Integrative Biology 200A "PRINCIPLES OF PHYLOGENETICS" Spring 2006
University of California, Berkeley Kipling Will- 25 Apr 2006

Biodiversity and Conservation Measures

I. Biodiversity Crisis

A. The unknown quantity of (meaningful) diversity is still an obstacle.

B. The current debate is over the *rate* of loss, not a debate about *if* humans have a significant impact.

C. Designating biodiversity as a resource leads to viewing the natural world only in terms of the bottom line $$ (*"A cynic is a man who knows the price of everything but the value of nothing."* Oscar Wilde)

D. Development and managed use (the Eden imperative) vs. conservation

E. Survival vs. quality of life

1. In reality there is a limit of time, money and willingness of people and governments. Faced with the need to choose, *now*, we must offer a variety of measures that can add to the likelihood that we will save the "right" organisms and areas. (*"Compromises proposed to satisfy both parties seldom satisfy either, not to mention the wildlife involved."* Brooks & McLennon 2002.)

II. More or less non-historical stop-gaps to keep from losing it all.

A. Most effort is placed on just saving habitat (pragmatic defense).

B. Mitigation and restoration based on a non-historical view (e.g. the area:species # relationship in island biogeography). The focus on community equilibrium suggest that vacancies made by extinction will simply be filled by speciation and recolonization.

C. Taxonomic inventories. Species richness is one of the most common rough estimators of biodiversity with many well recognized deficiencies. Enumeration and description is useful as we cannot preserve, protect or use undocumented and unnamed species or other collections of biologically meaningful diversity. (*"In the end we will conserve only what we love. We love only what we understand. We will understand only what we are taught."* Baba Dioum)

1. Collectors and collections are now information managers and libraries of data, respectively. These people and institutions are now vital for our understanding of biological theory and conservation policy formation.

D. Genetic diversity: Nee & May (1997) said that a loss of 50% of species would result in only a 5% loss in genetic diversity. Based on some faulty assumptions.

>species are interchangeable

>extinction is phylogenetically random

>ecological interaction is not important

Species and clades are more than the sum or their parts.

III. **A historical perspective** (lineages, clades and trees) emphasizes that changes we make (extinctions) are irreversible and that, at some level the "currency" of conservation characters.

A. Using patterns of phylogeny directly-

1. Erwin (1991) suggested the importance of the potential for evolution should be emphasized. "Species-dynamo" areas and rapidly evolving clades should be chosen for priority conservation. This is a descriptive, not numerical method.

2. Vane-Wright et al. (1991, see Williams et al. 1991 and Posadas et al 2003 also) emphasized basal diverging taxa using the root-weight (node counting) method. The emphasis on divergent, often isolated and sensitive taxa or Distinctiveness measures.

3. Nixon & Wheeler (1992) used weighted and unweighted node (position) and species counting (within clade diversity) method that is similar to root-weighting. This attempts to make a comparison between sister taxa to score phylogenetic uniqueness.

B. Using Branch lengths (see Faith numerous papers, Humphries 1995 for summary)

1. Character richness
2. Character combinations

- Greatest diversity of character difference genetic and/or morphological.
- Phylogenies are a biased and limited sample of characters
- Model choice and branch-length measures directly impact ranking
- However, the assumption that the tree topology reflects (predicts) diversity in un-sampled characters does seem well founded.

There is no truly objective measure. All are anthropocentric. Phylogenetic weighting is one "option value" we may use (Faith 1992). Is society willing to pay the option value -a premium on the actual value- to guarantee access to future supply (Humphries 1995)? Species (and other monophyletic groups) richness in many taxa also seems to be good (reasonably accurate, practical, easy) surrogate for character richness.

IV. Complementarity (see Faith et al. 2003)

A. " "Complementarity" is an estimate of the gain in biodiversity representation and persistence when an area is added to an existing set of protected-areas". In a simple minded sense you want the fewest areas that capture the greatest diversity (but see the Faith paper for all competing aspects that need to be included in the compliment calculus.)

>> (this is a very small sample of papers)

Faith, D.P., Carter. G, Cassis. G., Ferrier, S. and L. Wilkie. 2003. Complementarity, biodiversity viability analysis, and policy-based algorithms for conservation. Environmental Science & Policy 6 (2003) 311–328.

Humphries, C.J., Williams, P.H. and Richard I. Vane-Wright. 1995. Measuring Biodiversity Value for Conservation (in Special Section on Sustainability Issues). Annual Review of Ecology and Systematics. 26:93-111.

Nixon, K. C. and Wheeler, Q. D. 1992. Measures of phylogenetic diversity. *in* Novacek, M. J. and Wheeler, Q. D. Extinction and Phylogeny. New York: Columbia University Press. pp. 217-234.

Williams, P.H., C. J. Humphries and R. I. Vane-Wright. 1991. Measuring Biodiversity: Taxonomic relatedness for conservation priorities. Aus. Syst. Bot. 4:665-679.

A paper that is a recent example: Posadas, P., Miranda Esquivel, D.R., and J.C. Crisci. 2001. Using phylogentic diversity measures to set priorities in conservation: an example from southern South America. Conservation Biology. 15(5):1325-1334.

FOR LAB:

Read information at (I also recommend reading and working through examples in Williams et al. 1991)
http://www.nhm.ac.uk/research-curation/projects/worldmap/diversity/index.html
Download and install demo
http://www.nhm.ac.uk/research-curation/projects/worldmap/worldmap/soft.htm
Work through handout in groups of two or three.