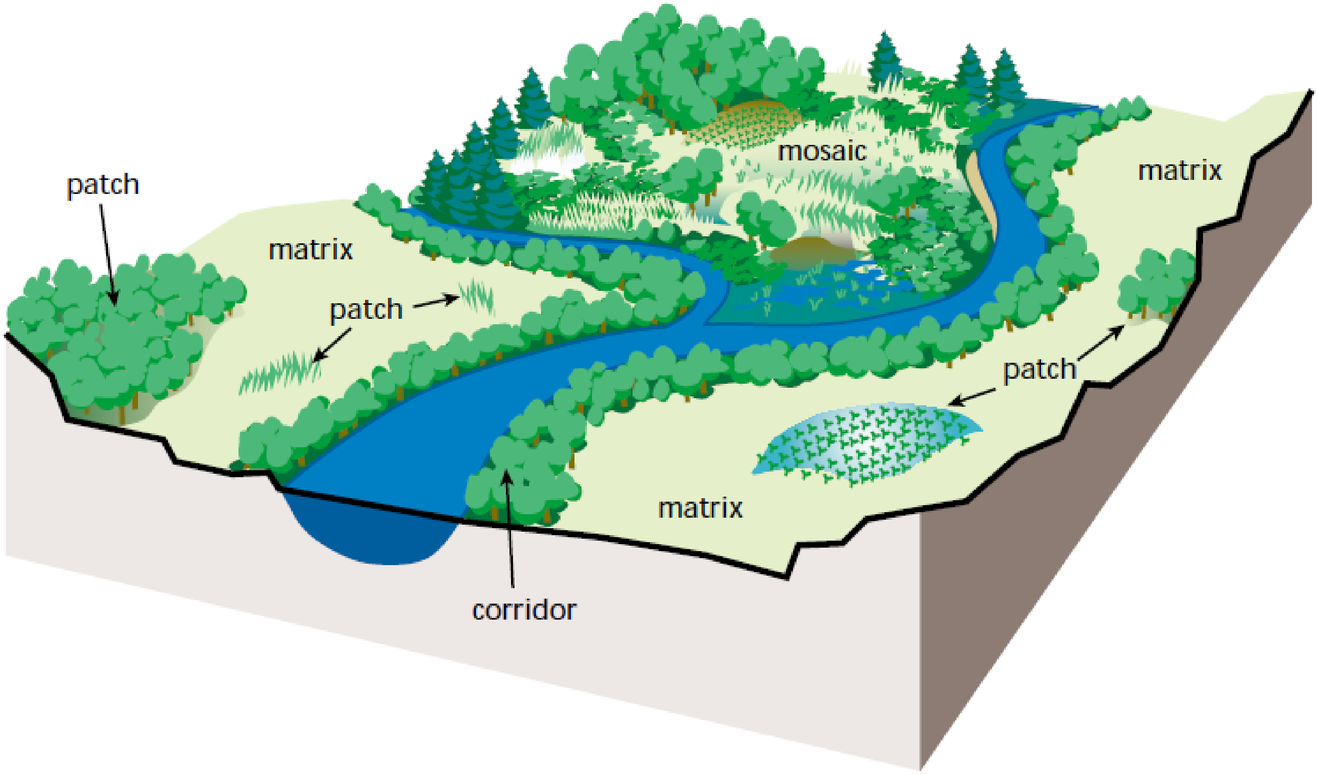

ISLANDS

centre for ecology, evolution and environmental changes

ISLANDS

Types of islands:

- Geological
  - Oceanic
  - Continental

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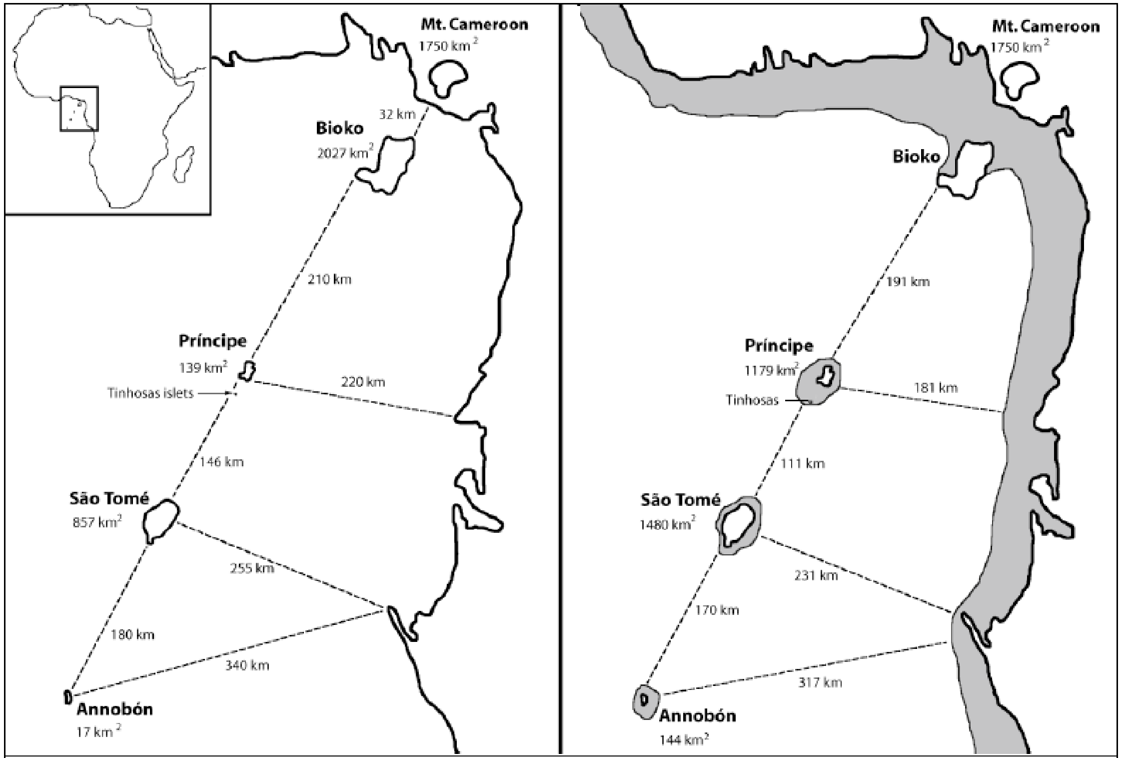


Fig. 1.2. The Gulf of Guinea island system, West Africa, showing island areas and distances between them and the mainland at the present day (left) and during glacial periods (right), This system includes an ecological island (Mt. Cameroon), a land-bridge island (Bioko) and three oceanic islands. Most endemism is concentrated in the two largest oceanic islands, São Tomé and Príncipe. Adapted from Jones & Tye (2006).

ISLANDS

Types of islands:

- Geological
  - Oceanic
  - Continental
- Ecological

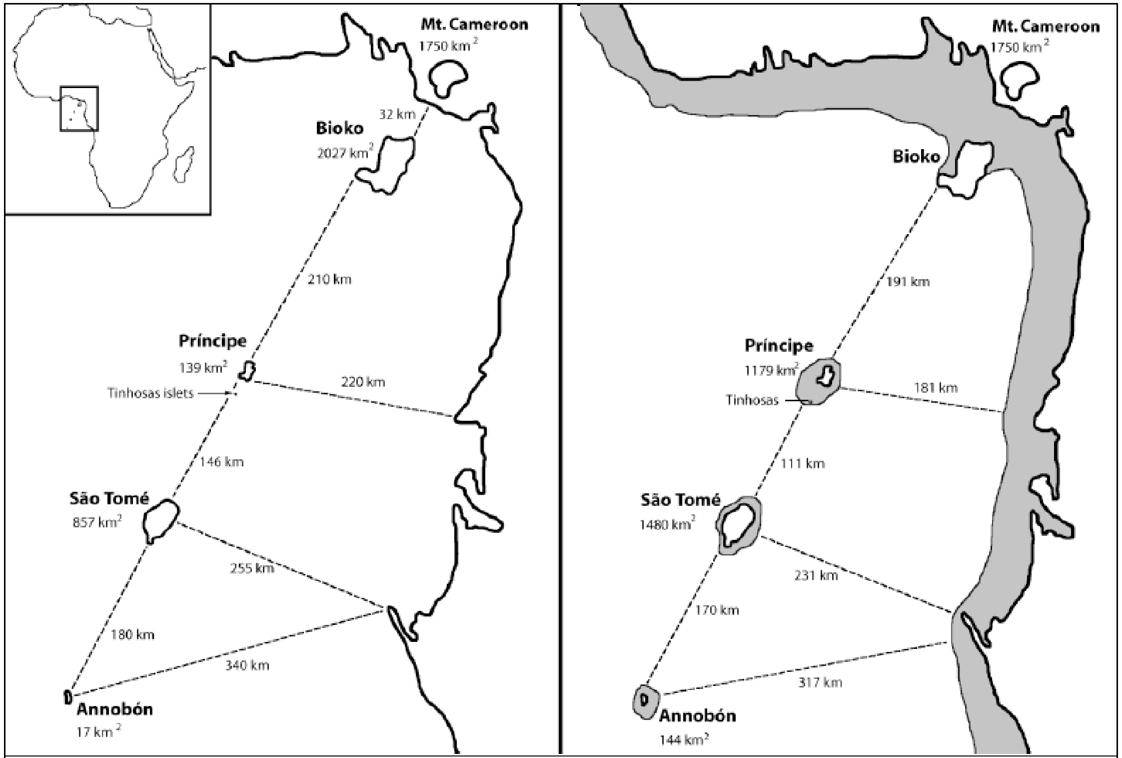
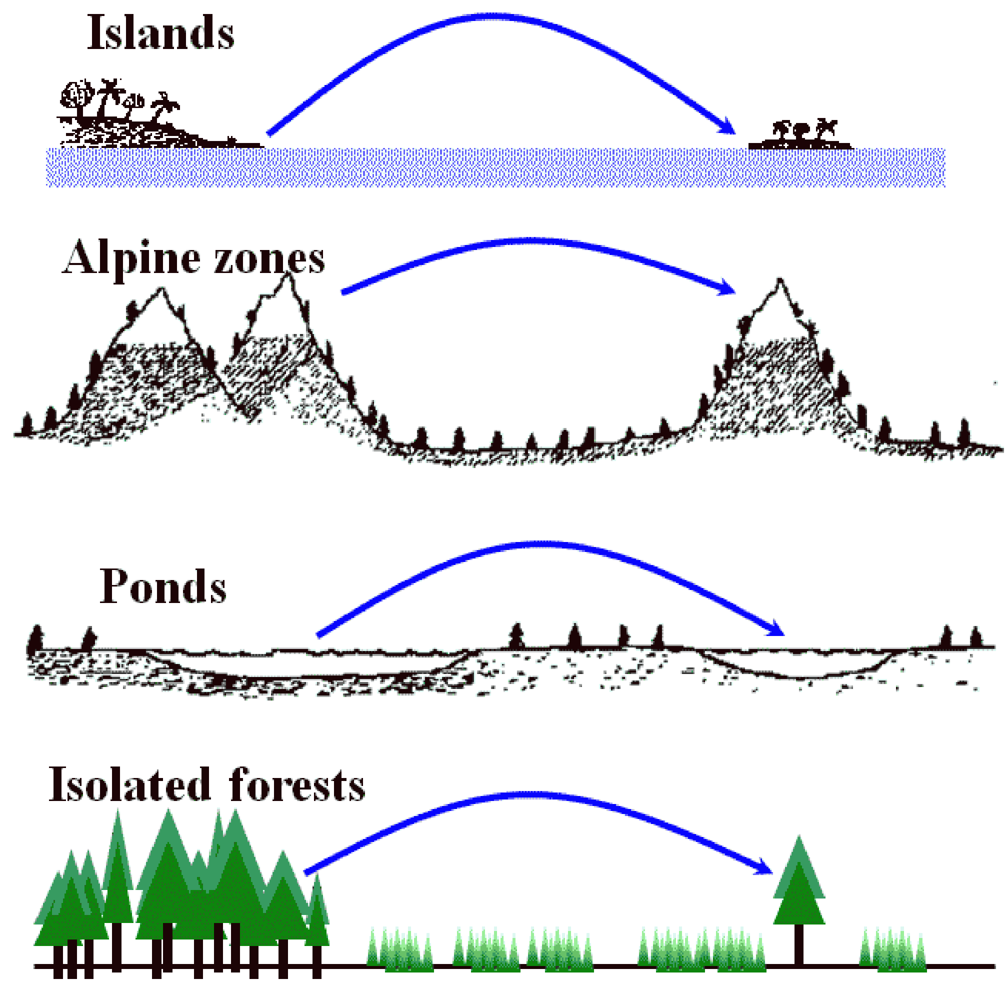


Fig. 1.2. The Gulf of Guinea island system, West Africa, showing island areas and distances between them and the mainland at the present day (left) and during glacial periods (right), This system includes an ecological island (Mt. Cameroon), a land-bridge island (Bioko) and three oceanic islands. Most endemism is concentrated in the two largest oceanic islands, São Tomé and Príncipe. Adapted from Jones & Tye (2006).

ISLANDS

Types of islands:

- Geological
  - Oceanic
  - Continental
- Ecological
  - Geological
  - Mountains
  - Lakes
  - Forest fragments
  - …



ECOLOGICAL ISLANDS

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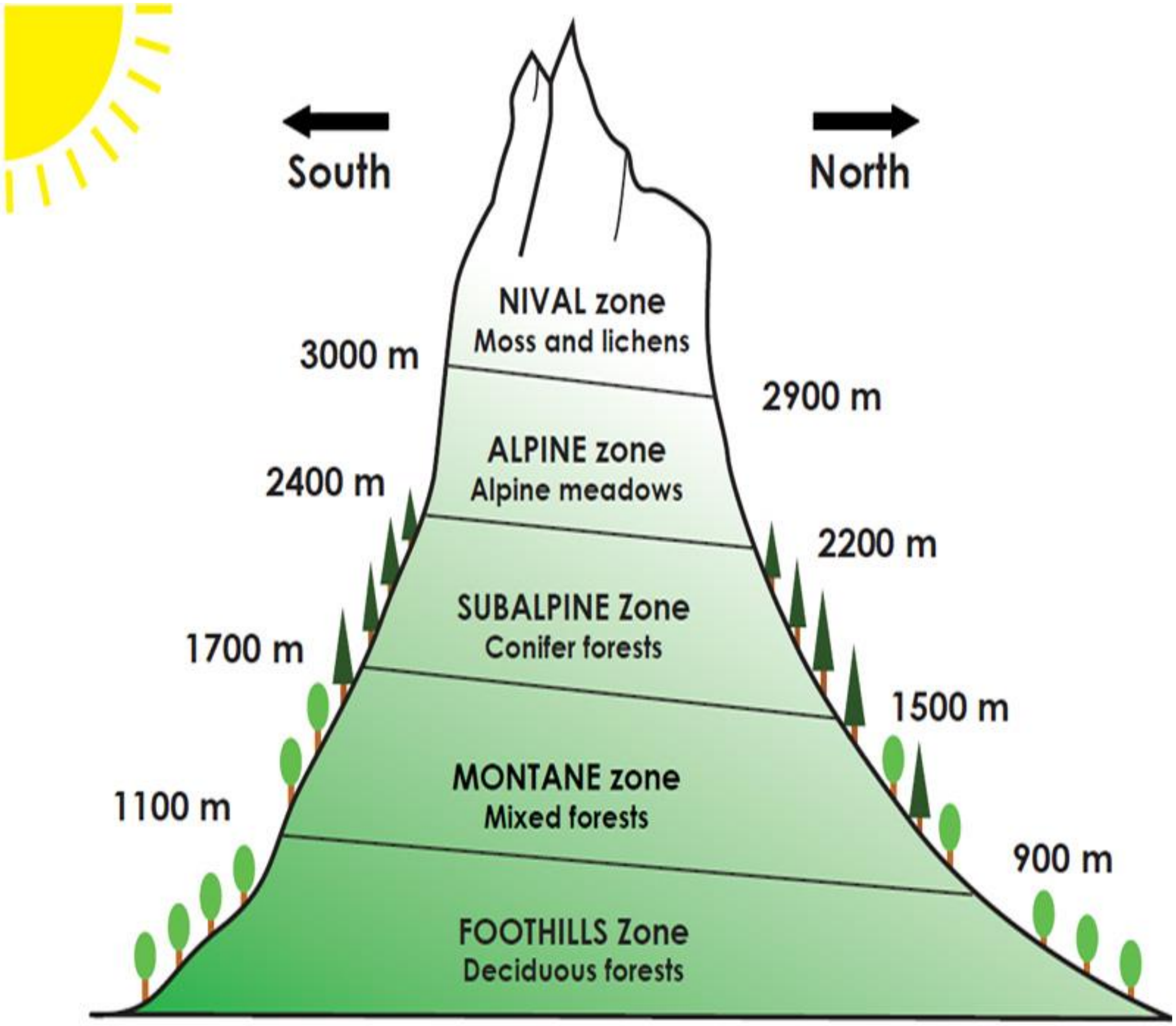

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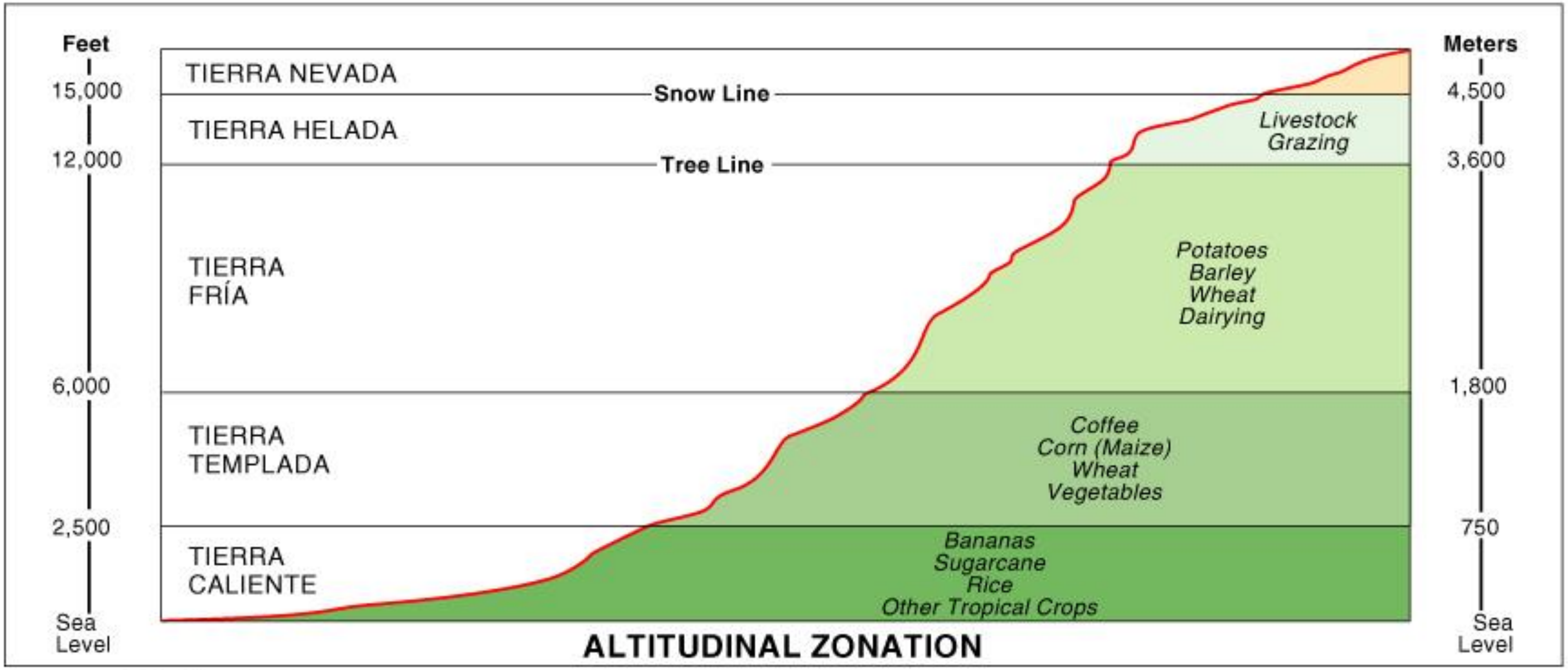

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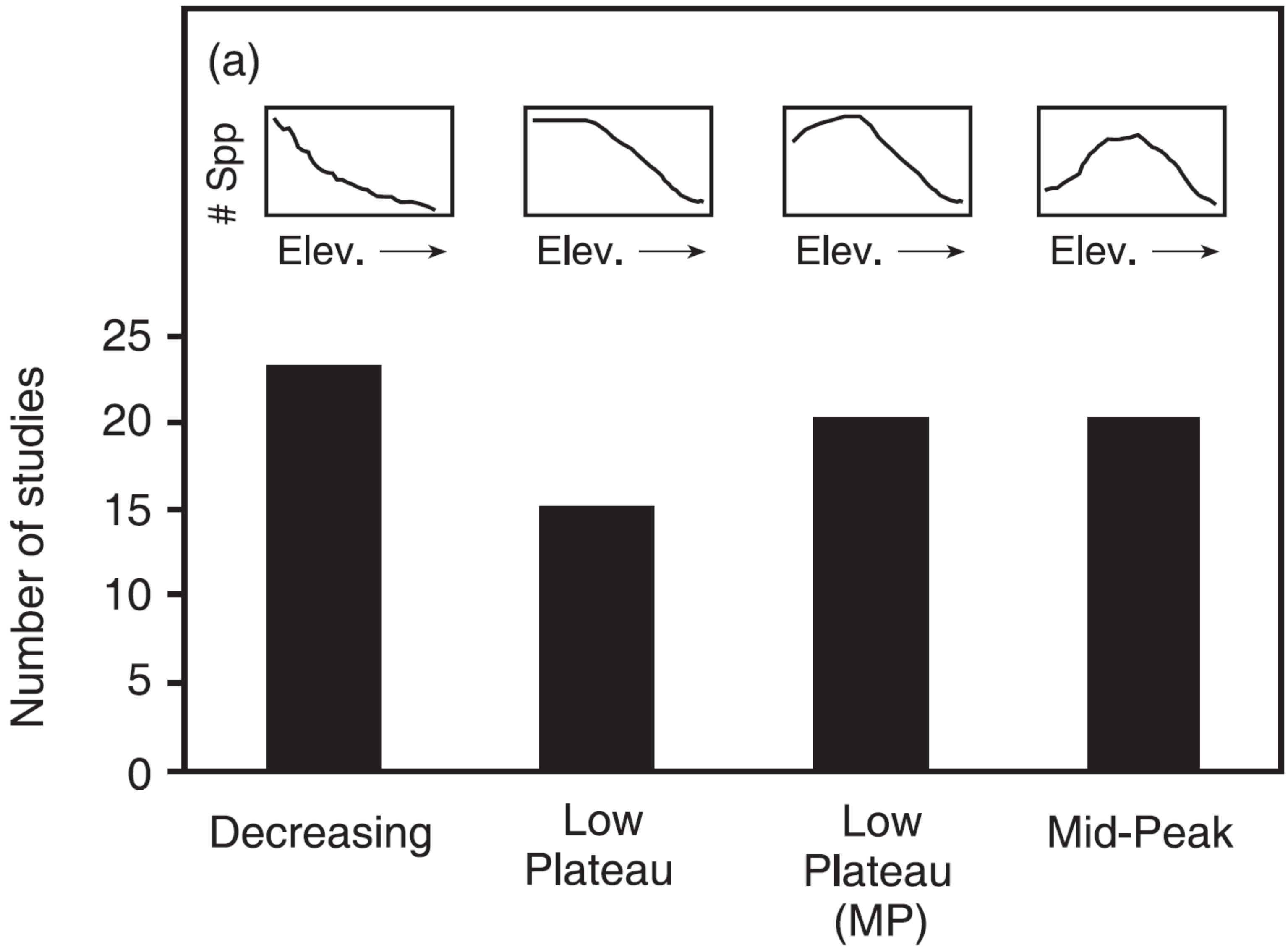

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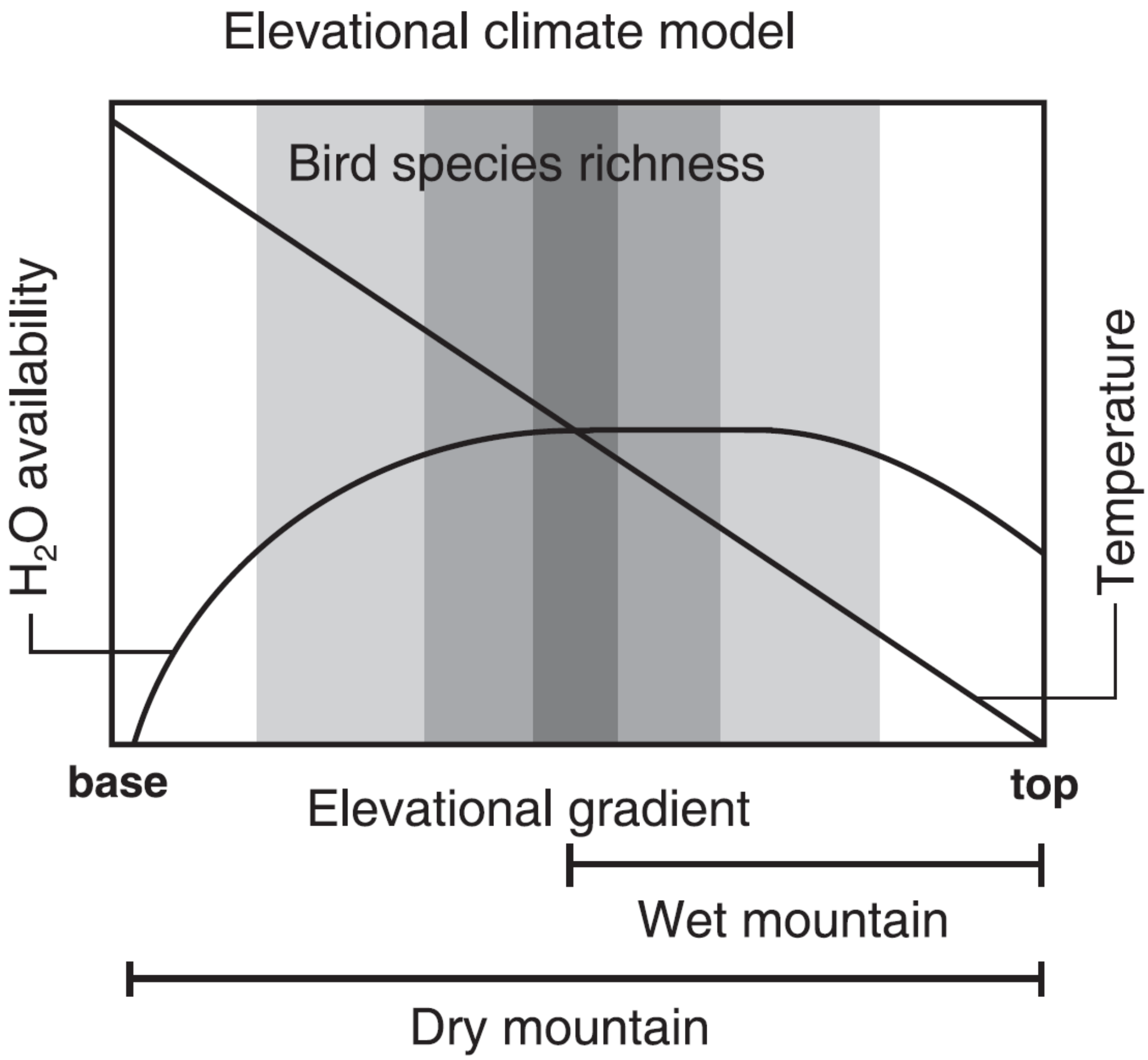

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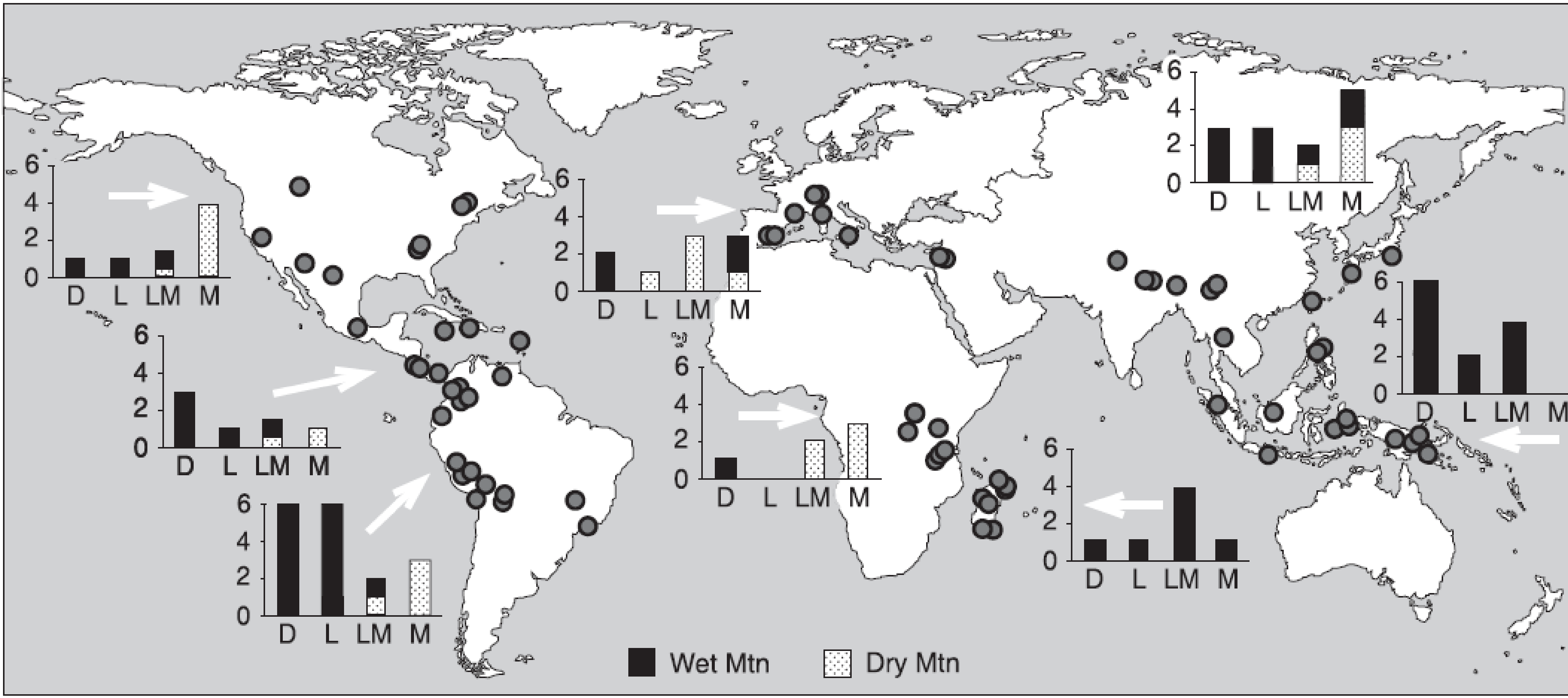


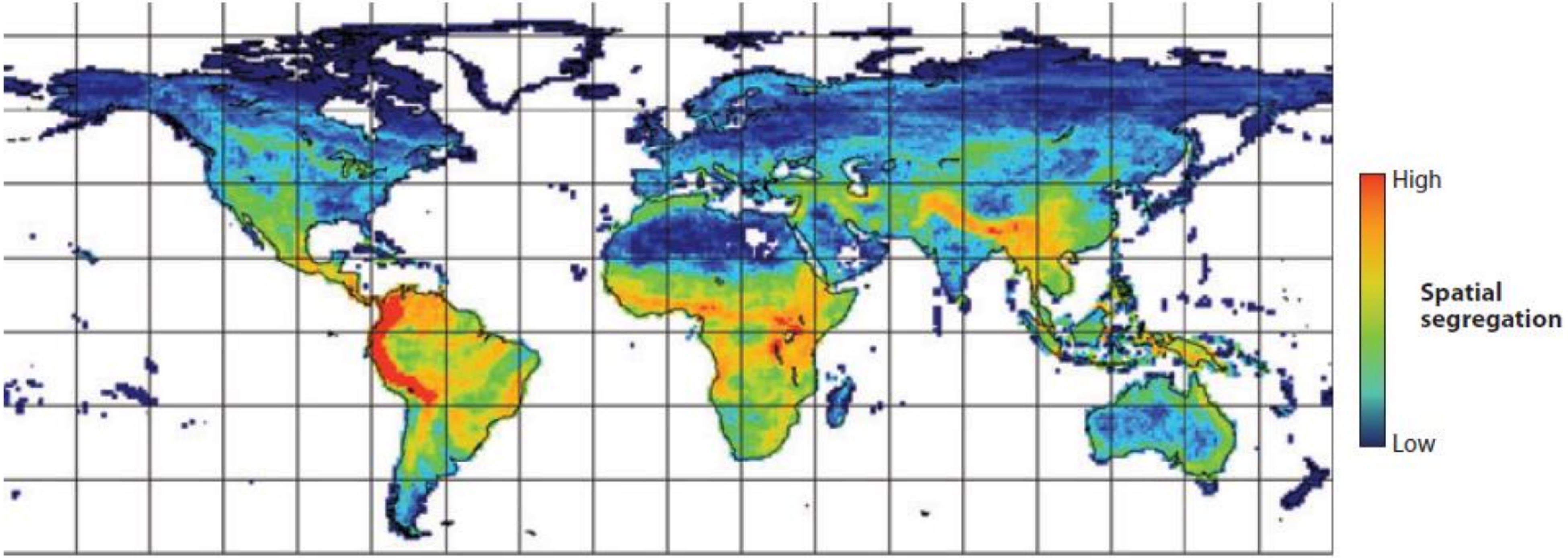
Decreasing

Low Plateau

Low Plateau (MP)

Mid-Peak

ECOLOGICAL ISLANDS



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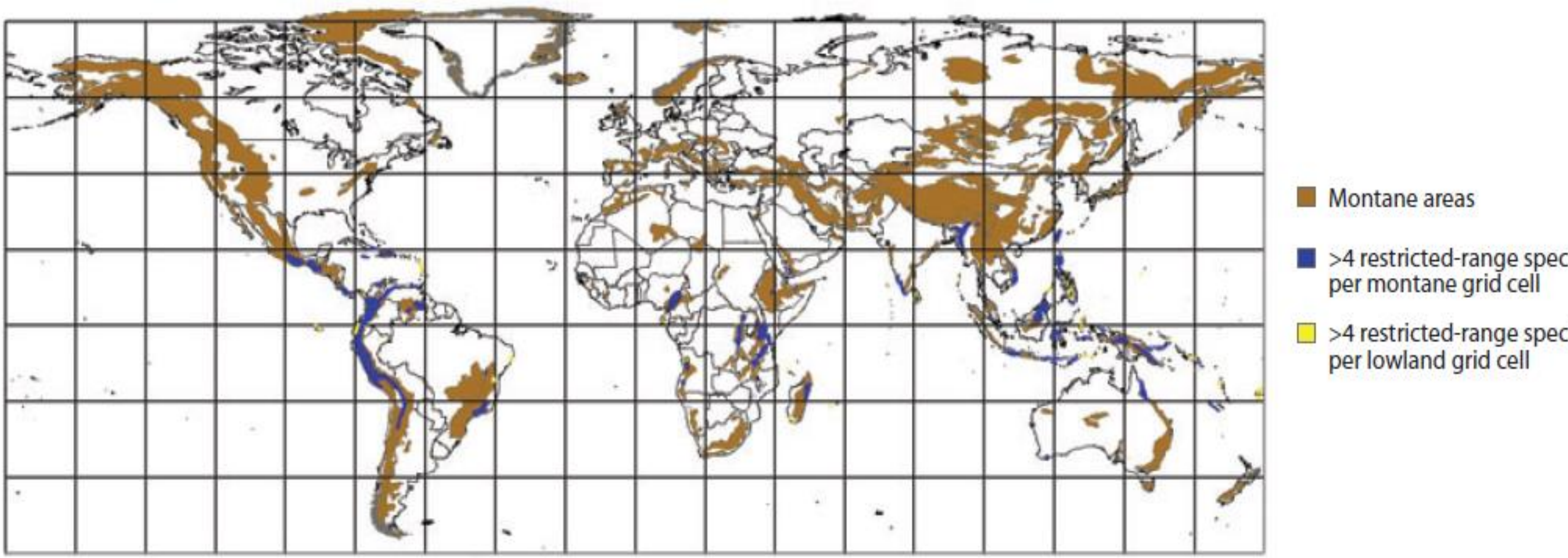

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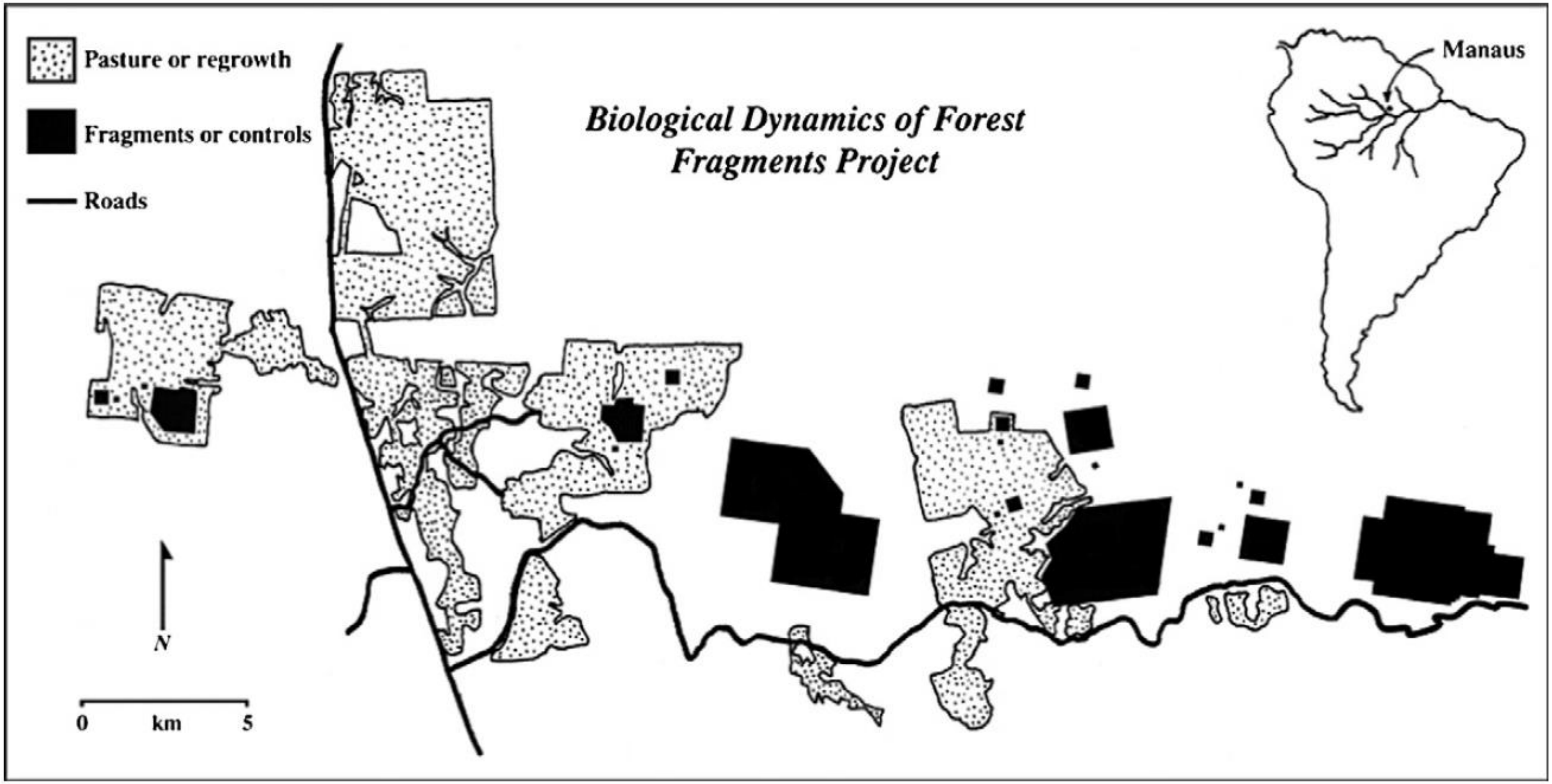

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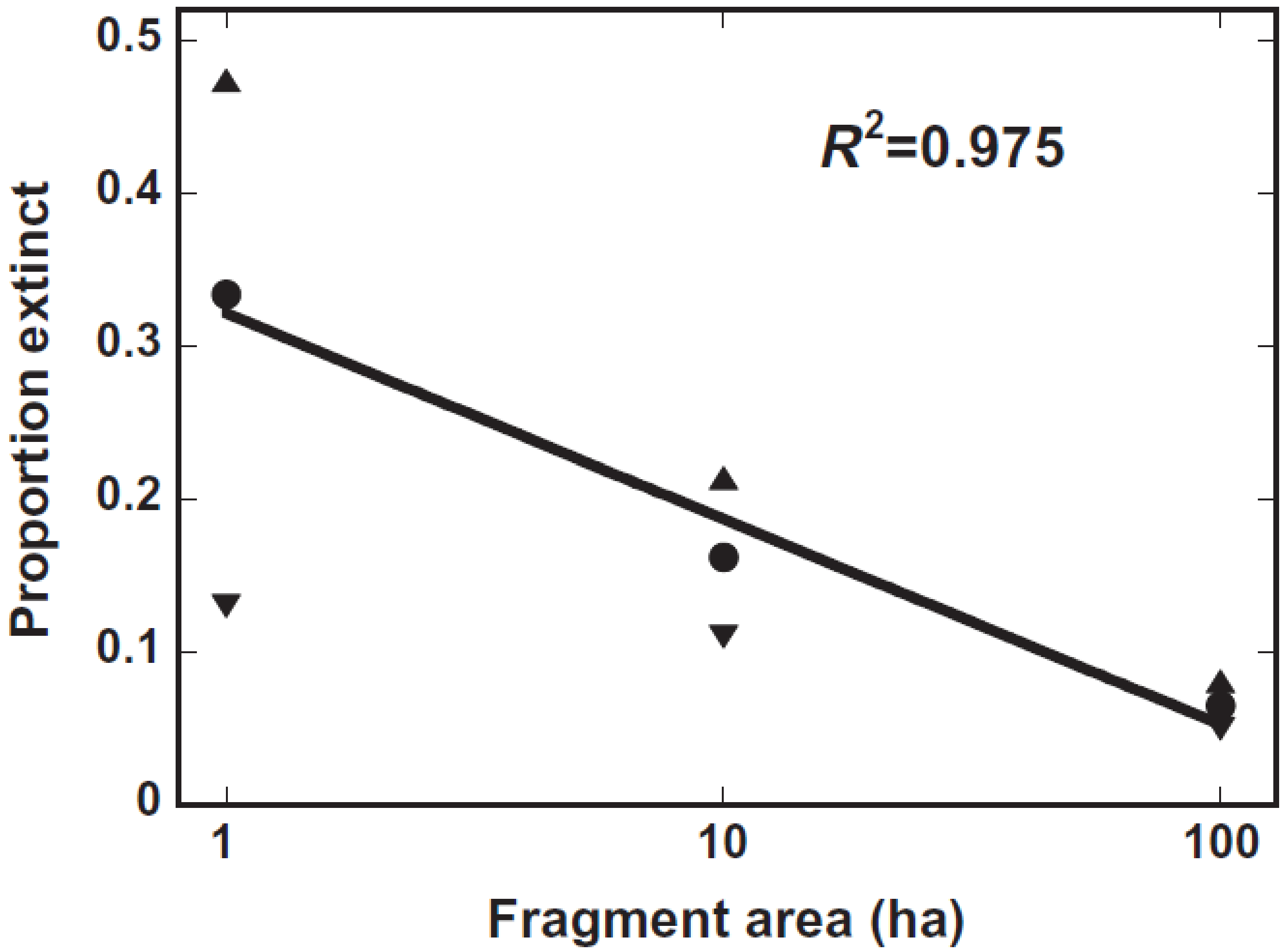

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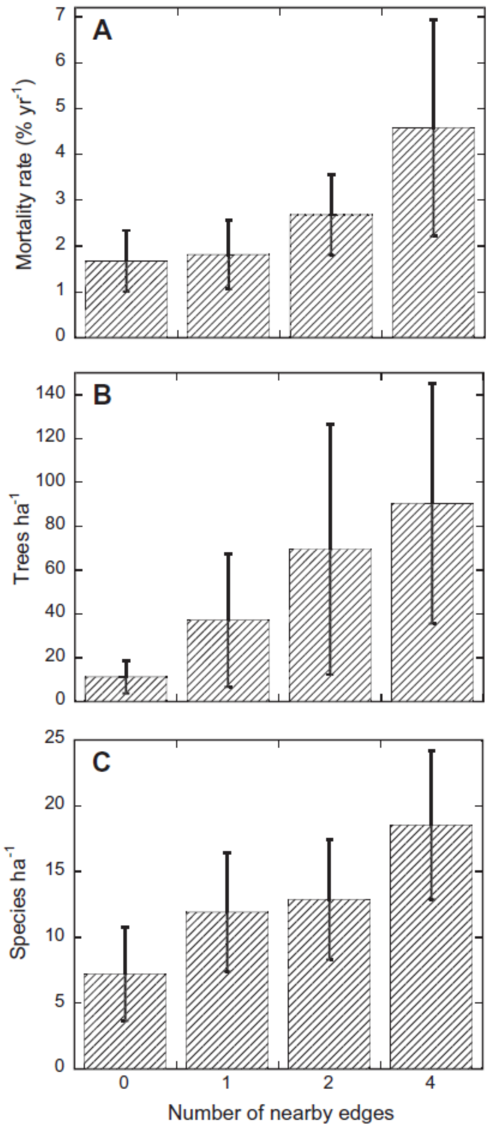

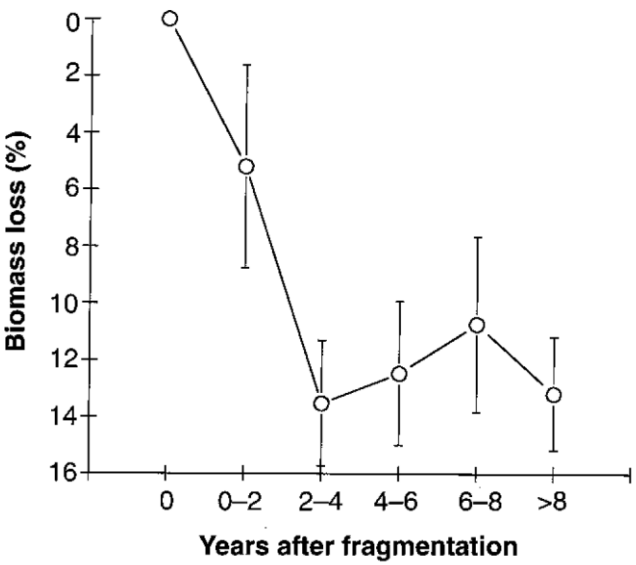

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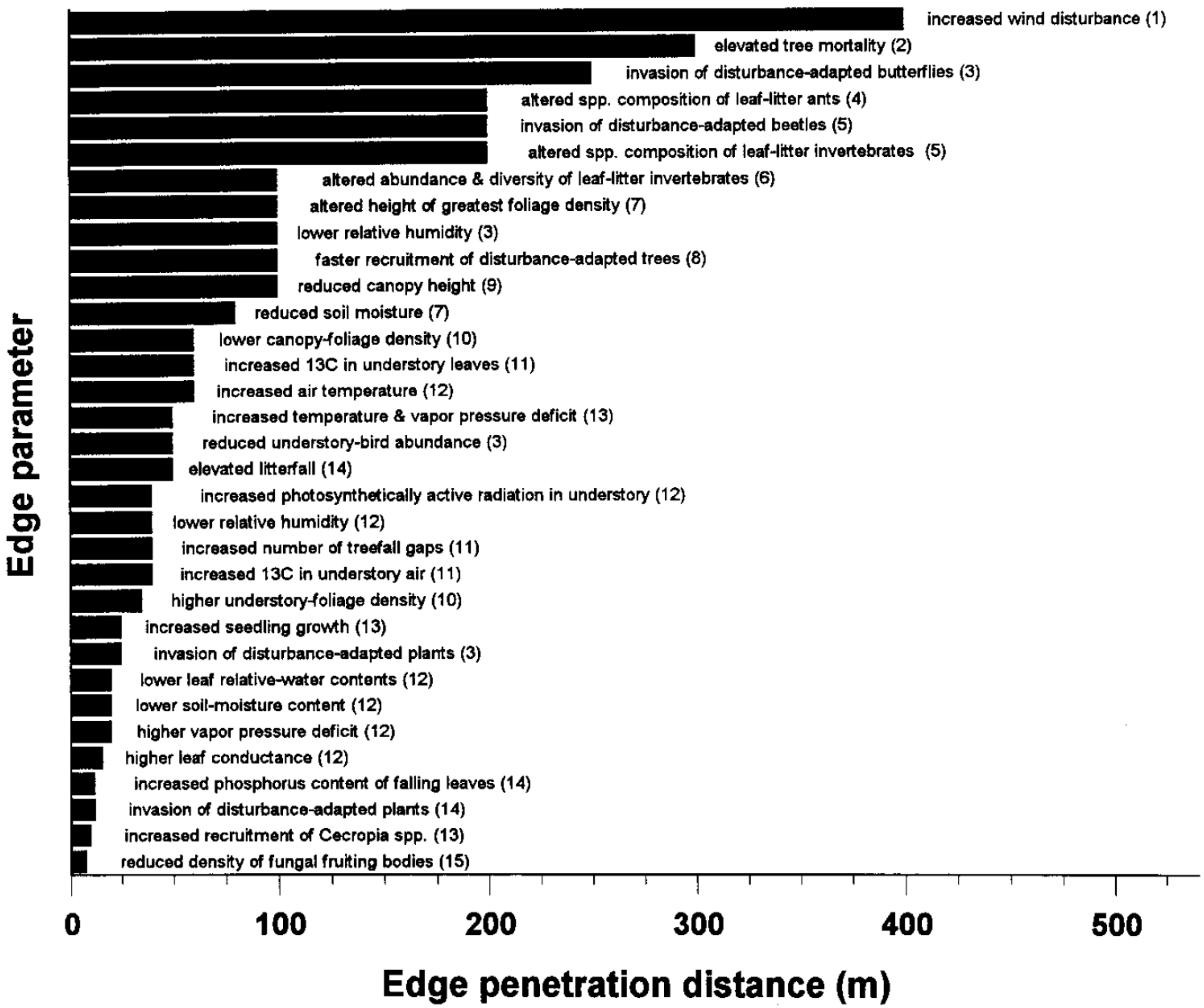

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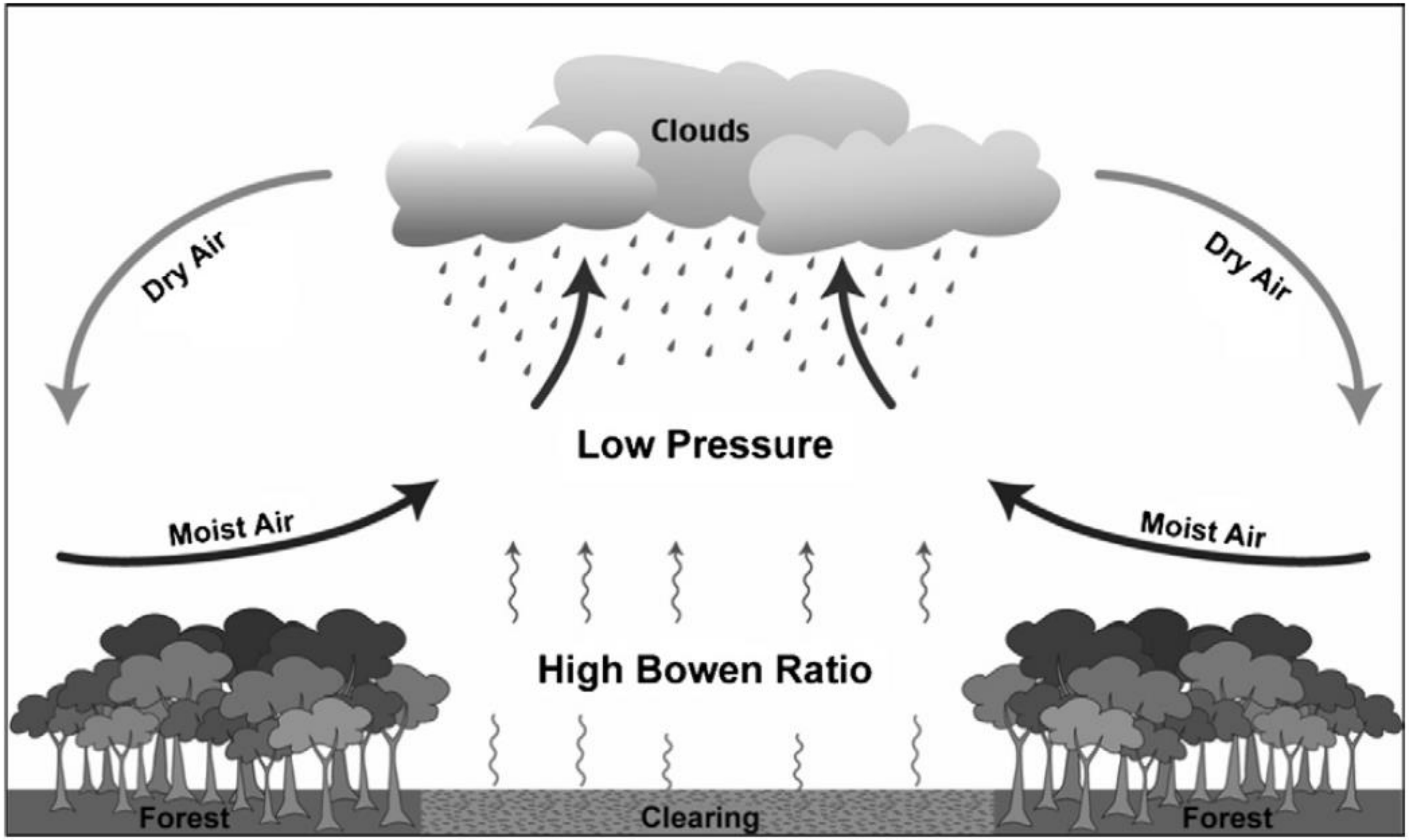

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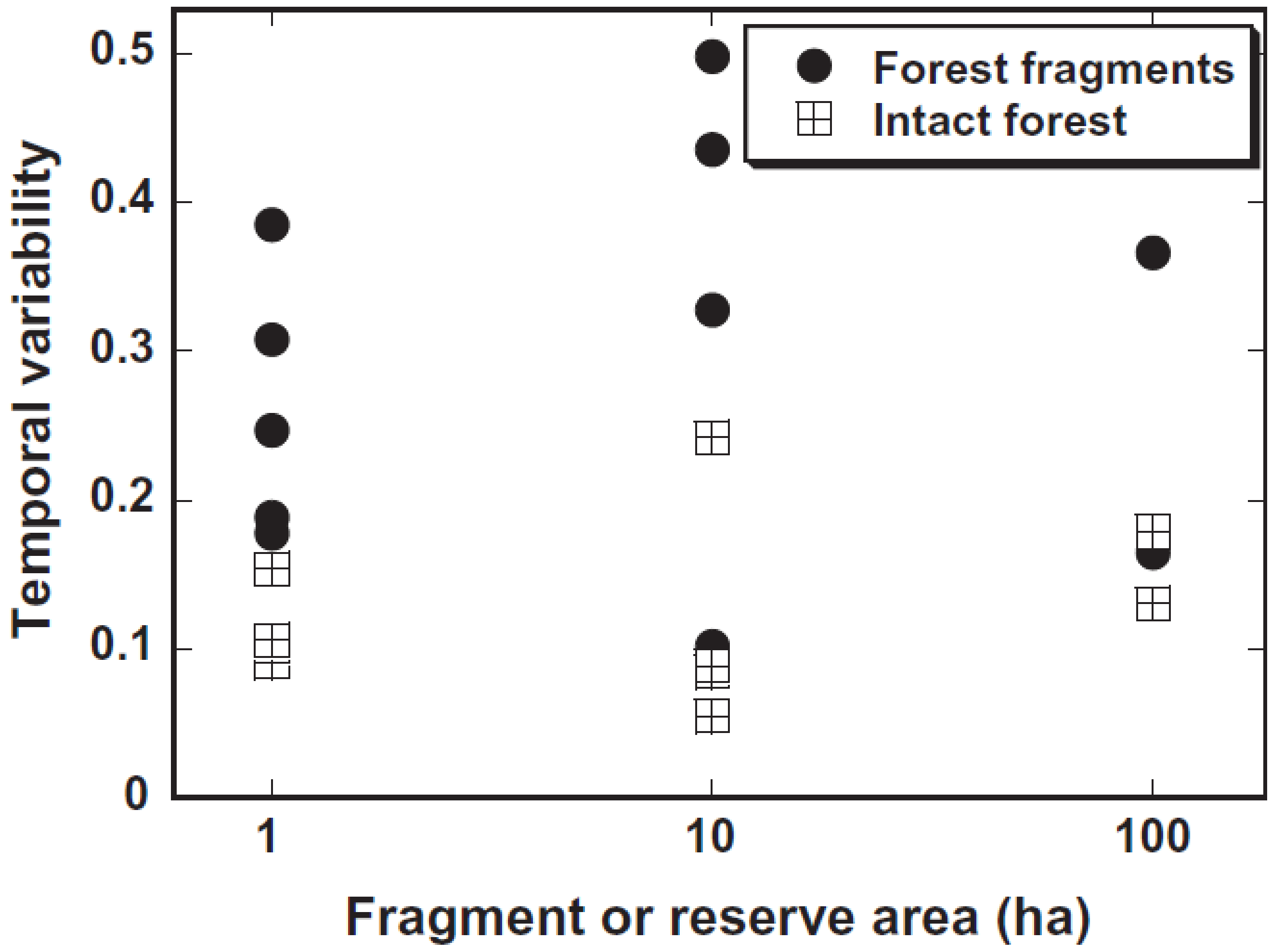
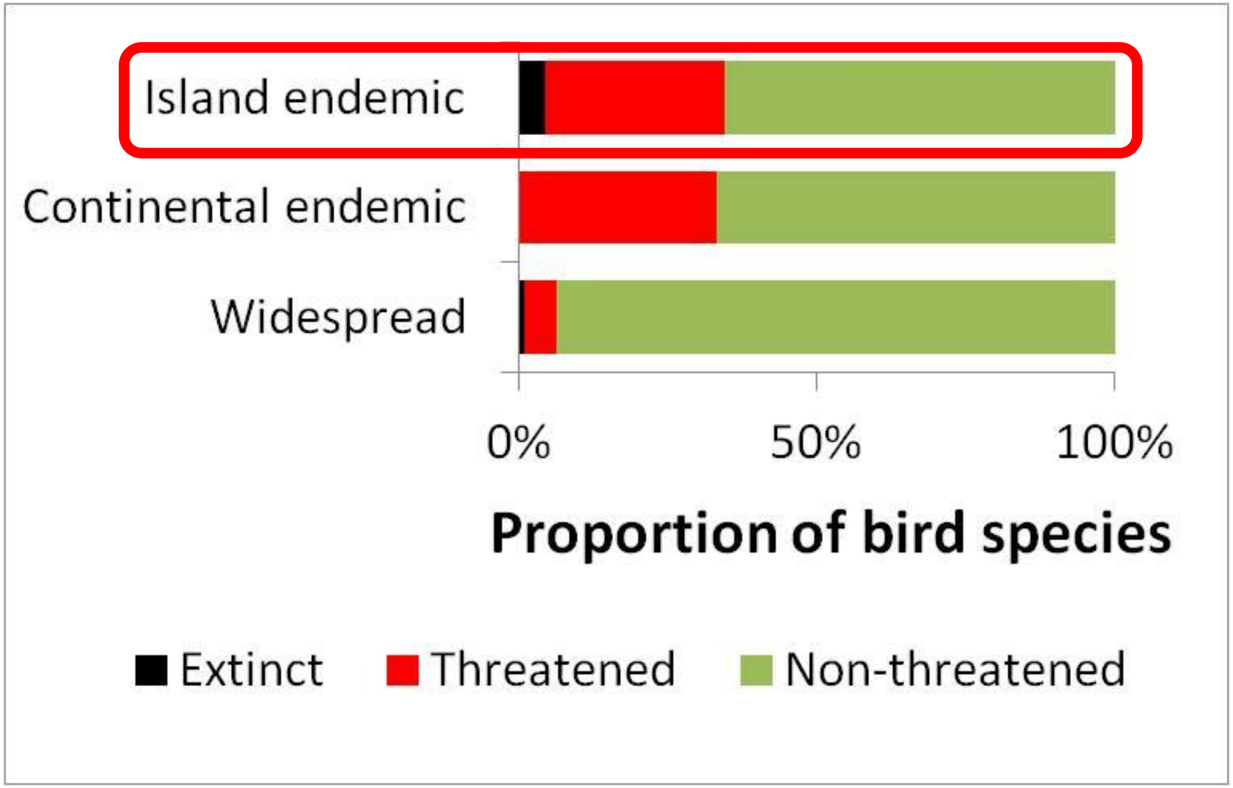


ISLANDS - THREATS



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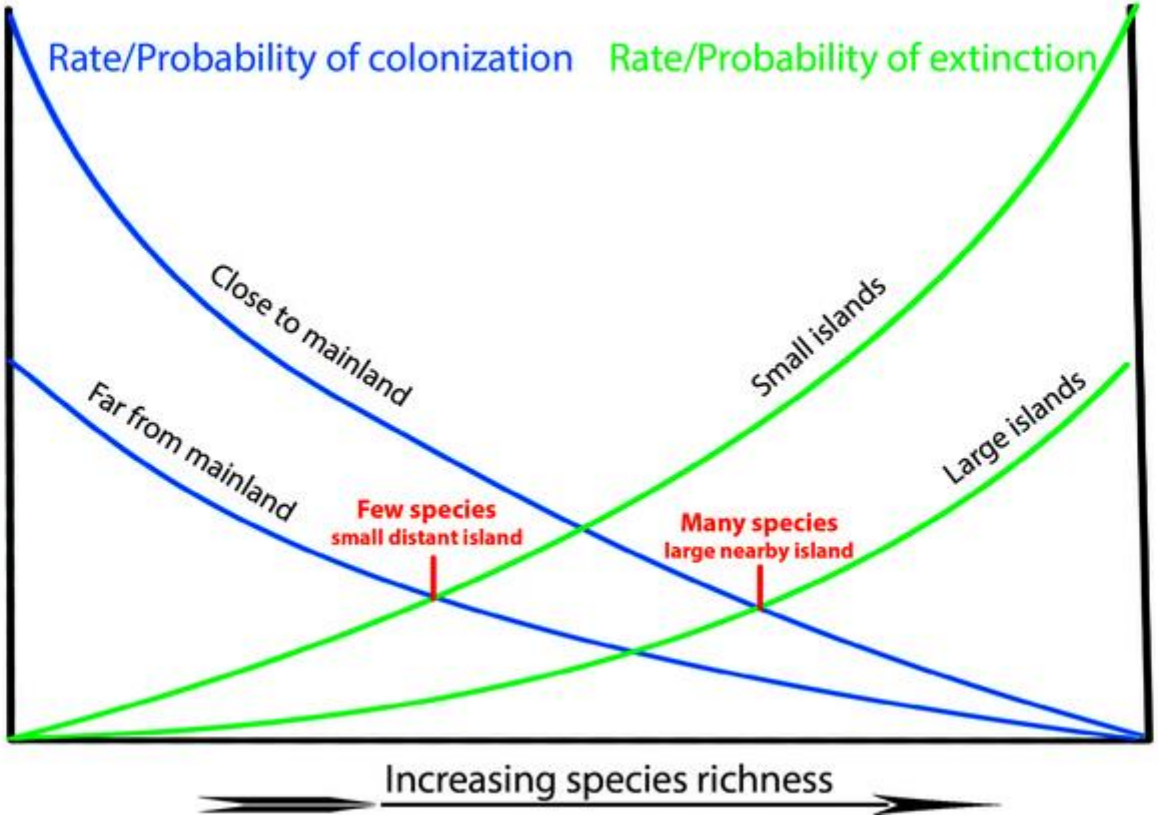

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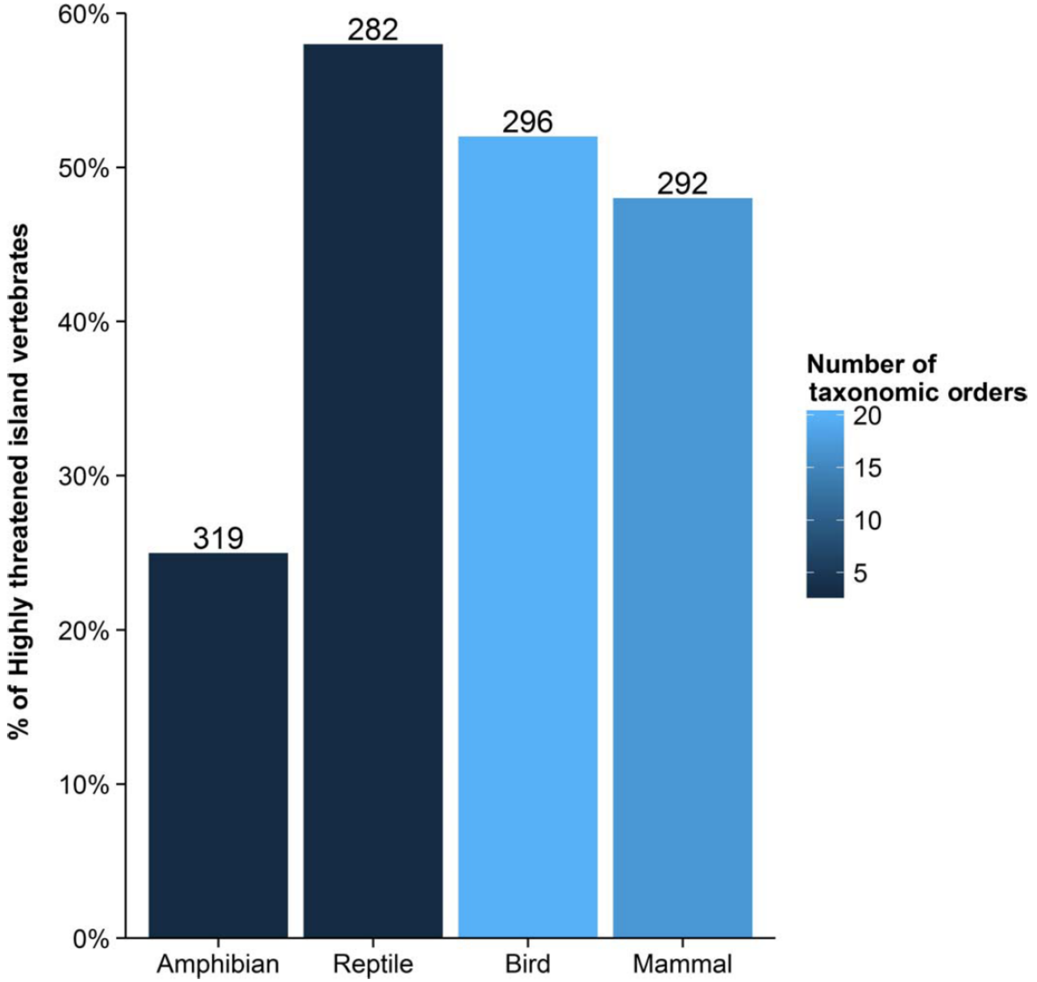

Fig. 1. Percentage of highly threatened vertebrates breeding on islands by vertebrate class. Numbers above the bar give the total number of highly threatened species that breed on islands. Color shading indicates the number of taxonomic orders within each island vertebrate class.

ISLANDS - THREATS

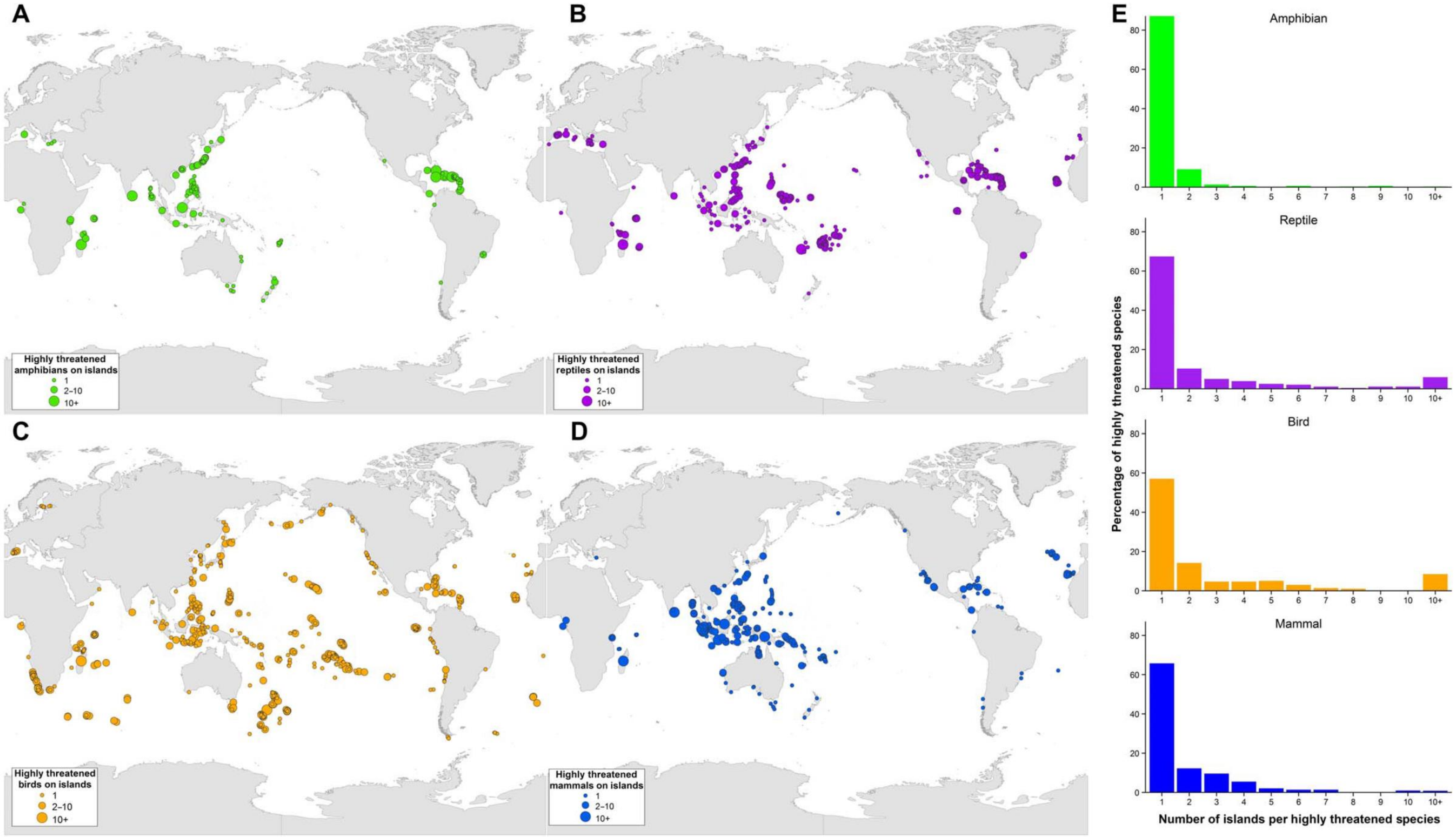

Fig. 4. The global distribution of highly threatened vertebrates. Location of islands supporting populations of highly threatened (**A**) amphibians, (**B**) reptiles, (**C**) birds, (**D**) mammals, and the number of islands with breeding populations per highly threatened species (**E**).

ISLANDS - THREATS

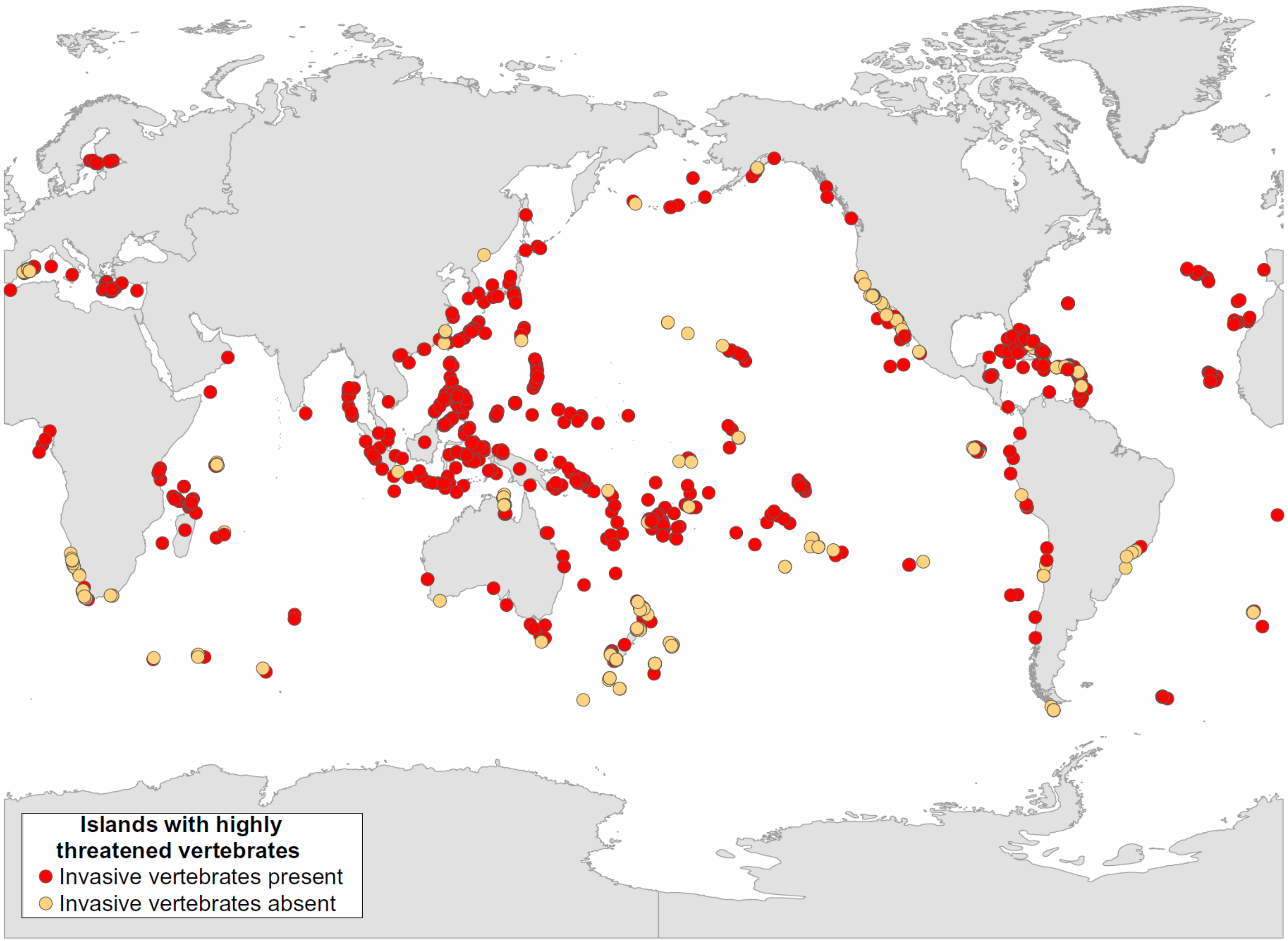

Fig. 5. The 1030 islands with highly threatened native vertebrates and information on the presence or absence of invasive vertebrates. Of these, 779 (76%) had at least one invasive vertebrate species present. Mammals were the most common invader on these islands (753 islands; 97% of islands with highly threatened vertebrates).

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The fate of Amazonian forest fragments: A 32-year investigation

William F. Laurance[a,b,*], José L.C. Camargo[a], Regina C.C. Luizão[a,c], Susan G. Laurance[a,b], Stuart L. Pimm[d], Emilio M. Bruna[e], Philip C. Stouffer[f], G. Bruce Williamson[g], Julieta Benítez-Malvido[h], Heraldo L. Vasconcelos[i], Kyle S. Van Houtan[d,j], Charles E. Zartman[k], Sarah A. Boyle[l], Raphael K. Didham[m,n], Ana Andrade[a], Thomas E. Lovejoy[o,p,*]

Biological Conservation 144 (2011) 56–67

Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2009) **18**, 346–360

RESEARCH PAPER

Global analysis of bird elevational diversity

Christy M. McCain

The Role of Mountain Ranges in the Diversification of Birds

Jon Fjeldså,[1] Rauri C.K. Bowie,[2] and Carsten Rahbek[3]

Annu. Rev. Ecol. Evol. Syst. 2012. 43:249–65

Biomass Collapse in Amazonian Forest Fragments

William F. Laurance,* Susan G. Laurance, Leandro V. Ferreira, Judy M. Rankin-de Merona,† Claude Gascon, Thomas E. Lovejoy‡

SCIENCE • VOL. 278 • 7 NOVEMBER 1997

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CONSERVATION BIOLOGY

Globally threatened vertebrates on islands with invasive species

Dena R. Spatz,[1,2]* Kelly M. Zilliacus,[1] Nick D. Holmes,[2,3] Stuart H. M. Butchart,[4,5] Piero Genovesi,[6] Gerardo Ceballos,[7] Bernie R. Tershy,[1,8] Donald A. Croll[1]

3:e1603080 25 October 2017

Ecosystem Decay of Amazonian Forest Fragments: a 22-Year Investigation

Conservation Biology, Pages 605-618
Volume 16, No. 3, June 2002

WILLIAM F. LAURANCE,*† THOMAS E. LOVEJOY,†‡
HERALDO L. VASCONCELOS,† EMILIO M. BRUNA,† RAPHAEL K. DIDHAM,†**
PHILIP C. STOUFFER,† †† CLAUDE GASCON,†‡‡ RICHARD O. BIERREGAARD,†§§
SUSAN G. LAURANCE,†*** AND ERICA SAMPAIO† †††

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A call for a new paradigm of island biogeography

MARK. V. LOMOLINO *Oklahoma Biological Survey, Oklahoma Natural Heritage Inventory and Department of Zoology, University of Oklahoma, Norman, OK 73019, U.S.A.,*

nature Vol 436|18 August 2005|**doi:10.1038/nature03850**

Global hotspots of species richness are not congruent with endemism or threat

C. David L. Orme[1], Richard G. Davies[3], Malcolm Burgess[1], Felix Eigenbrod[1], Nicola Pickup[1], Valerie A. Olson[4], Andrea J. Webster[5], Tzung-Su Ding[6], Pamela C. Rasmussen[7], Robert S. Ridgely[8], Ali J. Stattersfield[9], Peter M. Bennett[4], Tim M. Blackburn[5], Kevin J. Gaston[3] & Ian P. F. Owens[1,2]

PNAS | **December 20, 2005** | vol. 102 | no. 51 | **18497–18501**

Pinpointing and preventing imminent extinctions

Taylor H. Ricketts[a,b], Eric Dinerstein[a], Tim Boucher[c], Thomas M. Brooks[d], Stuart H. M. Butchart[e], Michael Hoffmann[d], John F. Lamoreux[f], John Morrison[a], Mike Parr[g], John D. Pilgrim[d], Ana S. L. Rodrigues[d], Wes Sechrest[f,h], George E. Wallace[g], Ken Berlin[i], Jon Bielby[j], Neil D. Burgess[a], Don R. Church[d], Neil Cox[h], David Knox[d], Colby Loucks[a], Gary W. Luck[k], Lawrence L. Master[l], Robin Moore[m], Robin Naidoo[a], Robert Ridgely[g], George E. Schatz[n], Gavin Shire[g], Holly Strand[a], Wes Wettengel[a], and Eric Wikramanayake[a]

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SPECIAL PAPER

Body size evolution in insular vertebrates: generality of the island rule

Mark V. Lomolino*

Dramatic niche shifts and morphological change in two insular bird species

Per Alström[1,2,†], Knud A. Jønsson[3,4,5,†], Jon Fjeldså[3], Anders Ödeen[6], Per G. P. Ericson[7] and Martin Irestedt[8,†]

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VOL. 180, NO. 1 THE AMERICAN NATURALIST JULY 2012

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Revisiting the Ants of Melanesia and the Taxon Cycle: Historical and Human-Mediated Invasions of a Tropical Archipelago

Evan P. Economo[1,*] and Eli M. Sarnat[2]

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BIODIVERSITY RESEARCH

Invasion of pollination networks on oceanic islands: importance of invader complexes and endemic super generalists

JENS M. OLESEN[1]*, LOUISE I. ESKILDSEN[1] and SHADILA VENKATASAMY[2]

Received 2 Oct 2014 | Accepted 23 Jan 2015 | Published 10 Mar 2015

DOI: 10.1038/ncomms7376

Bird–flower visitation networks in the Galápagos unveil a widespread interaction release

Anna Traveset[1], Jens M. Olesen[2], Manuel Nogales[3], Pablo Vargas[4], Patricia Jaramillo[5], Elena Antolín[6], María Mar Trigo[6] & Ruben Heleno[1,7]

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Rita Covas[1,2,3,4,*]