Community Structure II

Ch. 22

III. Processes affecting diversity – large scale

C. Equilibrium model of island biogeography

1. Effects of island size and distance

2. The balance between immigration and extinction

D. The latitudinal species gradient

1. The patterns

2. The hypotheses

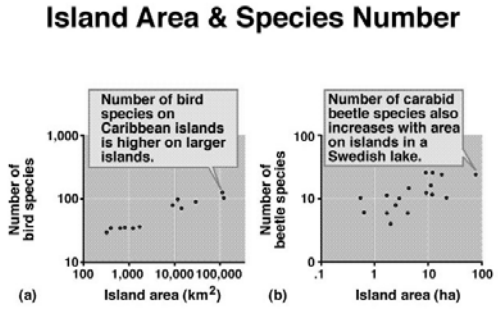
C. Island biogeography

Patterns of species richness depend on

Island size

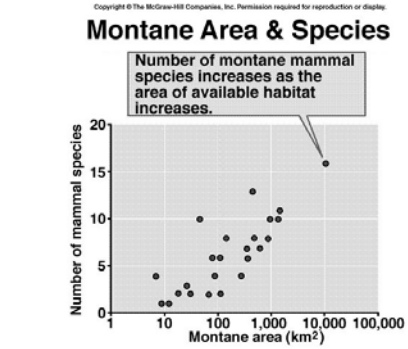
Island isolation

Number of species increases as island area increases



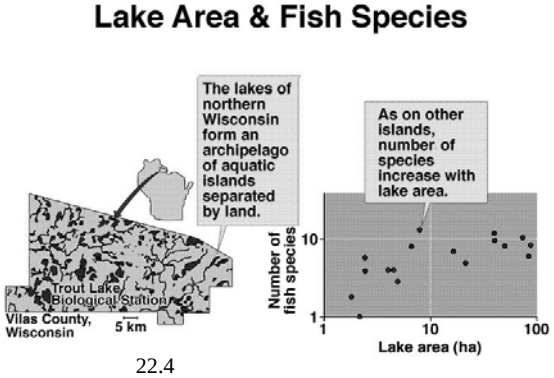
22.2

Mountains are islands too



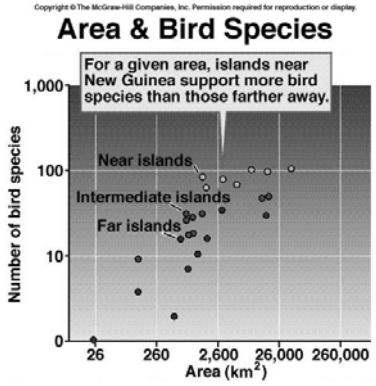
22.3

Lakes are islands?



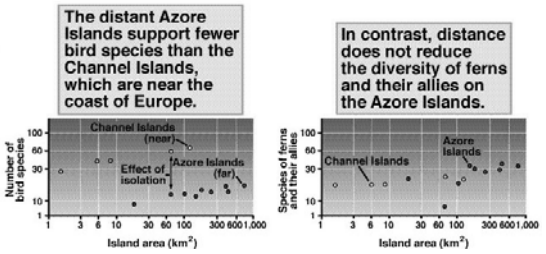
22.4

Closer islands have more species than farther islands



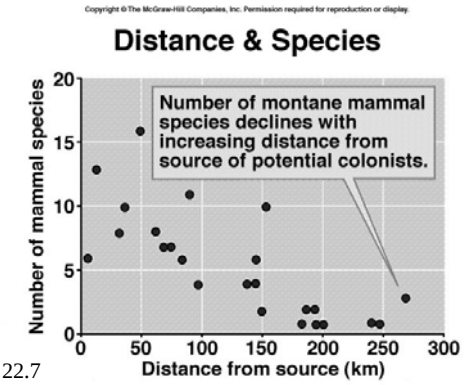
22.5

Effects of distance depend on taxa – why?

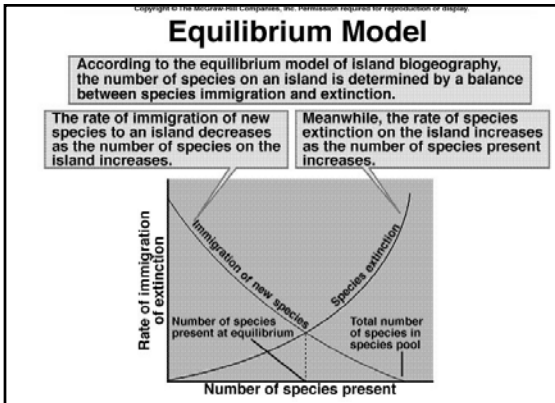


22.6

Mountain distance matters for mammal diversity

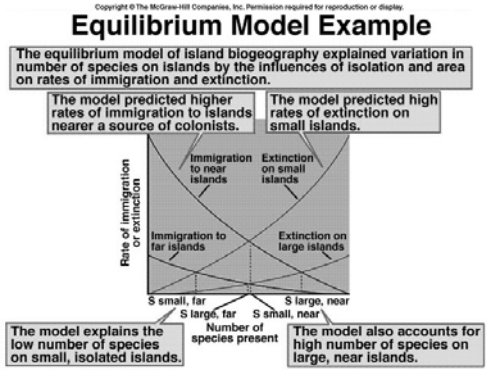


22.7



22.8

Large near islands have more species than small far islands



22.9

Simberloff & Wilson tested EMIB on Florida mangrove islands

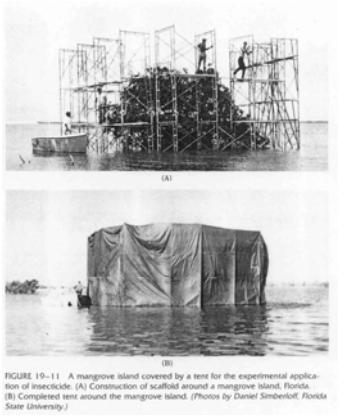
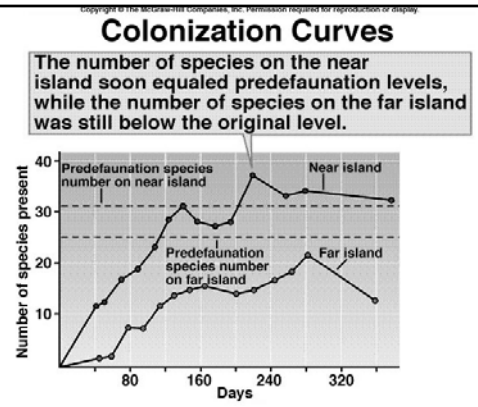
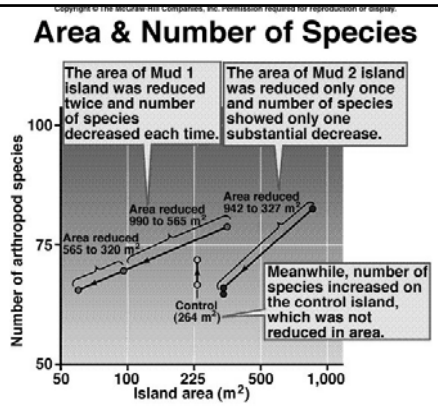


FIGURE 19–11 A mangrove island covered by a tent for the experimental application of insecticide. (A) Construction of scaffold around a mangrove island, Florida. (B) Completed tent around the mangrove island. (Photos by Daniel Simberloff, Florida State University.)

Ehrlich & Roughgarden 1985



22.12



22.14

Mangrove island recolonization

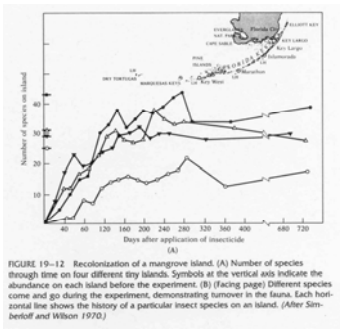
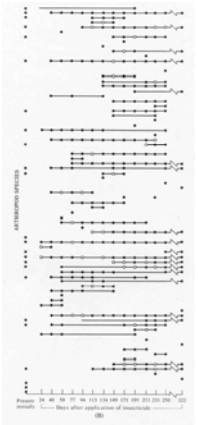
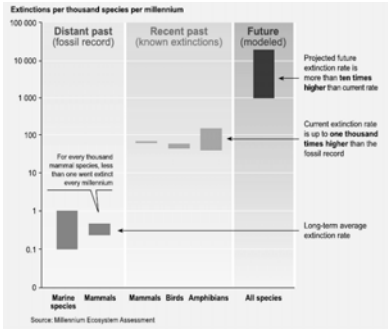


FIGURE 19–12 Recolonization of a mangrove island. (A) Number of species through time on four different tiny islands. Symbols at the vertical axis indicate the abundance on each island before the experiment. (B) (Facing page) Different species come and go during the experiment, demonstrating turnover in the fauna. Each horizontal line shows the history of a particular insect species on an island. *(After Simberloff and Wilson 1970.)*

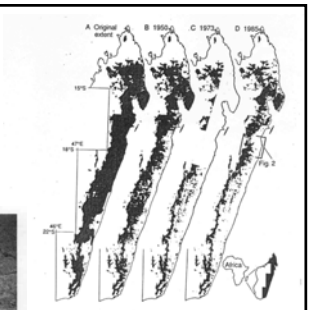


Ehrlich & Roughgarden 1985

Using species-area relationships to predict rates of extinction



Deforestation leads to habitat fragmentation: islands



re 1b. Aerial photography showing rainforest distribution in eastern Madagascar over 35 years. Map A represents the supposed rainforest coverage before human colonization. Extensive cloud cover disrupted mapping of the northeastern region in 1973 (modified from Green and Sussman, 1990).

Experimental reduction of fragment size

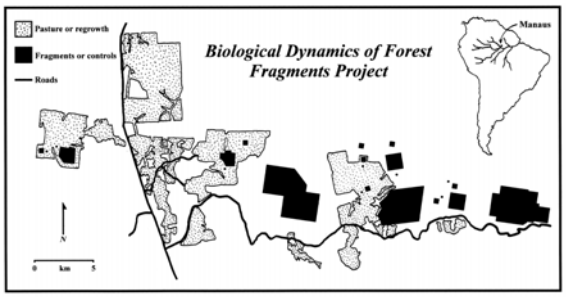


Figure 1. The Biological Dynamics of Forest Fragments Project study area in central Amazonia, showing locations of forest fragments and control sites in intact forest.

Laurance et al. 2002 Cons. Biol.

Effects of area and matrix

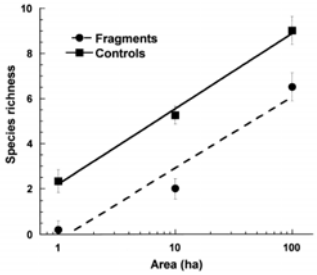
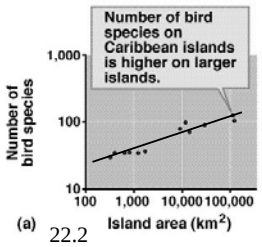


Figure 2. Species-area relationships for nine species of terrestrial insectivorous birds (mean ± SE) in the Biological Dynamics of Forest Fragments Project study area. Regression lines are fitted separately for fragments (R^2 = 94.3%) and control sites (R^2 = 99.4%) (after Stratford & Stouffer 1999).

Laurance et al. 2002 Cons. Biol.

Calculating species extinctions from habitat area

$S = cA^z$ (draw)



log(S) = log(c) + zlog(A)

z = slope of regression line

Bottom line: overall rates of extinction are **10-100 fold** higher than background.

22.2

Range of z's for Iowa grasslands

Table 2. Predictions from species-area extinction theory of the number of plant species (S) that should be extant in all Iowa prairie remnants, which make up 0.1% (124 km², Sanson & Knopf 1994) of their original (123,893 km²) extent, or in the area encompassing the 22 preserves that have been sampled (7.12 km²).

	Original*			Current		
	z value	A^z	C	Iowa A^z	S for all of Iowa	S for sampled remnants only
Green (1907)	0.15	5.81	138.73	2.06	285.8	186.2
	0.20	10.44	77.20	2.62	202.5	114.3
	0.25	18.76	42.96	3.54	143.5	70.0
	0.30	33.72	25.90	4.25	101.6	43.1
	0.35	60.61	15.30	5.40	71.8	26.5
Cratty (1933)	0.15	5.81	154.40	2.06	318.1	207.3
	0.20	10.44	85.92	2.62	225.1	127.2
	0.25	18.76	47.81	3.54	159.7	78.1
	0.30	33.72	26.60	4.25	113.1	47.9
	0.35	60.61	14.80	5.40	79.9	29.4

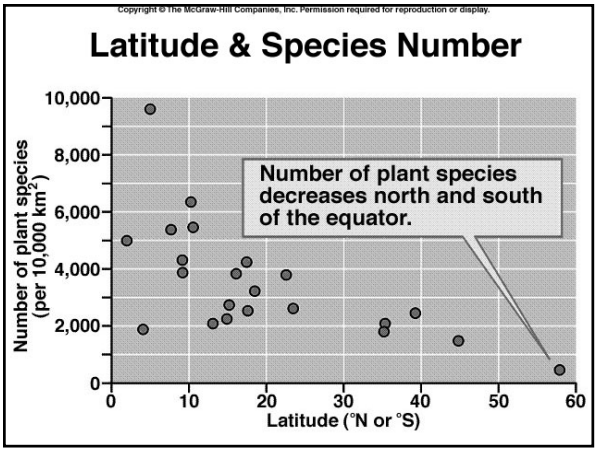
*Estimates of the original number of native prairie species were 806 species (Greene 1907) or 897 species (Cratty 1933). The actual number of species found in surveys of 22 of the 26 remaining remnants was 491.

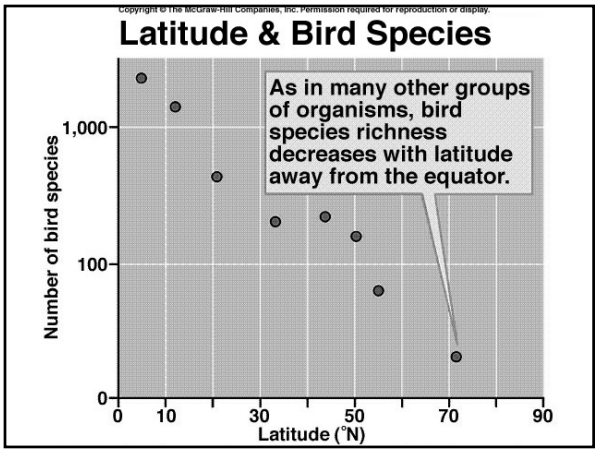
Wilsey et al. 2005 Cons. Biol.

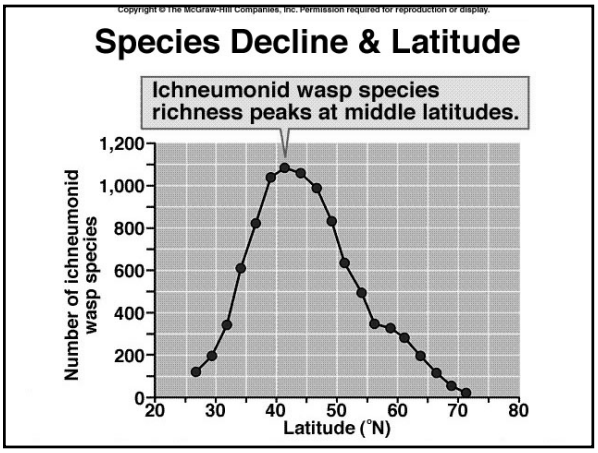
D. Latitudinal gradient in species richness

pp. 517-520 (check page numbers)

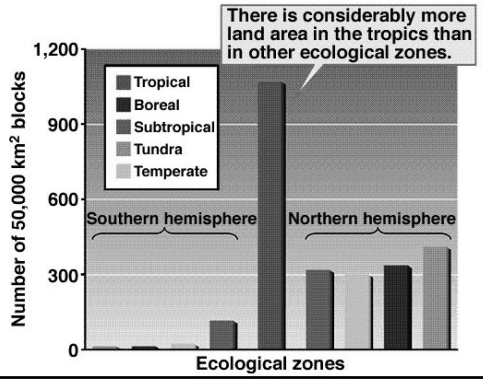
1. What is the latitudinal species richness gradient?
2. Does it hold for all species?
3. What are the hypotheses about why this gradient exists?
4. Have any of them been proven to be the sole factor responsible for the observed patterns?



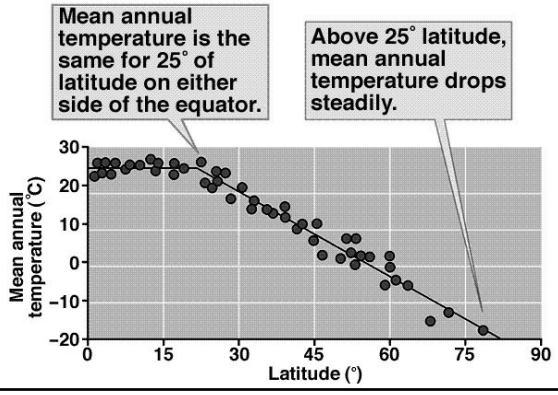




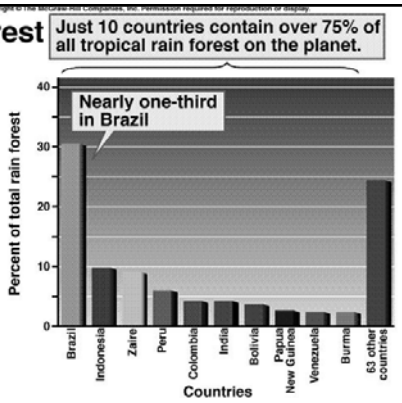
Area & Ecological Zones



Temperature & Latitude

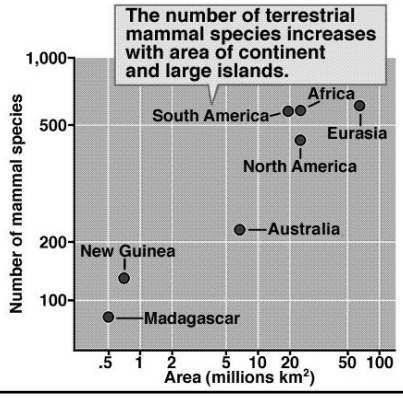


Rain Forest Area

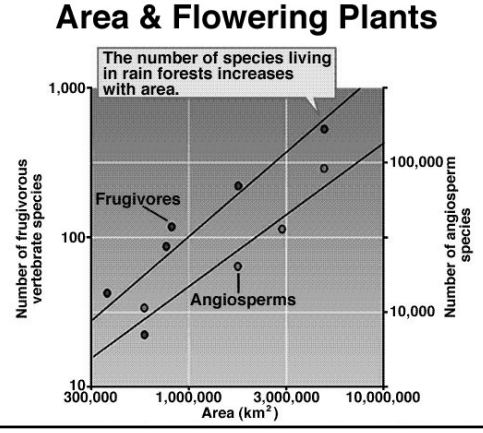


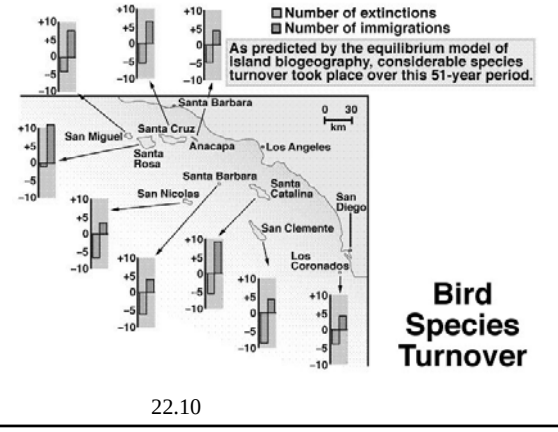
23.15

Land Area & Number of Mammals



Area & Flowering Plants





22.10