

Biodiversity distribution

Table 4.1
Numbers of Species Living Today

Kingdom	Phylum (Division)	Number of described species	Estimated number of species	Percent described
Monera	Viruses and bacteria*		?????	<1%?
Protista		100,000	250,000	40.0
Fungi	Eumycota	80,000	1,500,000	5.3
Plantae	Bryophyta	14,000	30,000	46.7
	Tracheophyta	250,000	500,000	50.0
Animalia	Porifera	5,000		
	Cnidaria	10,000		
	Ctenophora	100		
	Platyhelminthes	25,000		
	Nemertea	900		
	Gastrotricha	500		
	Kinorhyncha	100		
	Priapulida	16		
	Entoprocta	150		
	Nematoda	20,000	1,000,000	2.0
	Rotifera	1,800		
	Annelida	75,000		
	Arthropoda	1,250,000	20,000,000	5.0
	Mollusca	100,000	200,000	50.0
	Sipunculida	250		
	Echiurida	150		
	Pogonophora	145		
Ectoprocta	5,000			
Phoronida	70			
Brachiopoda	350 ^a			
Hemichordata	100			
Chateognatha	100			
Echinodermata	7,000			
Urochordata	1,200			
Chordata	40,000	50,000	80.0	

How to count species?

MacArthur and Wilson (1967):
the theory of island biogeography

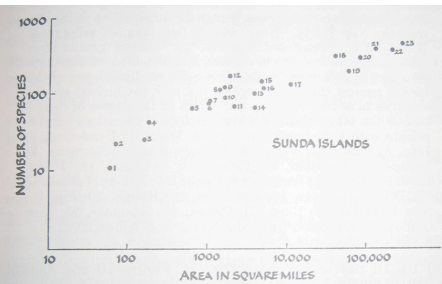
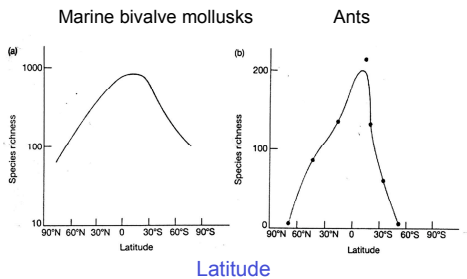


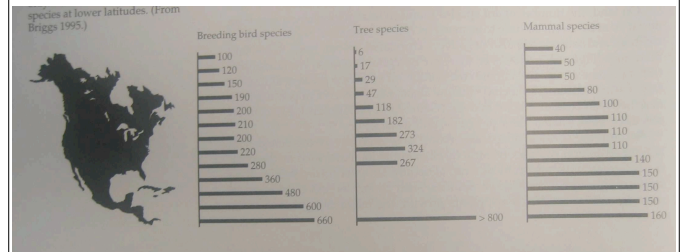
FIGURE 9. The numbers of land and fresh-water bird species on various islands and archipelagos of the Sunda group, together with the Philippines and New Guinea. The islands and archipelagos are grouped close to one another and to the Asian continent and Greater Sunda group, where most of the species live; and the distance effect is not apparent. Christmas, 1; Bawean, 2; Engano, 3; Savu, 4; Simalur, 5; Alors, 6; Wetar, 7; Nias, 8; Lombok, 9; Billiton, 10; Mentawai, 11; Bali, 12; Sumba, 13; Bangka, 14; Flores, 15; Sumbawa, 16; Timor, 17; Java, 18; Celebes, 19; Philippines, 20; Sumatra, 21; Borneo, 22; New Guinea, 23. (Modified from MacArthur and Wilson, 1963.)

Global distribution of biodiversity

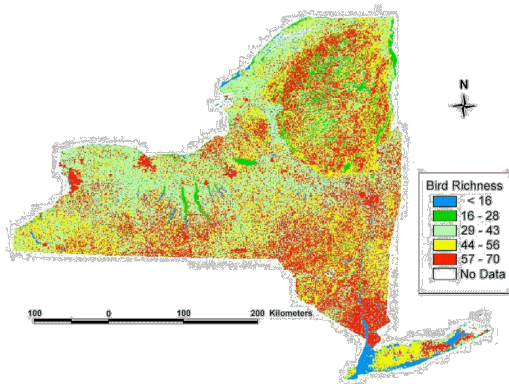


~~Global~~ distribution of biodiversity

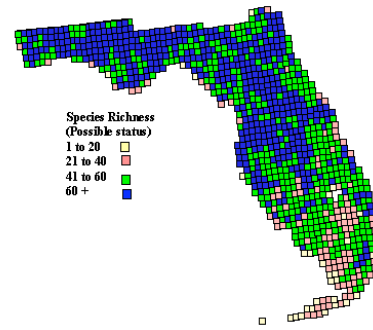
North America



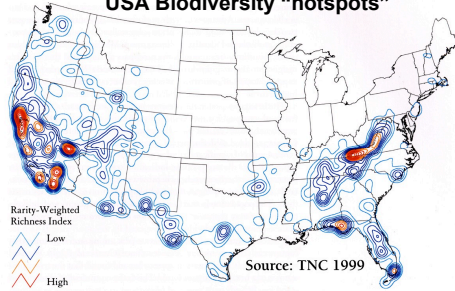
Breeding bird richness in the state of New York



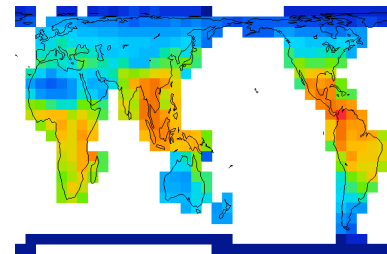
Breeding bird richness in Florida



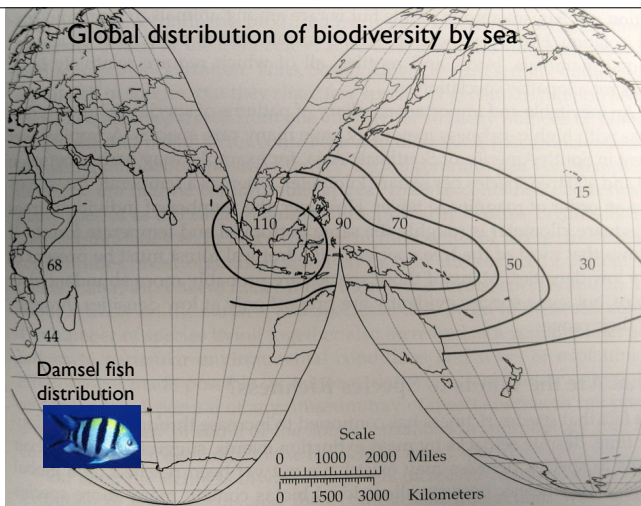
USA Biodiversity "hotspots"



Global distribution of biodiversity on land



Global distribution of biodiversity by sea



Is evenness or richness a good indicator for conservation?

- Treats all species the same
- Favors large population sizes (not all measures)

NO, but is there any better?

Towards a phylogenetic informed biodiversity measure

- instead of weighting population sizes we also could weight position on the phylogeny
- What is worth more, a Sphenodon (Tuatara) or a 10 song bird species?



Towards a phylogenetic informed biodiversity measure

- Phylogeny should play a role
- Abundance should play a role
- Ecological connection should play a role
- [I don't want to make such decisions]

Endemism

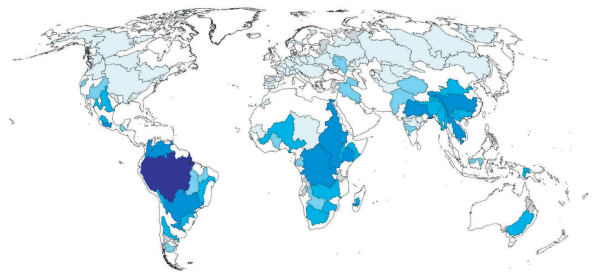


Florida scrub jay



Summer
All Year
Winter

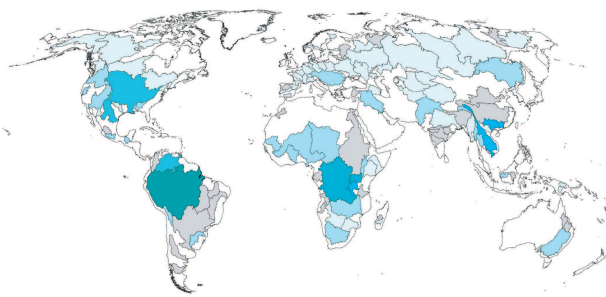
Distribution of endemic bird species



Number of Endemic Bird Areas
0
1
2-4
5-9
10-24

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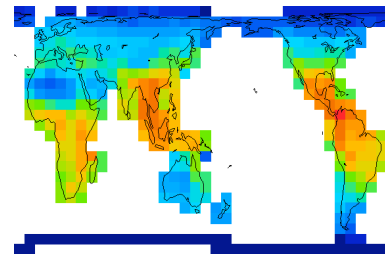
Distribution of endemic fish species



Number of Endemic Fish Species
0 - 5
5 - 50
50 - 100
100 - 250
250 - 500
500 - 1000
No Data

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Global distribution of biodiversity on land



High endemism correlates with high diversity

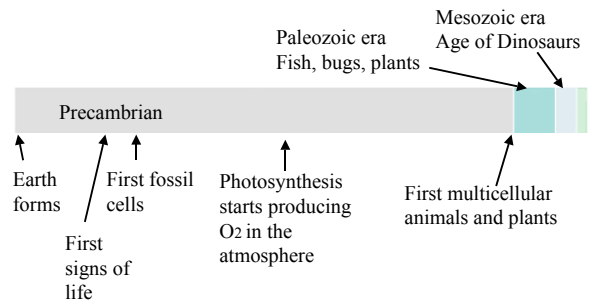
Taxon	Correlation of richness with endemism
Mammals	.81
<i>Lasioglossum</i> (bee)	.85
<i>Papilionidae</i> (butterflies)	.7
<i>Plusiinae</i> (moths)	.77



Extinctions

- Background extinction
- Current, recent extinctions

Geological time scale



Geological Time Scale

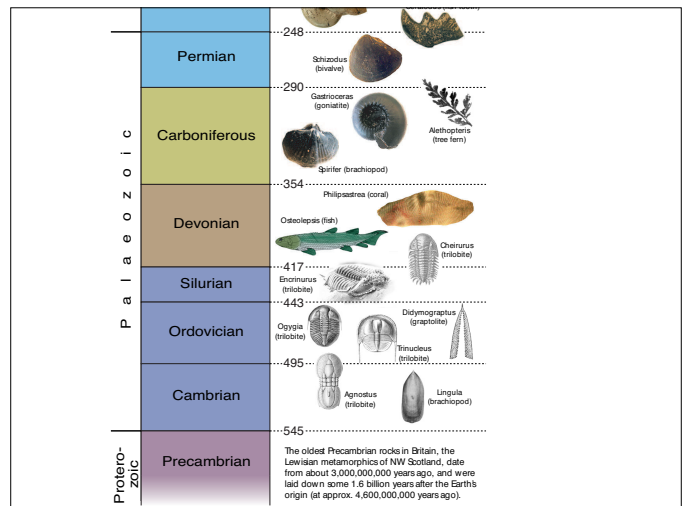
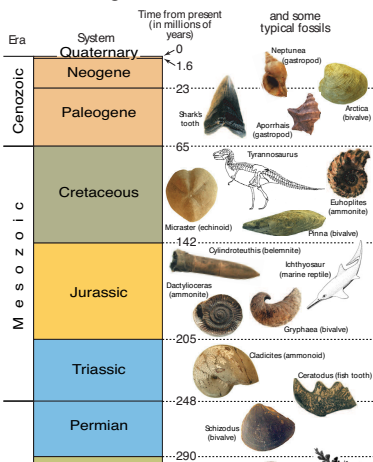
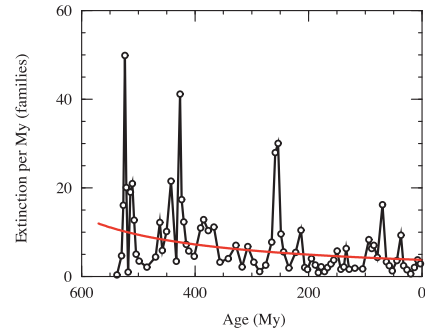
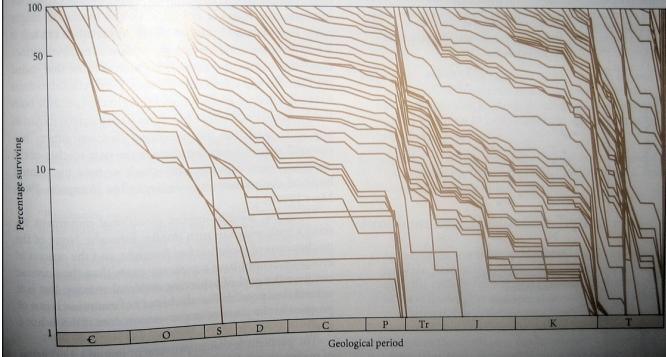


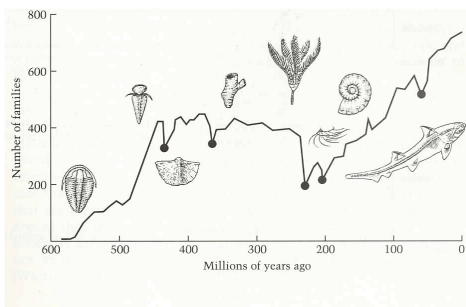
FIGURE 24.22 Survivorship of marine families over Phanerozoic time. Each curve traces the proportion of surviving families among those present during a certain geological stage (thus each stage begins with 100 percent). Steep portions of a curve show intervals of high extinction; shallow portions, intervals of

low extinction rates. Note that except for times of mass extinction (such as the end of the Permian, Cretaceous, and Eocene), the slopes do not change appreciably between the early and late Phanerozoic. (After Flessa et al. 1986.)



The number of families of known marine organisms becoming extinct per unit time in each stratigraphic stage as a function of time during the Phanerozoic. The red line is the average decline in extinction. The data are from the compilation of Sepkowski (1992) [Newman & Ebke, 1999]

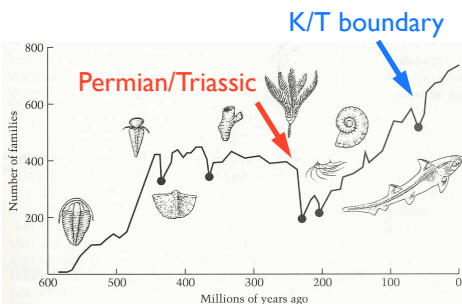
Diversification of marine organisms



Extinction rate: general patterns

- Extinction rates vary a lot
- A steady rate of extinctions, it even seems that the extinction rate was larger long time ago
- Speciation rate > Extinction rate
- Species last about 1- 25 My years
- On average about 1-2 species go extinct each year

Catastrophic extinction events



Possible Sources

- Large meteorites hitting earth
- Climate change
- Vulcanism: Effect on climate, changing landscape
- Glaciation: Cooling shrinks range of species, might increase competition
- Formation of super-continent: better adapted species win, changes in number of habitats



K/T boundary mass extinction was caused by meteor impact



Current extinction

- Direct observation is difficult.

Table 1.2 Species in major taxa that have become extinct since 1600 or are threatened with extinction. (After Smith *et al.*, 1993a.)

	No. of species certified extinct since 1600	No. of species listed as threatened*	Approx. total of recorded extant species (in thousands)	Approx. extinct (%)	Approx. threatened (%)
Animals					
Molluscs	191	354	100	0.2	0.4
Crustaceans	4	126	40	0.01	0.3
Insects	61	873	1000	0.006	0.09
Vertebrates	229	2212	47	0.5	5
Fishes	29	452	24	0.1	2
Amphibians	2	59	3	0.1	2
Reptiles	23	167	6	0.4	3
Birds	116	1029	9.5	1	11
Mammals	59	505	4.5	1	11
Total (animals)	485	3565	1400	0.04	0.3
Plants					
Gymnosperms	2	242	0.8	0.3	30
Dicotyledons	120	17474	190	0.06	9
Monocotyledons	462	4421	52	0.9	9
Palms	4	925	2.8	0.1	33
Total (plants)	584	22137	240	0.2	9

*'Threatened' here includes IUCN categories of 'vulnerable', 'endangered', 'probably extinct', but does not include other categories of concern, such as 'rare' or 'insufficiently known'

How sure are we about these numbers?
Obviously not very sure, because citing the same sources authors arrive at different numbers.

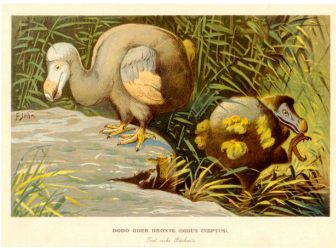
Table 2.1 Extinctions recorded since 1500 A.D. "Extinct in wild" indicates that individuals of the species continue to exist, but only in captivity (e.g. zoos or captive breeding programs). Data from (IUCN 2004).

	# Extinct	# Extinct in wild
Animals	697	36
Plants & algae	87	24
Total	784	60



Dodo

extinct in the 17th century



Steller's sea cow



- Extinct 1768, 27 years after being detected



Great Auk

- hunted for fat and feathers
- extinct 1844

Passenger pigeon



- Many millions during 19th century
- Last died in the Cincinnati Zoo in 1914

Passenger pigeon



Passenger Pigeon (*Ectopistes migratorius*) ©2003 Will Cook

Carolina Parakeet



- extinct around 1935? (1918?)

Parakeet (*Conuropsis carolinensis*) ©2003 Will Cook

Panthera leo barbaricus Barbary Lion



- Extinct 1922

Tasmanian Tiger



- Extinct 1936



Gastric brooding frog



- Extinct ?
- Not found since 1985

Table 2.2. A sample of species once thought extinct, but rediscovered.

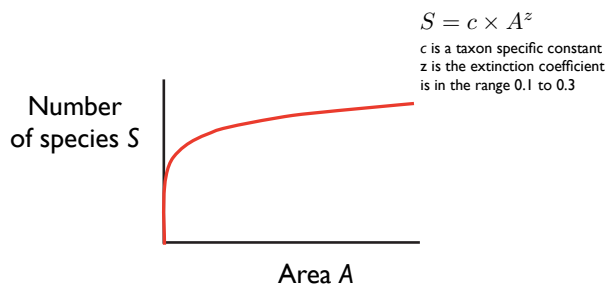
Species name	Common name	Date rediscovered	# yrs since	
			rediscovered	last sighting
<i>Dipsochelys hololissa</i>	Seychelles giant tortoise	1997	>150	
<i>Pterodroma cahow</i>	Bermuda petrel	1951	>300	
<i>Perameles bougainville</i>	Western barred bandicoot	1983	61	
<i>Trichocichla rufa</i>	Long-legged warbler	2003	109	
<i>Gastrolobium lehmannii</i>	Cranbrook pea	2001	83	
<i>Hapalopsittaca fuertesi</i>	Fuertes's parrot	2002	91	
<i>Hypsiprinus gilbertii</i>	Gilbert's potoroo	1994	85	
<i>Sida inflexa</i>	Virginia pine sida	1999	31	
<i>Lepidoptrix</i> (formerly <i>Pipra vilaboaasi</i>)	Golden crowned manakin	2002	45	



Measuring Current Extinctions

- Direct observation are difficult
- Indirect observation: species - area relationship

Species-Area relationship



Species-Area relationship

