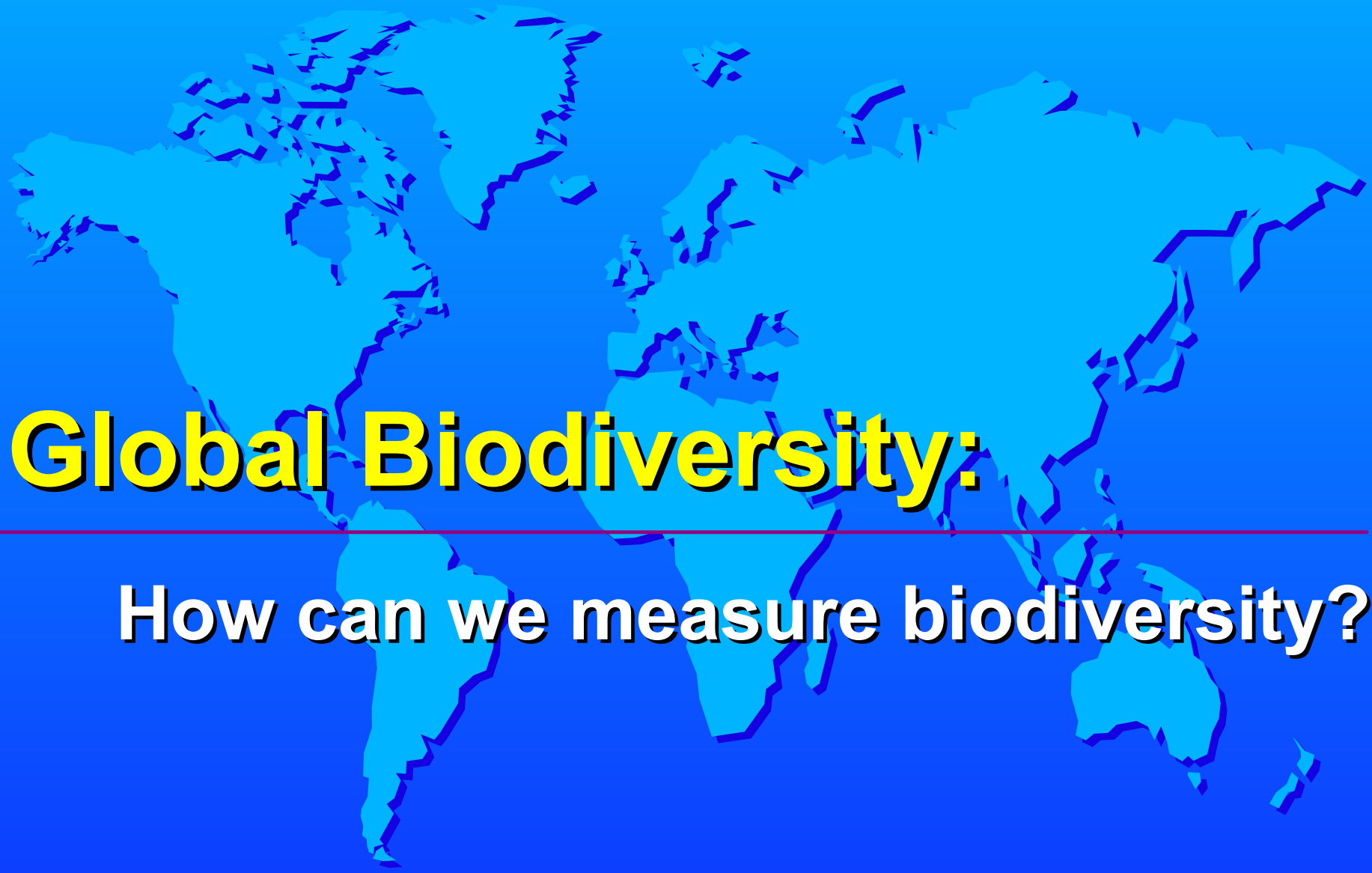

Global Biodiversity:

How can we measure biodiversity?

The Levels of Biodiversity

- Intraspecific genetic diversity - heterozygosity is considered to increase fitness.
- Species richness - the number of species present in an area. Common indices of species diversity are the Shannon-Weiner Index and the Simpson Index. These are "weighted" indices and reflect major changes in species abundance or loss.
- Conservation biologists often use unweighted measure of biodiversity.
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continued -

- Currently there are 1.5 million known species; total number of living species is estimated between 10-50 million.
- Most species on earth are undescribed and very little is known about the ecology of the species that have been named.

continued - *(continued)*

- Richness of Higher Taxa - Higher taxa provide rough measures of the distinctness of lineages; 34-35 extant multicellular phyla have marine origins (16 exclusively marine). The future of life on earth depends on these lineages not just on the number of species.
- Ecosystem and Biome Diversity - Terrestrial ecosystems have been classified by the dominant plants found in their communities (life zones, biomes).

continued -

- Preservation of the earth's biomes (life zones) is necessary for preservation of species.

Patterns of Richness

- Species richness over Geologic Time - Life arose about 3.8 Bya, eukaryotes about 2 Bya. There were three major periods of evolutionary explosions: Cambrian period (circa 600 Mya), Paleozoic era (about 500 Mya to 286 Mya) and the Triassic (250 Mya to present).

- Local Species Richness - point richness refers to the number of species at a single location; alpha richness refers to the number of species found in a small, homogenous area; beta richness refers to the rate of change in species composition across habitats; gamma richness refers to the rate of change across larger landscape gradients.

Patterns of Richness *(continued)*

- Alpha richness exhibits a latitudinal pattern with high richness at the equator and decreasing richness as you increase latitude.
- Richness of species diversity is positively correlated with habitat structural complexity.

Patterns of Richness *(continued)*

- Species richness increases with increasing primary productivity and is maximized at intermediate levels of productivity ("paradox of enrichment"). Examples : salt marshes, seagrass beds, hot springs, disturbed habitats (human agricultural landscapes).
- Species richness is related to the area of habitat and its diversity (islands). Species diversity on islands is positively correlated with island size and negatively correlated

continued -

- with distance from the nearest mainland.
- The rate at which the species composition of communities changes across environmental gradients is determined by the size of the range and the extent of habitat specialization (ex: many tropical species).
- Endemic species - a species that is found in a particular region but nowhere else. This is usually caused by vicariance; geographic isolation.

What are the limits to species richness? (Evolutionary)

- Continental drift - The breakup of Pangaea and later, Gondwanaland.
- Adaptive radiation and specialization.
- Covevolution of plants and animals.
- More than 99% of all species that have ever lived on earth are extinct.

What are the limits to species richness? (Evolutionary) *(continued)*

- Six mass extinctions have occurred during geologic history: at the end of the Cambrian period (half of all animal species); end of the Devonian period (345 Mya, 80% of all species); end of the Permian (about 250 Mya, 95% extinction rate, loss of trilobites); end of the Triassic, 75% extinction (180 Mya, 80% of reptiles and ammonites); end of the Cretaceous (65 Mya; 75% of all species including dinosaurs, large reptiles and most marine lineages).

limits continued -

- Following each mass extinction species richness recovered within 1-8 million years. Why should we been concerned about the extinctions today?

Ecological Limits to Species Richness

- Productivity-Stability Hypothesis - There is a good correlation between productivity and richness along latitudinal and altitudinal gradients. Exceptions to the hypothesis occur in some of the world's most productive ecosystems (ex: estuaries, seagrass beds, hotsprings) and areas with nutrient deficient soils (Fynbos of South Africa, Australia).

Ecological Limits to Species Richness *(continued)*

- Structural Hypothesis - Species richness correlates well to plant community structure. Bird species richness correlates well with foliage height diversity.
- Competition/Predation Hypothesis - *Keystone predators* can dramatically influence the structure of the ecological communities they are found in. *Ecological release* is another phenomenon seen on Islands which supports this hypothesis.

Ecological Limits to Species Richness *(continued)*

- Competition can reduce the number of species living in a community (*competitive exclusion*).
- Stability-Time Hypothesis - Stable environments have lower extinction rates due to low disturbance (Alfred Russel Wallace, 1878)

Ecological Limits to Species Richness *(continued)*

- **Productivity-Disturbance Hypothesis - Maximum species richness occurs when a balance exists between rates of population growth (and related competitive effects) and rates of disturbance. Disturbance (a density independent mortality factor) is thought to reduce population size and reduce the chance of competitive exclusion.**

The Future of Biodiversity Studies

- Endangered Species Phenomena
- Biodiversity Monitoring/Environmental Monitoring
- Megareserves - Costa Rica, UNESCO Man and the Biosphere (MAB) Biosphere Reserves, Wildlands Project (goal to set aside 50% of the NA continent as "wild land", Y2Y (Yellowstone to Yukon)
- E.O. Wilson suggests that we devote many professional lifetimes to categorizing organisms.