I. Island Biogeography
   A. Intro of species on islands…
   B. The concept of a dynamic equilibrium
   C. How the Theory of Island Biogeography works:
      1. Axes
      2. Extinction rate (local extinction) increases with increasing number of sp. on the island because:
         a. More species to go extinct!
         b. More interspecific competition, bigger chance of one species driving another to extinction.
      3. Immigration rate decreases with increasing number of sp. on the island because:
         a. Fewer left to arrive!
         b. More interspecific competition prohibits some from becoming established
      4. Equilibrium number of species
   D. Effects of island size and isolation.
      1. Large islands have lower extinction rates than small islands because high populations (possible on larger islands) reduces the chance of extinction.
      2. So we see that large islands support more species (at equilibrium) than small islands.
      3. Near islands (near to mainland source of species) have higher immigration rates than far islands because they are easier to reach by dispersing species.
      4. So we see that near islands support more species (at equilibrium) than far islands.

II. Concept of Fragmentation;
   A. Distinction between habitat loss, habitat fragmentation, and habitat degradation
   B. Habitat loss = a decline in area (e.g., acres) of habitat
   C. Habitat Fragmentation = a splitting of contiguous habitat into 2 or more pieces…a decline in connectivity…not necessarily accompanied by much (if any) habitat loss.
   D. Habitat degradation = a decline in the quality of the habitat for a particular species or suite of species (e.g., a clearing in the forest creates forest edges, and edges have different habitat attributes than “interior” forest).
   E. Effects of Fragmentation and Edges:
      1. Fragmentation. There are three main effects of forest fragmentation.
a. The splitting of large blocks of forest into smaller pieces results in pieces that may be too small to be used by some species; e.g., if the home range of the animal is bigger than the habitat fragment, that animal is SOL
b. Even if an individual animal or population can inhabit the fragment, the fragment is now isolated from the rest of the population...just like an island! Thus, the small population in the fragment may be vulnerable to extinction, especially if it’s chances of being “rescued” by immigrants from the “mainland” intact forest are low due to isolation or reduced dispersal capabilities. For the same reason, juveniles dispersing from fragments may have a hard time navigating to other fragments and successfully surviving natal dispersal.
c. Fragments have more edge than interior habitats.

2. Edges.
   a. Edges are created where two habitats come together.
   b. They occur naturally, but also by human creation.
   c. Human created habitats differ from natural edges in three ways: (1) they are biologically arbitrary (don’t follow topography or soil moisture, etc.), (2) they are abrupt (not ragged), and (3) they are long and straight.
   d. In short, edges have different physical properties that result in effects on plants, which in turn affect animals.
   e. Edges are sunnier, drier, and hotter than interior forests.
   f. That creates more shrub growth, more complexity in the habitat, and thus more biodiversity. Biodiversity is higher at edges than in interior forests.
   g. BUT, the species that respond favorably to habitat edges tend to be generalists, game species, and relatively common in many different places.
   h. The species the respond unfavorably to edges tend to be specialists and relatively rare.
   i. So, historically, edges were viewed as good for habitat management...but no longer! Now the pendulum has swung the other way, and “fragmentation” (which leads to creating edges) is the f-word in habitat management.

3. Edges are especially detrimental to small songbirds, and much work has been done on the effects if edges and fragmentation on cup-nesting songbirds.
   a. Nest Predation
   b. Nest Parasitism

III. What this theory (and other factors) means for the design of Nature reserves.
A. Diamond’s predictions.
   1. Large better than small. The reason is straight from TIB
   2. Single is better than several (due to less fragmentation)
   3. Closely spaced better than widely spaced because it increases “connectivity”
4. Connected better than separated because of better connectivity and reduced probability of extinction (rescue effect)
5. Round better than irregularly shaped reserves because of reduced edge effect
6. Several, smaller, widely spaced, linearly arranged, unconnected won’t be as good as a single large preserve. Huge discussion generated by this figure.

IV. But….SLOSS
A. Why Diamond might be wrong.
   1. Diamond’s figure really got people thinking – much debate over which would contain more species: a single large preserve or several small ones totaling the same area…..SL Or SS.
   2. Simberloff and Abele argued that although large preserves may contain more species based on TIB, reality is that several small preserves will more likely contain more habitat types and thus more species. So actually, the TIB does predict higher species on SS!! Also, several small preserves will help keep species from going extinct because individuals can disperse freely between preserves (a metapopulation). This is true because of the “not eggs in one basket” principle. By spreading a species among several subpopulations in partly dependent patches…the extinction of one subpopulation does not jeopardize the viability of the entire (meta) population. They verified these arguments by conducting very ambitious experiments with mangrove islands in the FL keys.
   3. What might be better?
      a. Simberloff and Abele cautioned against preserving only large preserves, because (1) TIB poorly tested, (2) theoretical arguments suggest SS might be better.
      b. In fact, over the years, most empirical studies have found SS to usually contain at least as many species, and often more, as a SL of same total area.

III. Conservation Reality. – Soule and Simberloff 1986
A. What are reserves for?
   1. Protect particular species.
   2. Preserving entire functioning ecosystems.
   3. Conserve biodiversity per se.
B. Where should reserves be located?
   1. Non-biological factors usually dictate where preserves may be located.
   2. Opportunity for establishing large preserves will soon be past (except in high latitudes and in very low-density human habitation).
C. How should reserves be designed?
   1. Three questions:
      2. How big, how many, how arranged? – Some analyses have suggested that SS might be best (often using empirical data). Soule and Simberloff disagree based on 5 reasons:
         a. Habitats are NEVER the same between a real-life decision of SL or SS. Let the habitat diversity make your decision for you – more habitat diversity is best, no brainer.
b. Analyses focus on species at a moment in time; in reality species in small preserves are likely to go extinct sooner than in larger preserves; most “large” parks in Africa contain fewer than 100 individuals of top carnivores.

c. So you say SS is better, eh? Welp, how many is several? Inarguably, subdivision will eventually lead to fewer species. 2 med may be better than 1 large, but 10 small really sucks.

d. Studies based on empirical data are flawed because the few large preserves that exist in the world usually lie in species poor biomes (deserts, arctic, etc.). That makes existing SS look better than they really are.

e. SLOSS depends on taxa. For top carnivores, SS is very, very poor.

D. The idea of MVP as a criterion in reserve design. Contain<maintain
1. “We will have gone a long way towards understanding the question of how large a reserve must be when we are able to determine the number of individuals in a population needed to guarantee a high probability of survival.”
2. We need to design preserves such that they not only contain species right now, but also maintain species for some time into the future.
3. “Effective population size” is always smaller than total number of individuals.
4. Extinction is simply a probability – all species eventually go. The smaller the population, the more likely that time will be soon. Thus, the minimum viable population is not some threshold above which a species is safe. Instead, it is some benchmark above which the probability of extinction is comfortably low. How low? Who knows, many MVP analyses operate on the idea of maintaining a population for 1000 years with a 95% probability.
5. Huge area of population biology – MVP. Anyone taking Dr. George’s course? We won’t go into the details here; the important point is that preserve design should satisfy area requirements to encourage MVPs for its most widely dispersed, lowest density species (often the top carnivores). This leads us directly into the idea of umbrella species. If we manage habitats for the largest, most area-demanding top carnivores (bears, wolves, lions, owls, eagles, etc.), we should be catching many other species with smaller MVPs and smaller area requirements.

E. A plea for bigness and multiplicity.
1. Small reserves are expensive to maintain and are less likely to contain MVPs, rendering them subject to premature species extinction.
2. “Nature reserves should be as large as possible, and there should be many of them.”
3. Perhaps top carnivores are worth of our most intensive efforts. Many people criticize the idea of managing only for “charismatic megafauna.” But maybe they’re wrong.