Biology 357 - Evolutionary Ecology – 3rd Exam 2004 ___________________________

1.) (6pts) Define connectance and explain how it is calculated.

Connectance is a numerical index of food web complexity. It is calculated by dividing the actual number of connections among members of a food web by the total possible number of connections (the total # connections = n(n-1)/2, where n = the # species).

How does connectance change as the number of species in a community increase?

it decreases

2.) (6pts) Only 10-20% of the energy at any given trophic level is available to the next higher trophic level. Describe how this inefficiency of energy transfer affects the trophic structure of a community. Draw a typical pyramid of energy for a community with 4 trophic levels.

the inefficiency of energy transfer sets an upper limit to the number of levels in a food web (4 levels on average) and determines the relative proportion of predators to prey.

See fig 17.7

3.) (4pts) Explain how pyramids of energy differ from pyramids of numbers and biomass.

A pyramid of energy consists of the rates of energy flow between trophic levels.

Pyramids of numbers and biomass represent instantaneous measures and thus have no time dimension. A pyramid of numbers measures the densities of individuals in each trophic level and pyramids of biomass measures standing crop as unit weight/unit area. These pyramids may be inverted unlike pyramids of energy.

4.) (4pts) How can terrestrial secondary succession be related to physiological trade-offs at the level of individuals?

Trade-offs at the level of individuals may dictate sequential patterns of species replacement that characterize secondary succession. Species with fast rates of photosynthesis and rapid growth are successful colonizing species, however these species are not competitive in light-limited situations. Species that are shade-tolerant are competitively superior in climax communities, but have slower photosynthetic and growth rates. Additionally, species may exhibit dispersal-competition tradeoffs. Colonizing species may be better dispersers, but climax species may be better at exploiting resources.

5.) (10pts) How does species diversity vary with latitude? Discuss three possible hypotheses explaining this trend.

see pg. 394-400

6.) (6 pts) Explain the species-area relationship. In addition to the effect of area, what other factors may influence this relationship?

Larger islands generally support more species of plants and animals than smaller ones. This relationship can be expressed as a power function (equation 19.1) or linear equation (equation 19.2).

In addition to area, habitat heterogeneity and distance of an island from a mainland may influence/confound this relationship.

7.) (8 pts) Draw two graphs describing the equilibrium theory of island biogeography (one illustrating the distance effect on one illustrating the area effect).

See figure 19.6.

8.) (6 pts) Compare and contrast the equilibrium conditions for near versus far islands and small versus large islands. How do turnover rates differ?

The number of species at equilibrium is greater on near islands compared to far and small islands compared to large islands. Turnover rates are higher on near islands compared with far and small islands compared with large.

9.) (10 pts.) Write MacArthur's community equation for species diversity, explain each of its terms, and indicate how each varies with the diversity of desert lizards.

$$N = \frac{R}{\bar{U}}\left(1 + C\frac{\bar{O}}{\bar{H}}\right)$$

N = number of species
R = resources available
U = average niche width
C = number of neighbors in niche space
O = average niche overlap
H = exclusive portion of niche width

$D_S = D_R / D_U$ (1 + c O)

D_S = species diversity
D_R = diversity of available resources
D_U = average niche breadth
c = number of neighbors in niche space
O = average niche overlap

10.) (8 pts.) Explain what Robert May did in his book "Complexity and Diversity in Model Ecosystems" Be sure to include his assumptions and methods, as well as his results, and indicate why his conclusions might be suspect.

See pp. 408-410

11.) (8 pts.) Describe in as much detail as you can what the earliest squamate reptiles were like and when and where they lived.

Ancestral squamates arose from Rhyncocephalians about 200 million years ago on the Gondwanan part of Pangaea. They had a hanging jaw setup with a moveable quadrate (streptostyly), picked up prey using their tongues (lingual prehension) and were visual ambush foragers that fed on mobile prey items

12.) (6 pts.) List six of the major key evolutionary innovations of snakes.\

Key Innovations of Snakes

Cranial kinesis
Independent movement of left and right maxillae
Infrared receptors (pit vipers)
Venom injection
Constriction
Reversion back to ambush foraging but using carefully located ambush sites via keen vomerolfaction
Liberation of the mandiblar symphysis
Forked tongues (“edge detectors”)

13.) (18 pts. total, 2 pts. each)

Autarchoglossan

Advanced lizards, the sister group to Gekkota, together with which constitutes Scleroglossa

Metapopulation

A population of populations

Macrodescriptor

An aggregate variable that describes some aspect of community structure, such as connectance, diversity, etc.

Mesokinesis

Situation in derived lizards (and snakes) in which the muzzle moves with respect to the braincase

Resilience

Rate of return of a community to equilibrium (Lyapunov stability)

Guild

A group of species that exploit similar resources in similar ways (potentially an arena of competition)

Strange attractor

A deterministic form of cyclic stability that emerges from non-linear dynamics in which a 3-D system winds out on one phase plane until it gets too far out, when it folds or inserts back towards the origin and then winds out on another phase plane until it reaches an upper limit, whereupon it re-inserts back near the origin of the first phase plane and repeats the process indefinitely.

Population viability analysis

A study based on demography that estimates how long a population is likely to persist (used in conservation biology)

Pseudocommunity

A replicate of an observed community that is changed, sometimes randomized, from the observed in a known way in order to detect structure in the observed community (see pp. 368-379).