

### What is biogeography?

*Patterns*  
MODIS Land Cover Type

Category	HEX	CODE
Water	000000	10
Swamp and freshwater marshes	008000	11
Emergent freshwater marshes	008000	12
Wetland non-flush forest	008000	13
Wetland non-flush forest	008000	14
Wetland non-flush forest	008000	15
Wetland non-flush forest	008000	16
Wetland non-flush forest	008000	17
Wetland non-flush forest	008000	18
Wetland non-flush forest	008000	19
Wetland non-flush forest	008000	20
Wetland non-flush forest	008000	21
Wetland non-flush forest	008000	22
Wetland non-flush forest	008000	23
Wetland non-flush forest	008000	24
Wetland non-flush forest	008000	25
Wetland non-flush forest	008000	26
Wetland non-flush forest	008000	27
Wetland non-flush forest	008000	28
Wetland non-flush forest	008000	29
Wetland non-flush forest	008000	30
Wetland non-flush forest	008000	31
Wetland non-flush forest	008000	32
Wetland non-flush forest	008000	33
Wetland non-flush forest	008000	34
Wetland non-flush forest	008000	35
Wetland non-flush forest	008000	36
Wetland non-flush forest	008000	37
Wetland non-flush forest	008000	38
Wetland non-flush forest	008000	39
Wetland non-flush forest	008000	40
Wetland non-flush forest	008000	41
Wetland non-flush forest	008000	42
Wetland non-flush forest	008000	43
Wetland non-flush forest	008000	44
Wetland non-flush forest	008000	45
Wetland non-flush forest	008000	46
Wetland non-flush forest	008000	47
Wetland non-flush forest	008000	48
Wetland non-flush forest	008000	49
Wetland non-flush forest	008000	50
Wetland non-flush forest	008000	51
Wetland non-flush forest	008000	52
Wetland non-flush forest	008000	53
Wetland non-flush forest	008000	54
Wetland non-flush forest	008000	55
Wetland non-flush forest	008000	56
Wetland non-flush forest	008000	57
Wetland non-flush forest	008000	58
Wetland non-flush forest	008000	59
Wetland non-flush forest	008000	60
Wetland non-flush forest	008000	61
Wetland non-flush forest	008000	62
Wetland non-flush forest	008000	63
Wetland non-flush forest	008000	64
Wetland non-flush forest	008000	65
Wetland non-flush forest	008000	66
Wetland non-flush forest	008000	67
Wetland non-flush forest	008000	68
Wetland non-flush forest	008000	69
Wetland non-flush forest	008000	70
Wetland non-flush forest	008000	71
Wetland non-flush forest	008000	72
Wetland non-flush forest	008000	73
Wetland non-flush forest	008000	74
Wetland non-flush forest	008000	75
Wetland non-flush forest	008000	76
Wetland non-flush forest	008000	77
Wetland non-flush forest	008000	78
Wetland non-flush forest	008000	79
Wetland non-flush forest	008000	80
Wetland non-flush forest	008000	81
Wetland non-flush forest	008000	82
Wetland non-flush forest	008000	83
Wetland non-flush forest	008000	84
Wetland non-flush forest	008000	85
Wetland non-flush forest	008000	86
Wetland non-flush forest	008000	87
Wetland non-flush forest	008000	88
Wetland non-flush forest	008000	89
Wetland non-flush forest	008000	90
Wetland non-flush forest	008000	91
Wetland non-flush forest	008000	92
Wetland non-flush forest	008000	93
Wetland non-flush forest	008000	94
Wetland non-flush forest	008000	95
Wetland non-flush forest	008000	96
Wetland non-flush forest	008000	97
Wetland non-flush forest	008000	98
Wetland non-flush forest	008000	99
Wetland non-flush forest	008000	100

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### What is biogeography?

*Patterns*

**Lodgepole pine**

Pinus contorta

Little (1971); USGS

**Mountain Pine Beetle**

Amman (1990)

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### What is biogeography?

**biotic factors**

- ① Differential "ecological engineering" on the geographic template
- ② Interactions among species
- ③ Resilience of biotic communities, dispersal, population viability
- ④ The geographic template

**physical environment (abiotic factors)**

**historical context (all)**

(e.g., formation of beaver ponds, forest fragmentation, and pollution)

⑤ Ecological dynamics of the geographic template (plate tectonics, sea level changes, climate change, invasive species)

Lomolino et al., 2006

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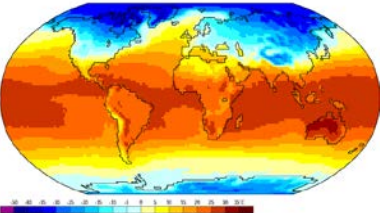
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What is biogeography?  
*Process: Abiotic factors*

Air Temperature Jan



www.physicalgeography.net

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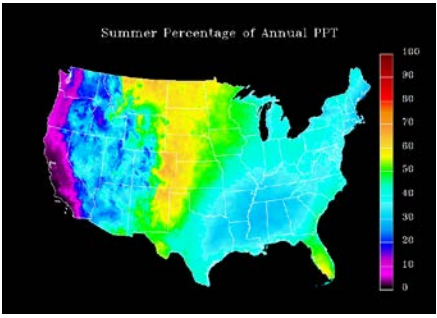
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What is biogeography?  
*Timing of precipitation: Summer = May-Sep*

Summer Percentage of Annual PPT



PRISM database

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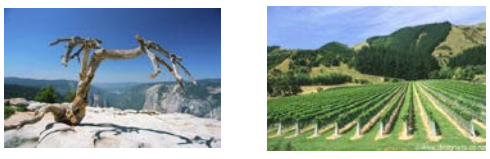
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What is biogeography?  
*Process: Abiotic factors*  
*Soil fertility*



www.naturalbornhikers.com

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What is biogeography?  
*Process: Abiotic factors*  
*Disturbance type, severity, frequency*



Sept 2005, Railroad Ridge, ID      Jan 2001, Tapajós, Brazil      Photo by K. Wattenmaker, firepix.blm.gov

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What is biogeography?  
*Process: Abiotic factors*  
*Physical environment*



ocean-ridge.ideo.columbia.edu/courses/subgeol/hot\_springs      www.alpine-club.mb.ca

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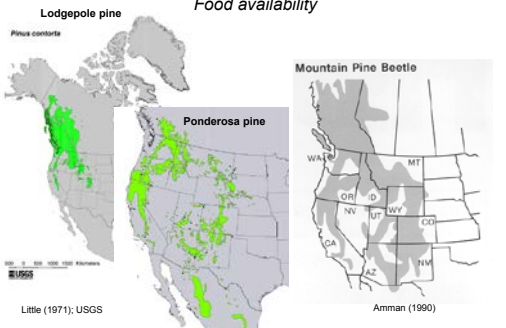
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What is biogeography?  
*Process: Biotic factors*  
*Food availability*



Lodgepole pine  
*Pinus contorta*

Ponderosa pine

Mountain Pine Beetle

Little (1971); USGS      Amman (1990)

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What is biogeography?  
*Process: Biotic factors*  
*Evolution*



www.futura-sciences.com

Hyracotherium (50 mya)  
Mesohippus (25 mya)  
Hipparion (8 mya)  
Pliohippus (4 mya)  
Equus (recent)

www.emc.maricopa.edu/faculty/farabee/biobk/BioBookEVOL11.html

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What is biogeography?  
*Process: Biotic factors*  
*Competition*



hyenas.zoology.msu.edu/beamweb/images



www.lzw-berlin.de/en/research/fig1/index.html?themen/thema\_hyaene/projekt.html-rechts



hyenas.zoology.msu.edu/images/crocuta

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What is biogeography?  
*Process: Biotic factors*  
*Extinction*



we.vub.ac.be/~dglg/Web/Claeys/Chicxulub/



Edouard Poppig

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**What is biogeography?**  
 Process: *History*  
 Dispersal

*Rapid: Introduction of European starling*      *Slow: Expansion of crops, oaks*

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**What is biogeography?**  
 Process: *History*  
 Invasion

**Cheatgrass**

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**What is biogeography?**  
 Process: *History*  
 Colonization

**FIGURE 13.19** As an empty island accumulates species, its insular communities may pass through a series of equilibria reflecting demographic, ecological, and evolutionary processes. (After Simberloff and Wilson 1969, 1970.)

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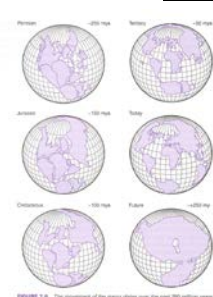
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What is biogeography?  
Scales: Temporal



Geologic

FIGURE 1.8 The movement of the supercontinent Gondwana over the last 200 million years and the northern supercontinent Laurasia into the tectonic plates of today. 1970, Scotese, 1988, PALEODIMAP files, and the present-day map are provided here by Google, 2009.

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What is biogeography?  
Scales: Temporal


*Evolutionary: depends on organism!*

Fruit fly: 10 day life-cycle



[home.primus.com.au/bonno/evolution4.htm](http://home.primus.com.au/bonno/evolution4.htm)

Bristlecone pine: 1000s of years



[www.photo.net/ca/sierra](http://www.photo.net/ca/sierra)

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What is biogeography?  
Scales: Temporal

*Time scale of stresses/disturbances*

- climate change and variability (e.g., droughts)
- fires/insect outbreaks
- invasive species
- human pressure (e.g., hunting)

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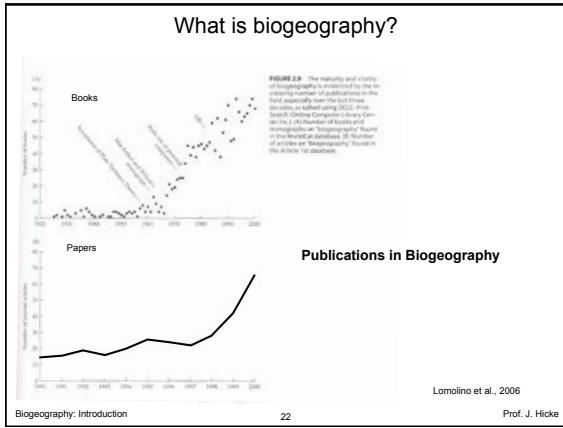
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