Biodiversity

Preview

1. Types of Biodiversity
2. Biodiversity Measures
3. Scale and Biodiversity
4. Biodiversity Concepts

1.

Types of Biodiversity

- Variety of life
  - In all its forms
  - At all levels of organization
- Concept and a quantity
  - Life is diverse
  - It can be measured and compared

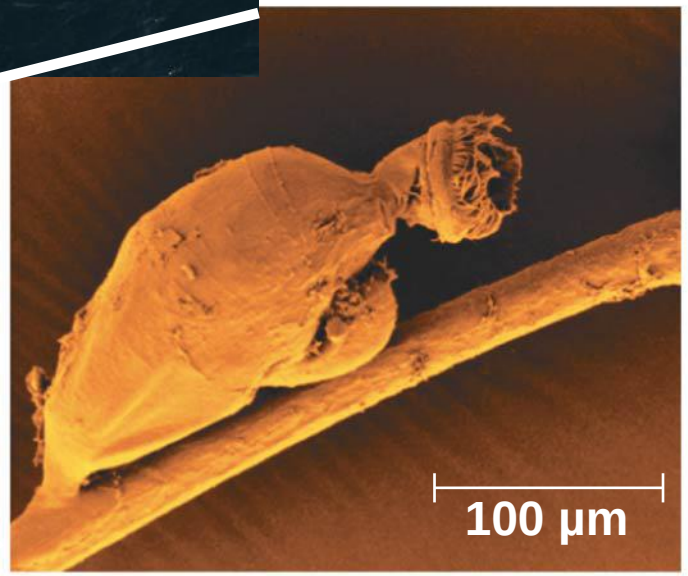
1.

Types of Biodiversity

- Species Diversity
  - Biological entities
  - Based on reproductive isolation
    - Charismatic megafauna vs. cryptic microorganisms

1.

A blue whale



A cycliophoran

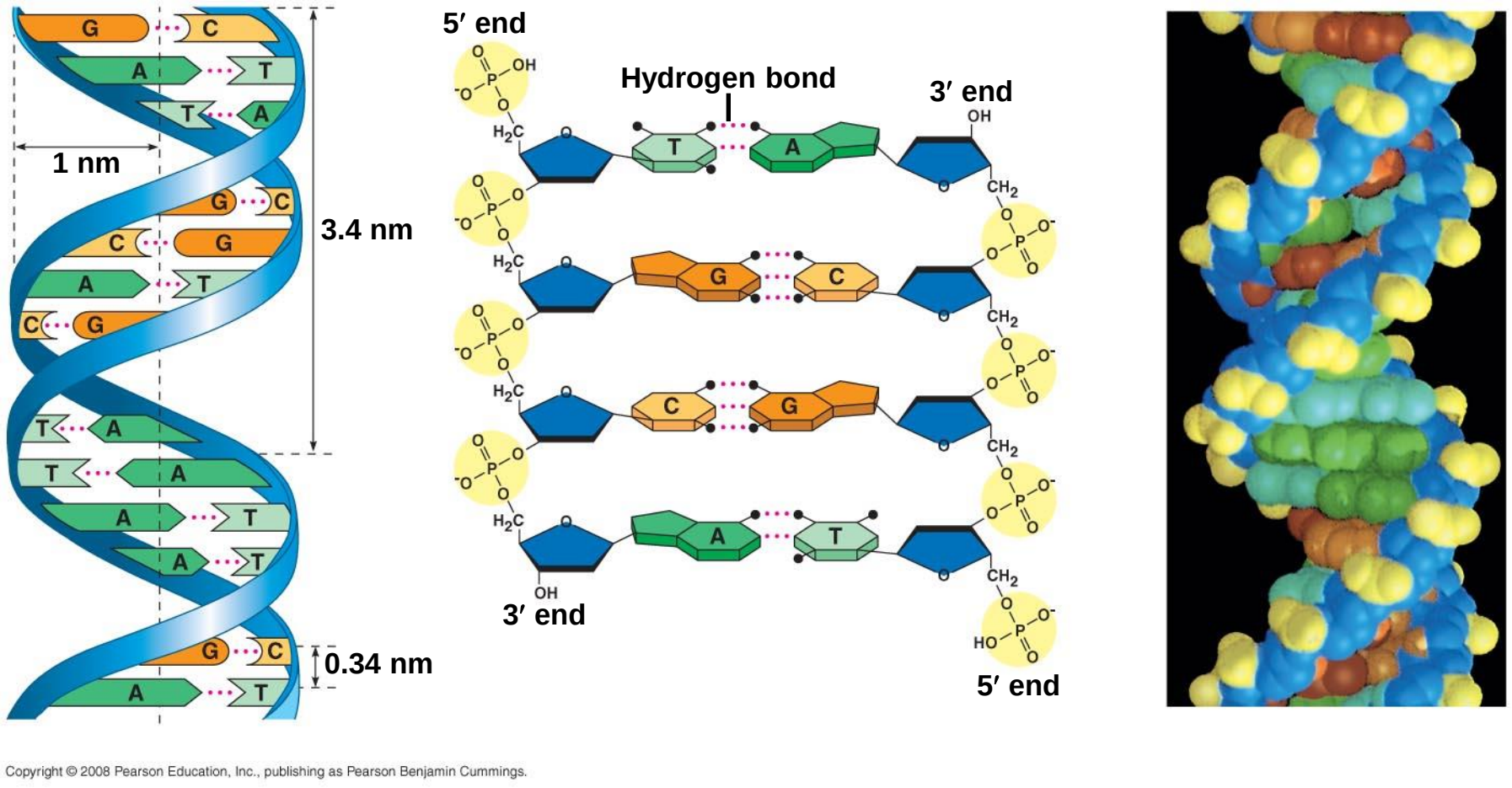
Images: www.worldwildlife.org; www.wikipedia.org; Reece et al. 2014

1.

Types of Biodiversity

- Genetic diversity
  - Self-replicating pieces of DNA
  - Instructions that shape form and function
  - Evolution acts when genes differ within a population

1.



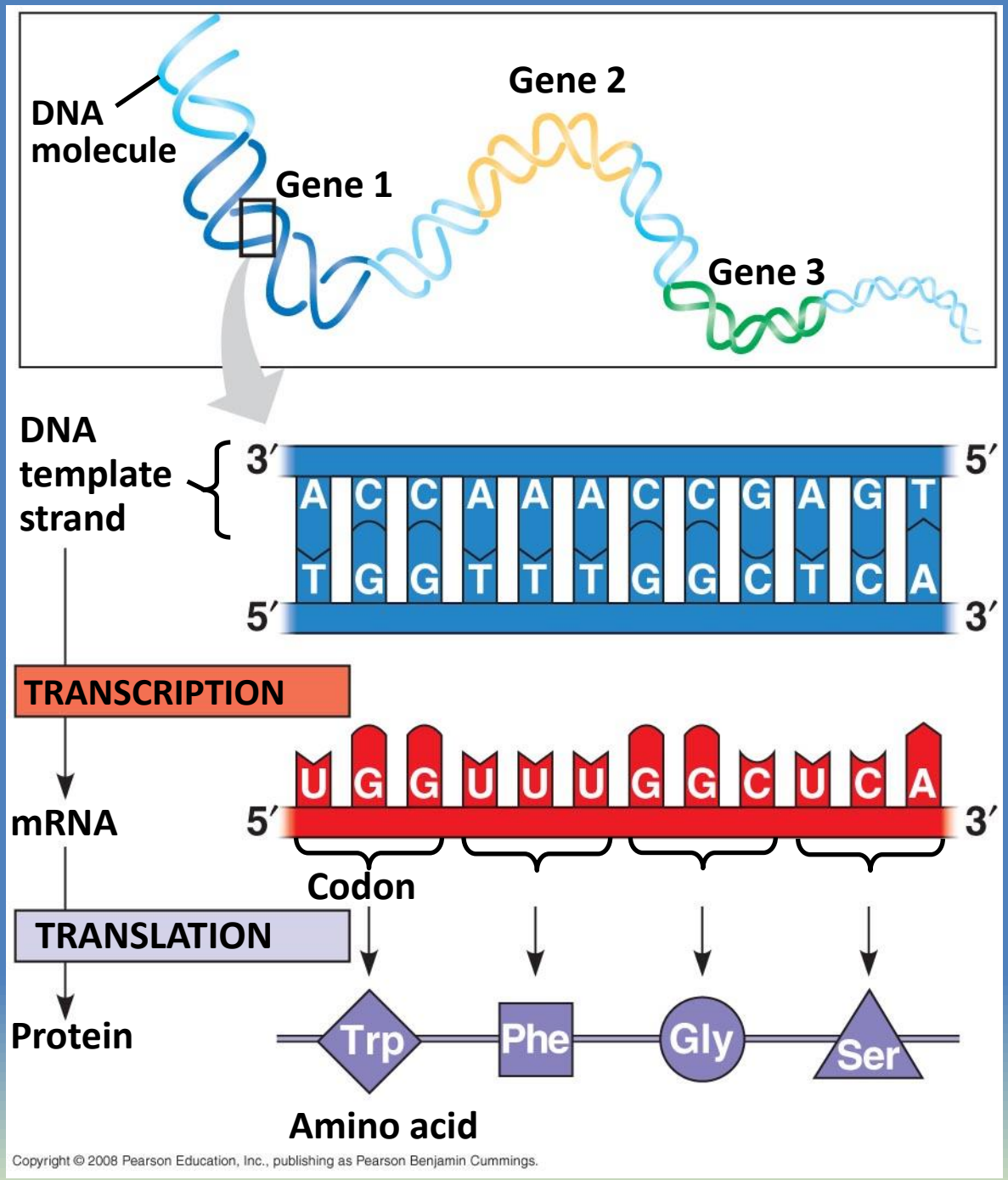
(a) Key features of DNA structure

(b) Partial chemical structure

(c) Space-filling model

Reece et al. 2014

1.



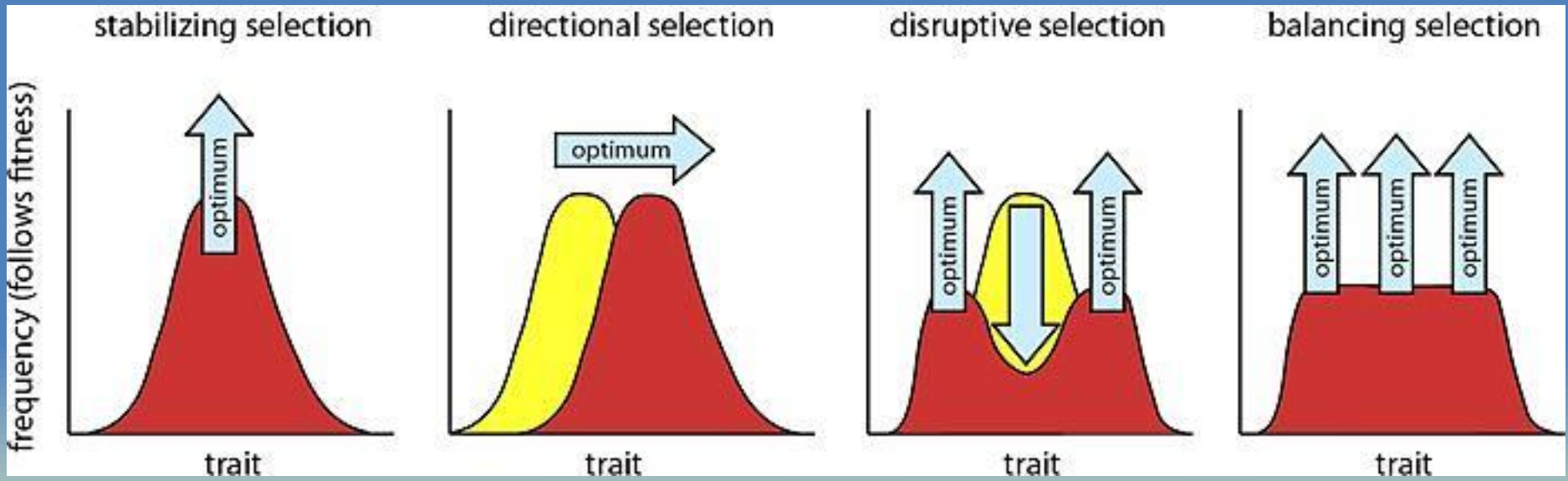
Reece et al. 2014

1.

Now

?

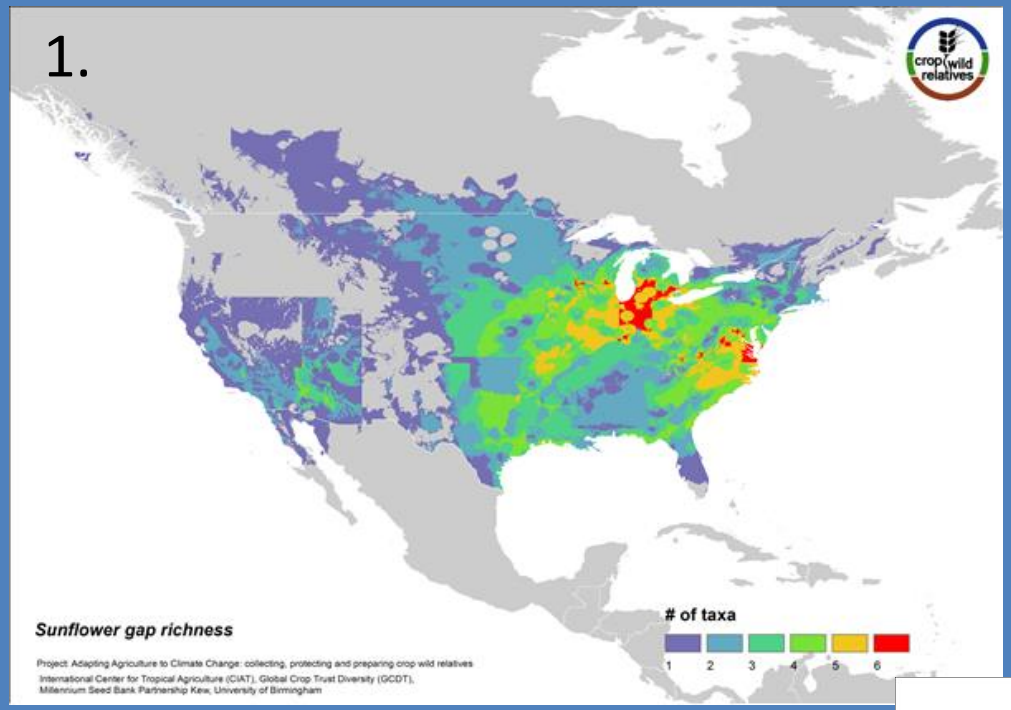
Later

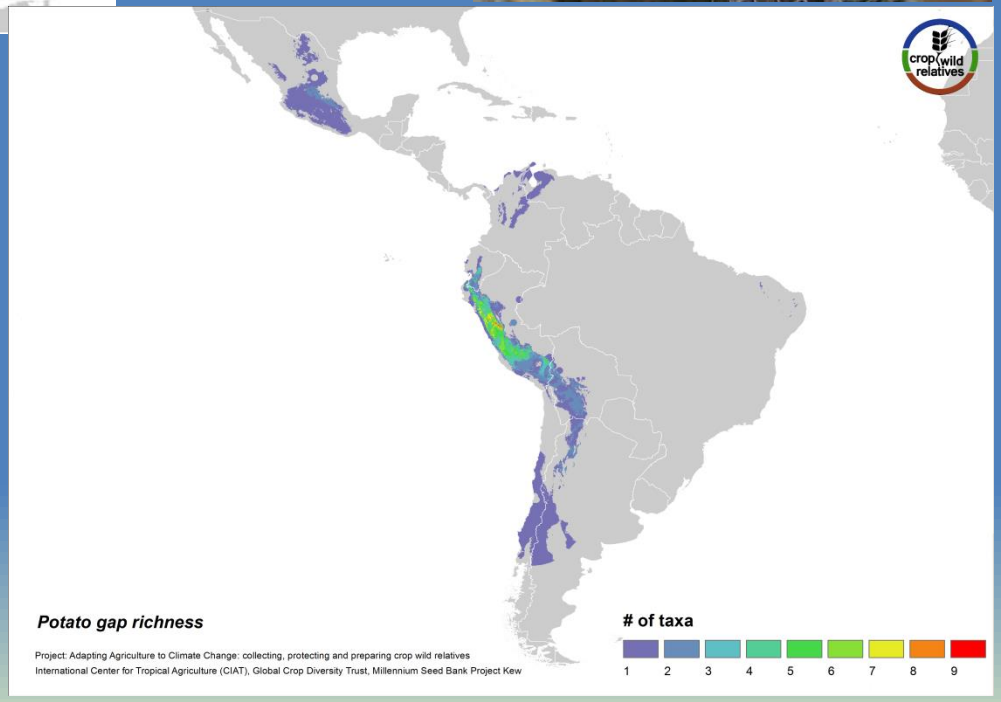


Images: www.wikipedia.org; www.nature.com

1.

Gap analysis for wild relatives of cultivated species





Images: www.wikipedia.org; www.cwrdiversity.org

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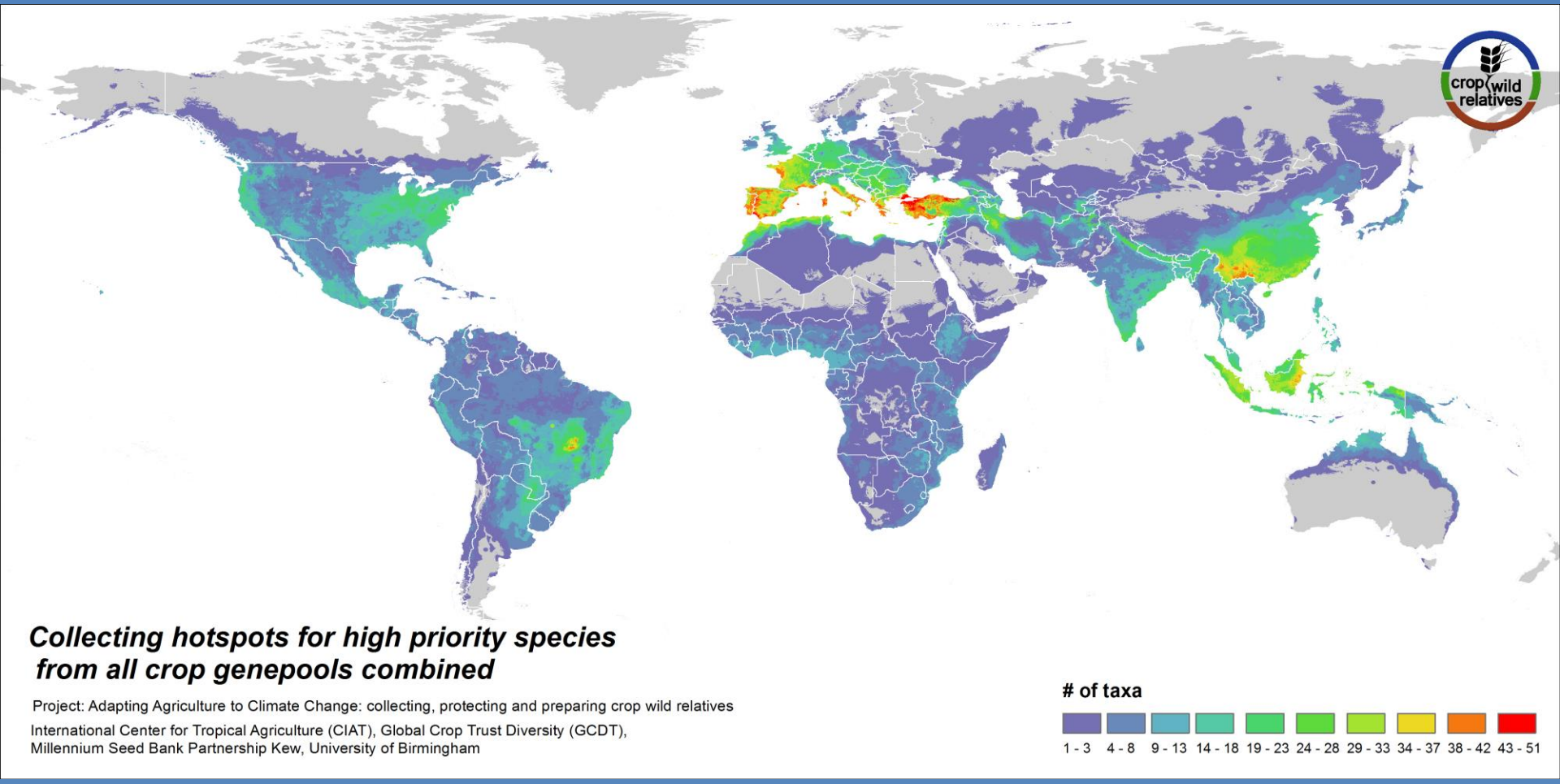


www.cwrdiversity.org

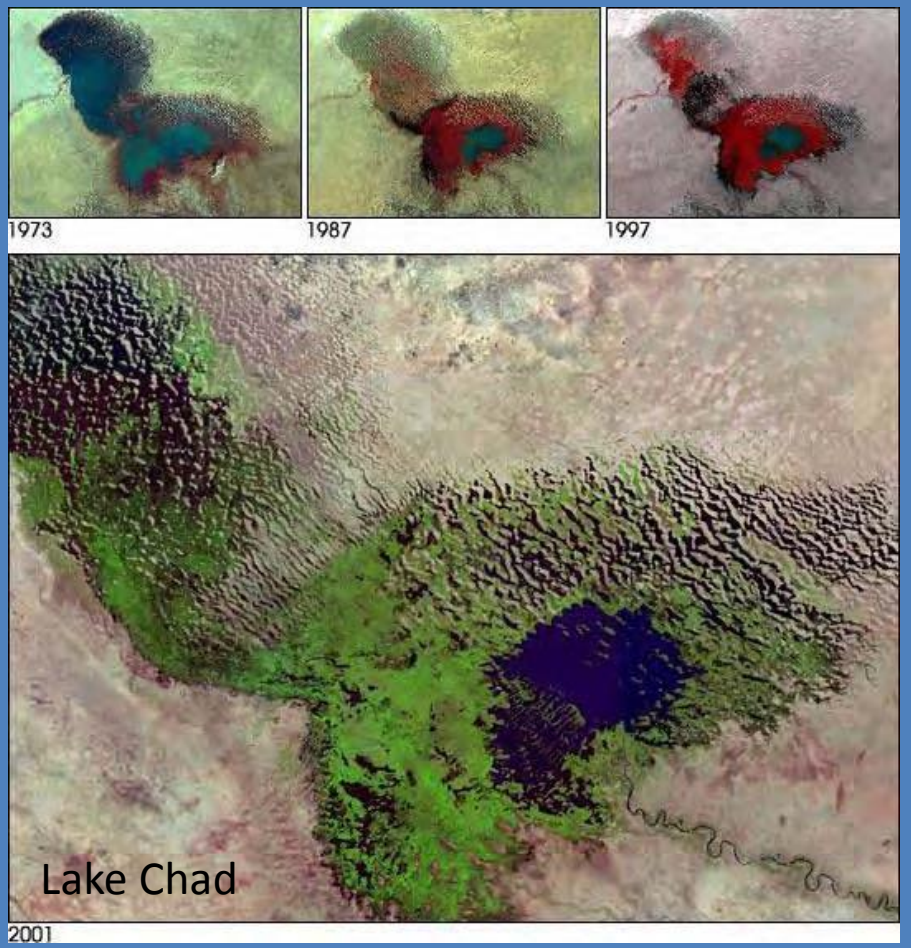
1.

Types of Biodiversity

- Ecosystem Diversity
  - Simple in theory; difficult in practice
  - Edges and ecotones
  - Where to draw the line?

1.

Spatial Changes



Temporal Changes

Images: www.wikipedia.org

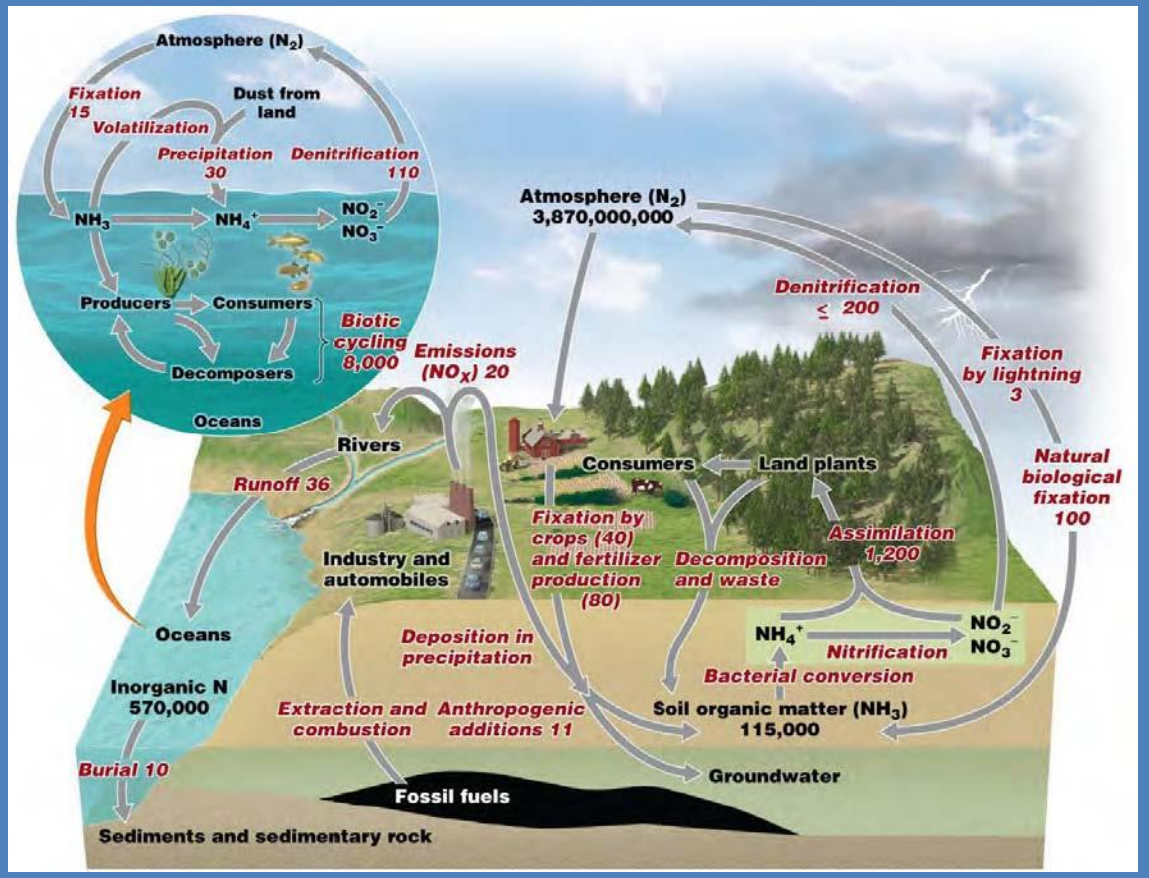
1.

Types of Biodiversity

- Structural vs. functional
  - Structural
    - Forms of life present
    - Levels of organization (e.g., genera, phyla)
  - Functional
    - "richness, abundance, and variability of plant and animal species and communities and the ecological processes that link them with one another and with soil, air, and water." (The Wildlife Society 1993)

1.

Lupine vs. The Nitrogen Cycle



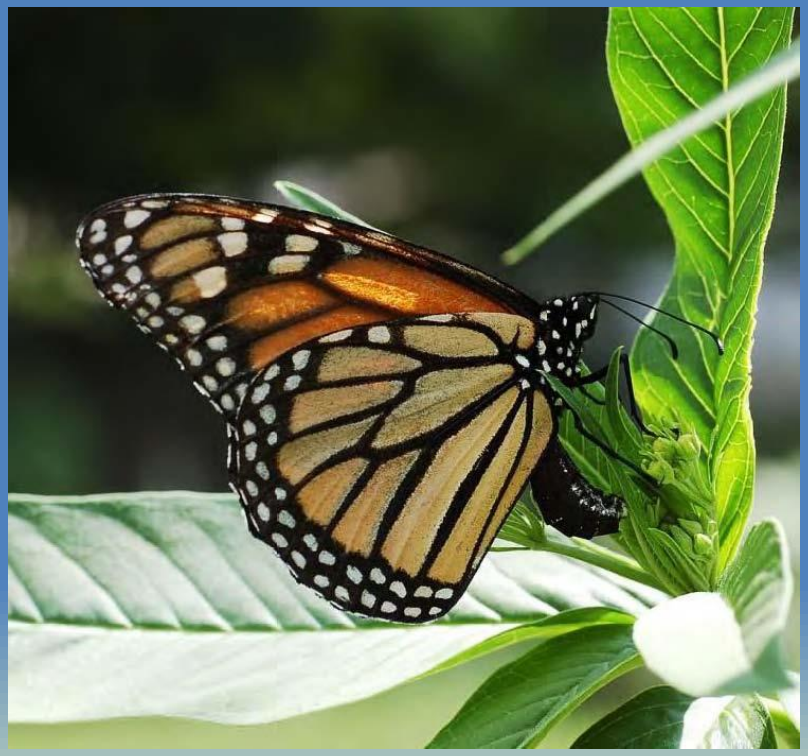
www.wikipedia.org; Withgott and Laposata 2012

1.

Types of Biodiversity

- MUCH easier to protect species than processes
- Assumption: if structure is maintained, evolutionary processes will also be maintained
  - Mutualisms
  - Predator-prey
  - Trophic relationships

1.



MONARCHWATCH.ORG

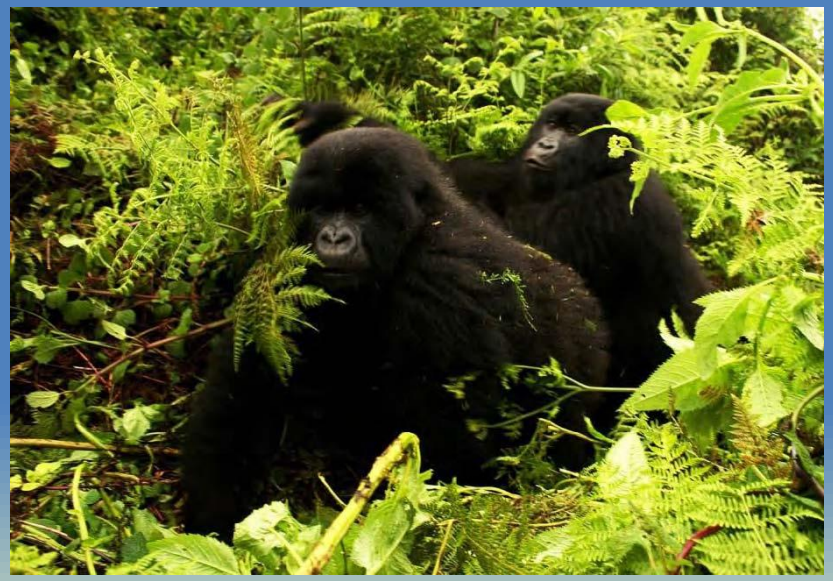
Education · Conservation · Research

Images: www.wikipedia.org

1.

Types of Biodiversity

- Conservation projects in Africa
  - Largely funded by EU and investors
  - Focused on species and processes



www.wikipedia.org

2.

Biodiversity Measures

- Measuring biodiversity
  - Number of species
    - Given place and time
    - Dependent on detectability

Biodiversity Measures

- Two aspects of diversity
  1. How many are there?
     =Richness

Species Richness

2.

Biodiversity Measures

- Species richness = 5
  1. Goldenrod
  2. Aster
  3. Indiangrass
  4. Little Bluestem
  5. Blazing Star

Biodiversity Measures

- Two aspects of diversity
  1. How many are there?

     =Richness
  2. How are they distributed?

     =Evenness

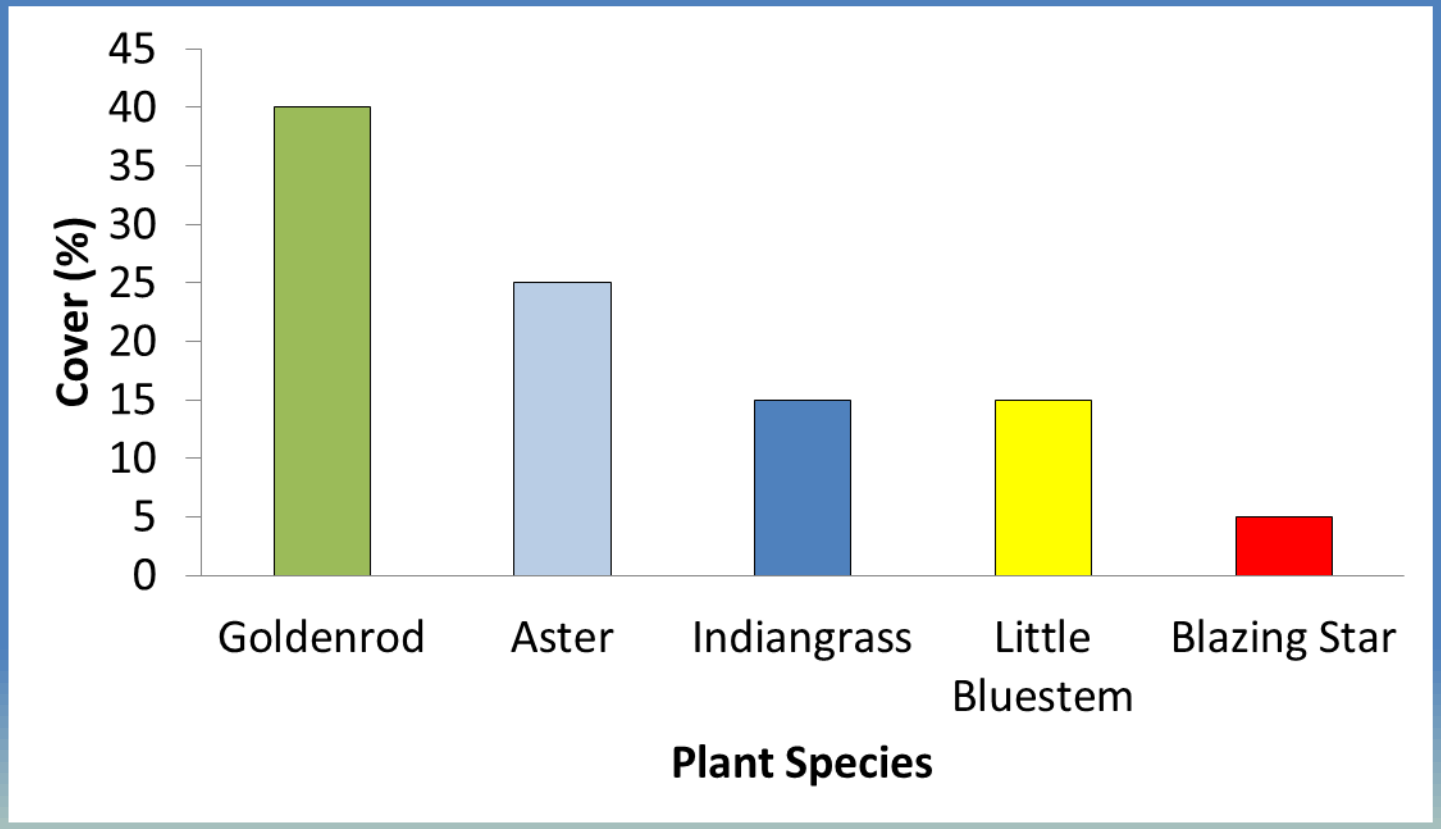
2.

Species Evenness

2.

Biodiversity Measures

- Species Evenness



2.

Biodiversity Measures

- Diverse communities have:
  - Many species
  - Even numbers of species

2.


A
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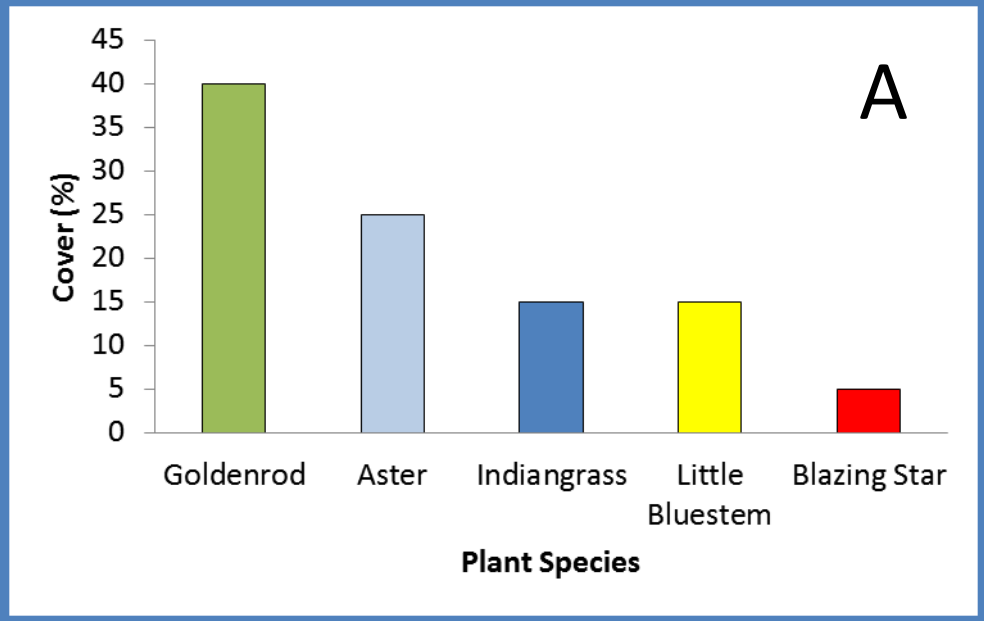
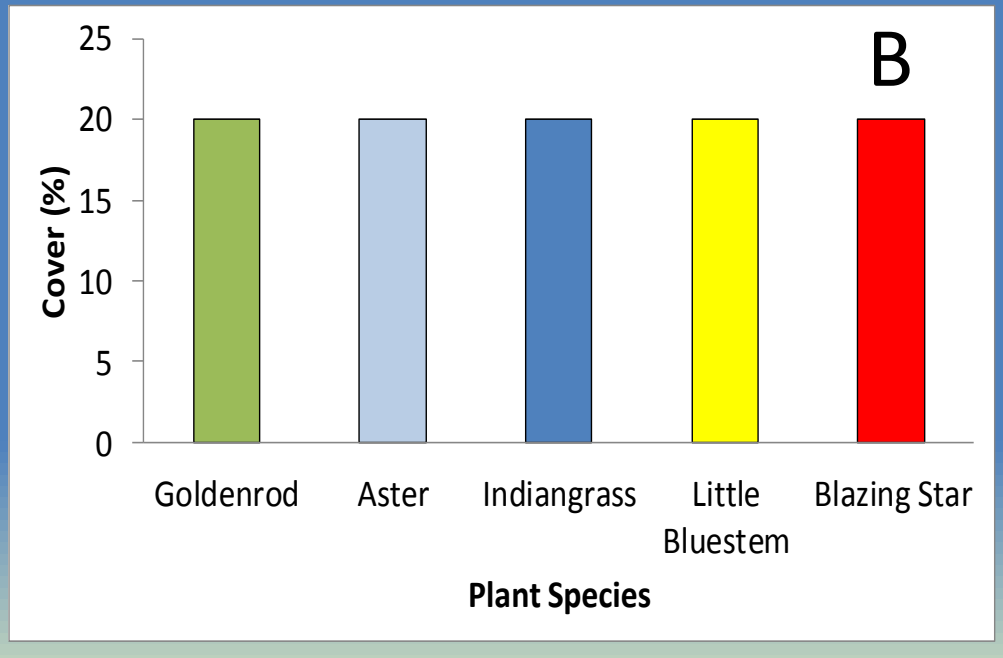

A
45
40
35
30
25
20
15
10
5
0
Cover (%)
Goldenrod
Aster
Indiangrass
Little Bluestem
Blazing Star
Plant Species


B


B
25
20
15
10
5
0
Cover (%)
Goldenrod
Aster
Indiangrass
Little Bluestem
Blazing Star
Plant Species

2.

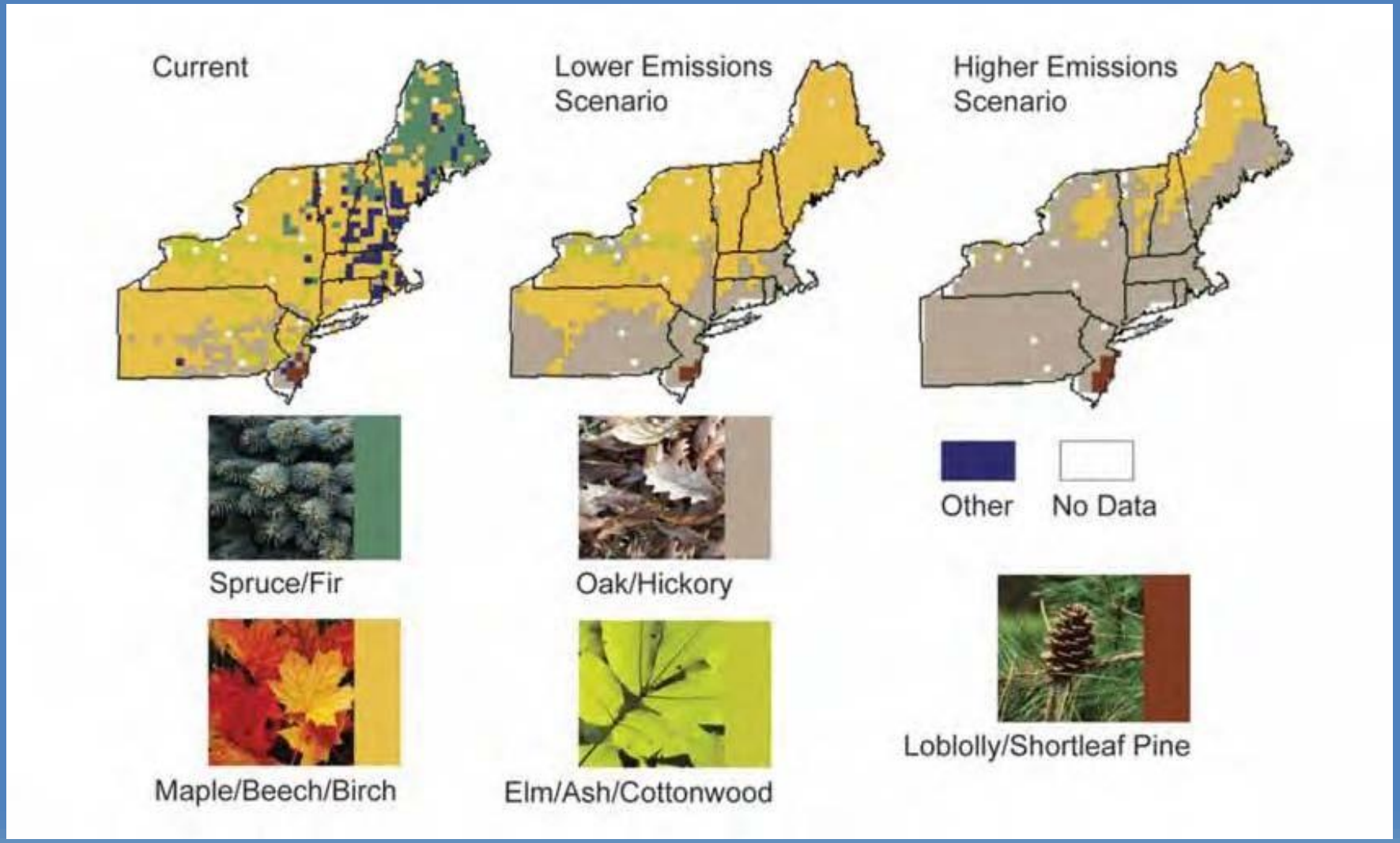
Eastern redcedar in prairie

2.

Biodiversity Measures

- Comparing biodiversity
  - Are all species equal?
  - Rare vs. abundant
  - Native/non-native
  - Dispersal ability
  - Endemic vs. cosmopolitan
  - Genetic variability

2.



[Forest Service Climate Change Atlas]

www.epa.gov

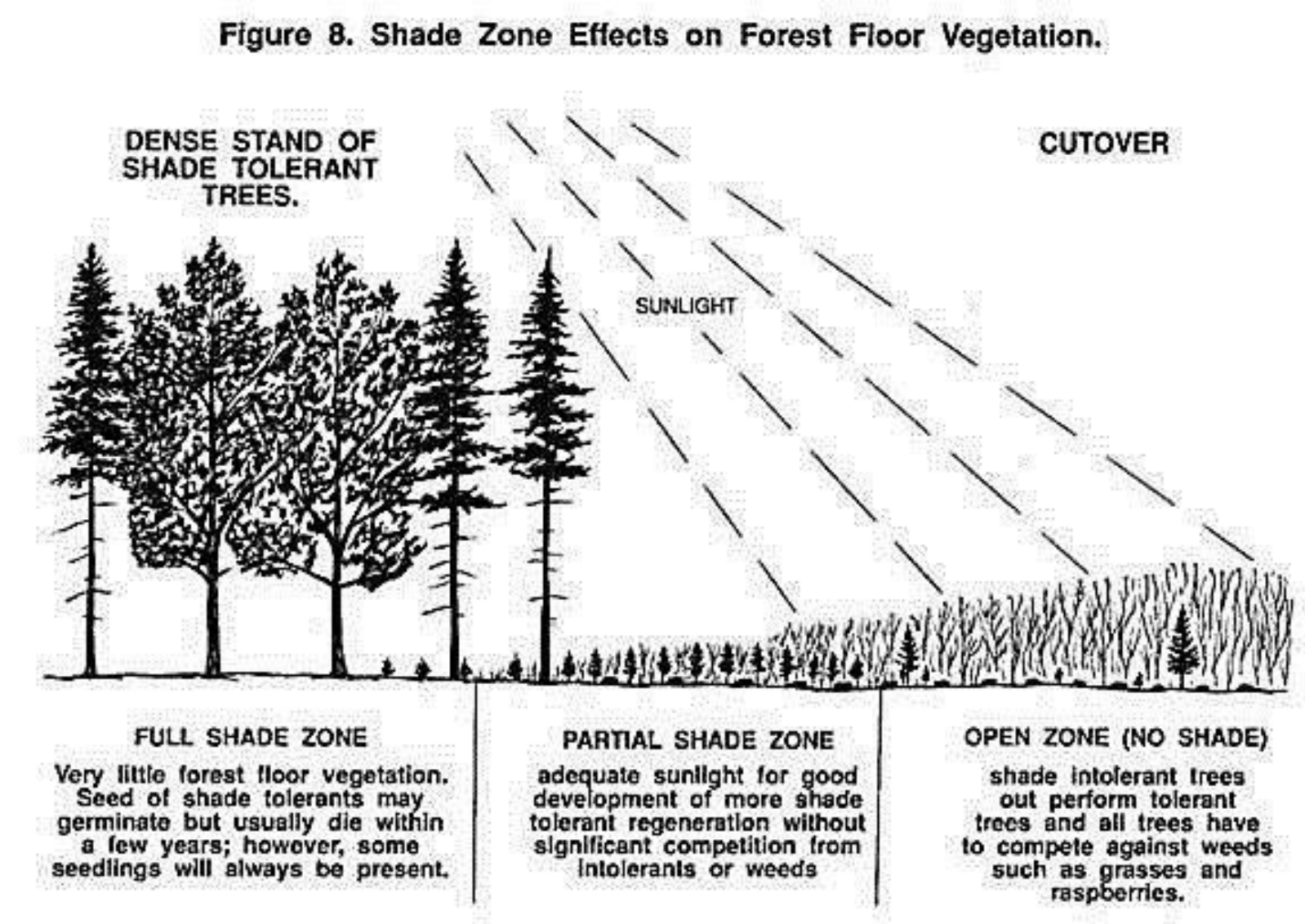
2.

Biodiversity Measures

- Comparing biodiversity
  - –Are all ecosystems equal?
    - Carbon fixation
    - Nutrient loss/erosion control
    - Importance of disturbance

Forest	Marsh	Grassland
Black oak	Reed-grass	White prairie clover
Shagbark hickory	Painted turtle	Horned lark
Gray Squirrel	Red-winged Blackbird	Black-footed ferret
White-tailed deer	Muskrat	
Raccoon		

2.



Shade tolerant vs. intolerant

novascotia.ca

3.

Scale and Biodiversity

- Extinction: disappearance of a species from Earth
  - Local vs. regional extinction
  - Extirpation
  - Endemic
  - Size of extinction related to conservation concern

3.

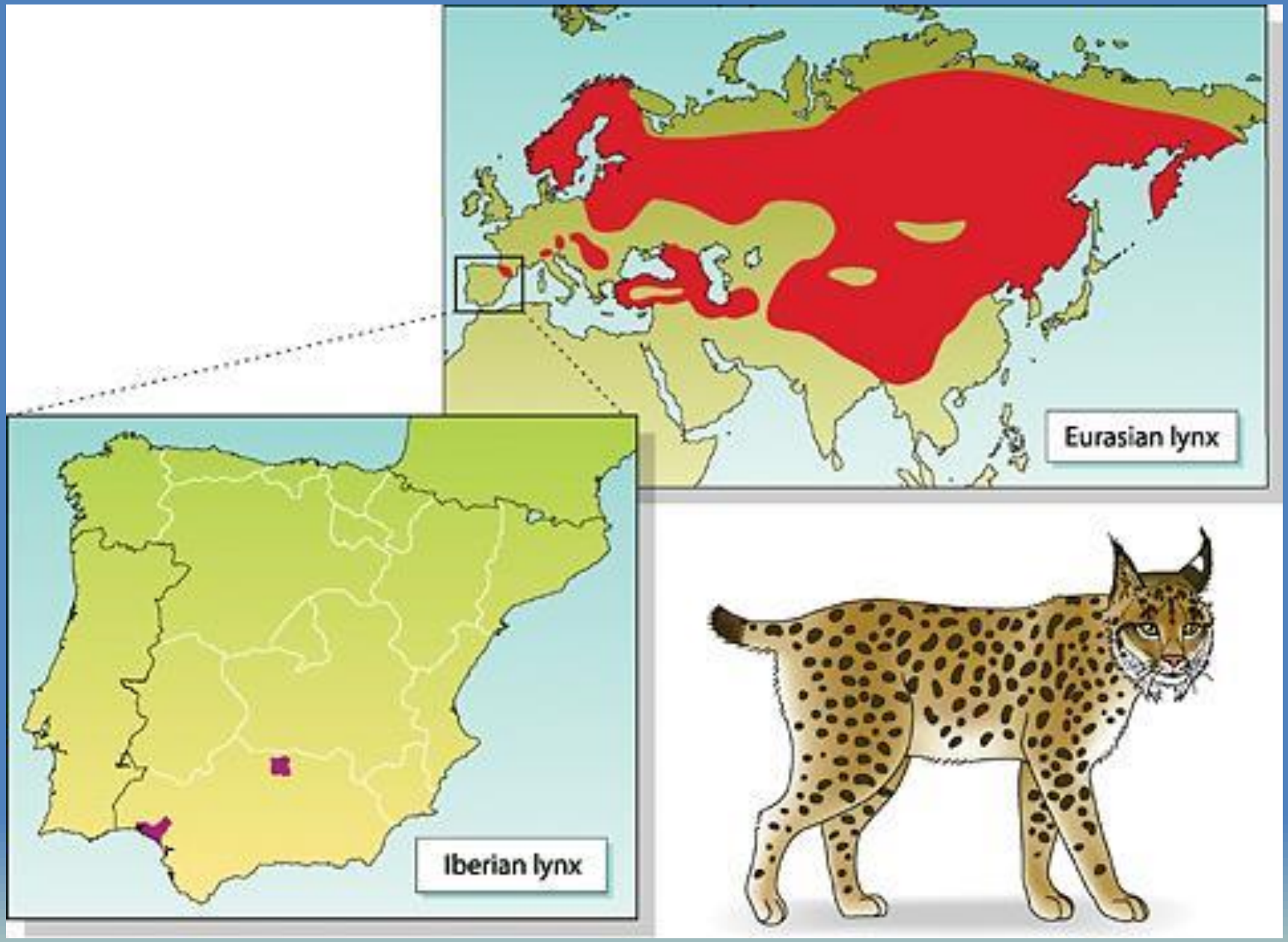


Figure 2.2

3.

Scale and Biodiversity

- Whitaker (1960): Three scales of diversity
  - Alpha
  - Beta
  - Gamma
  - Scale WAGS the tail of biodiversity

3.

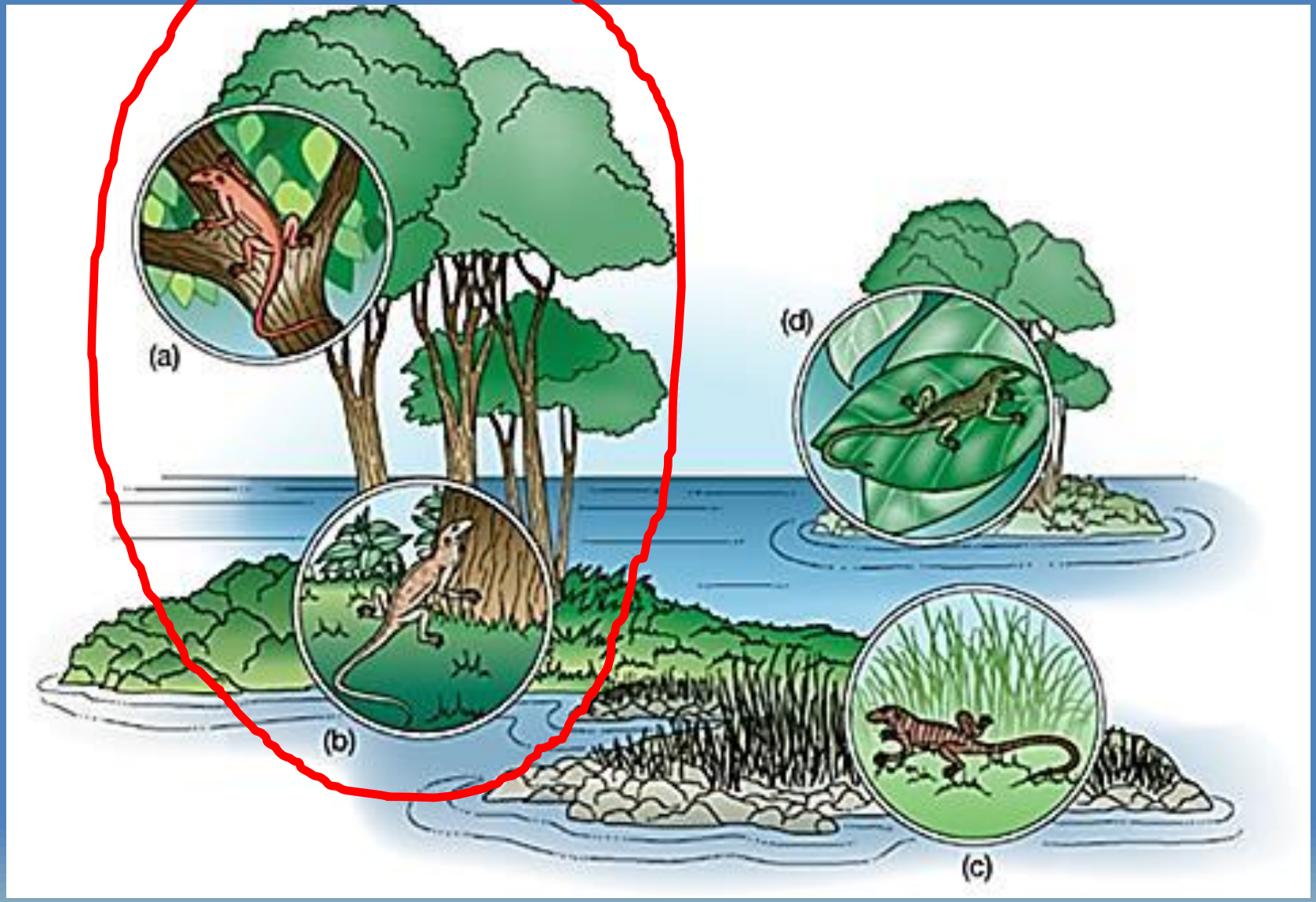


Figure 2.3

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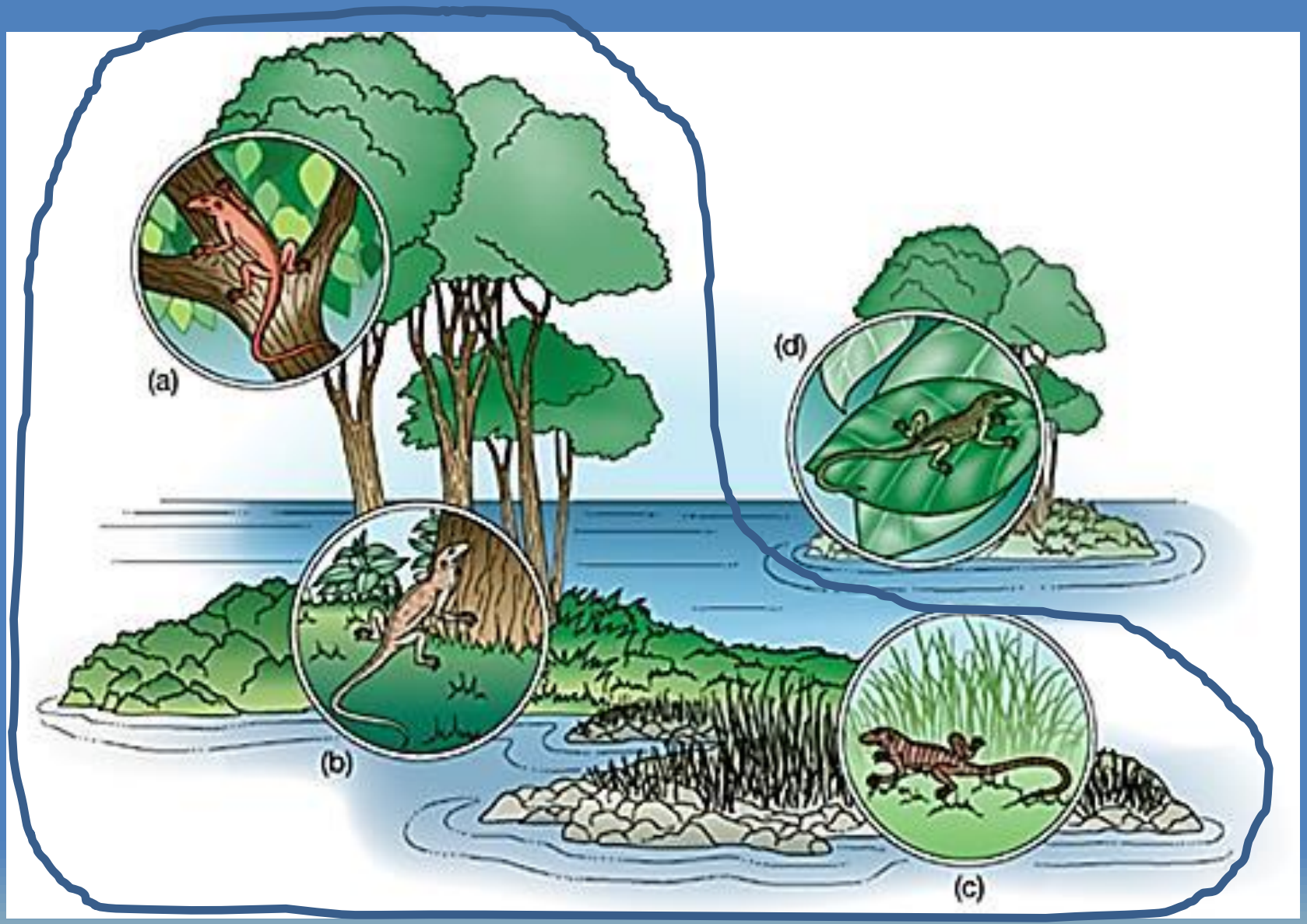

Figure 2.3

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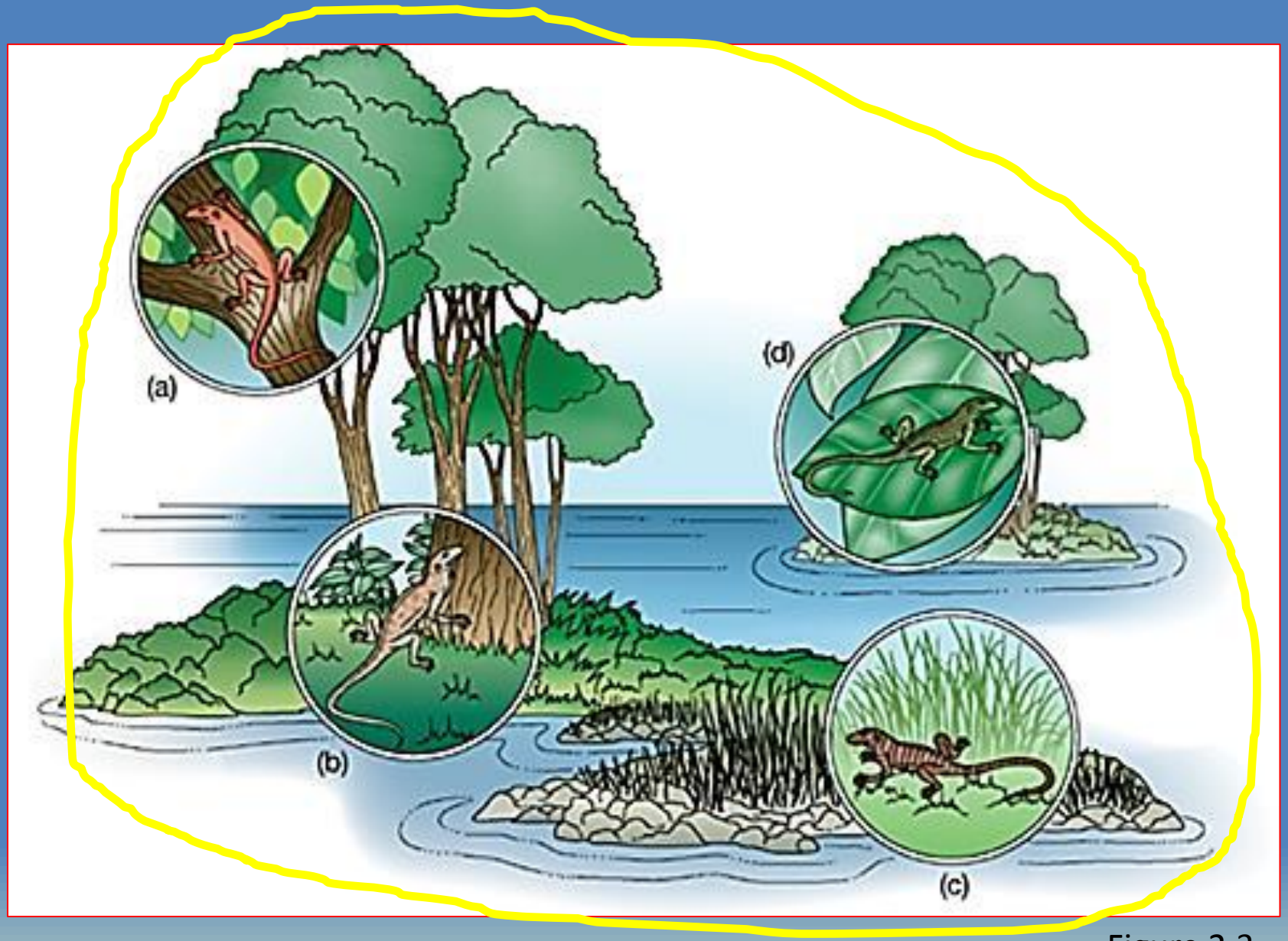


Figure 2.3

3.

Scale and Biodiversity

- Case Study: Clear Lake
  - 12 native species; 3 endemics
  - Construction of dam
  - Some natives extirpated (-2)
  - Introductions of sport fish (+16)
  - 4 natives remain

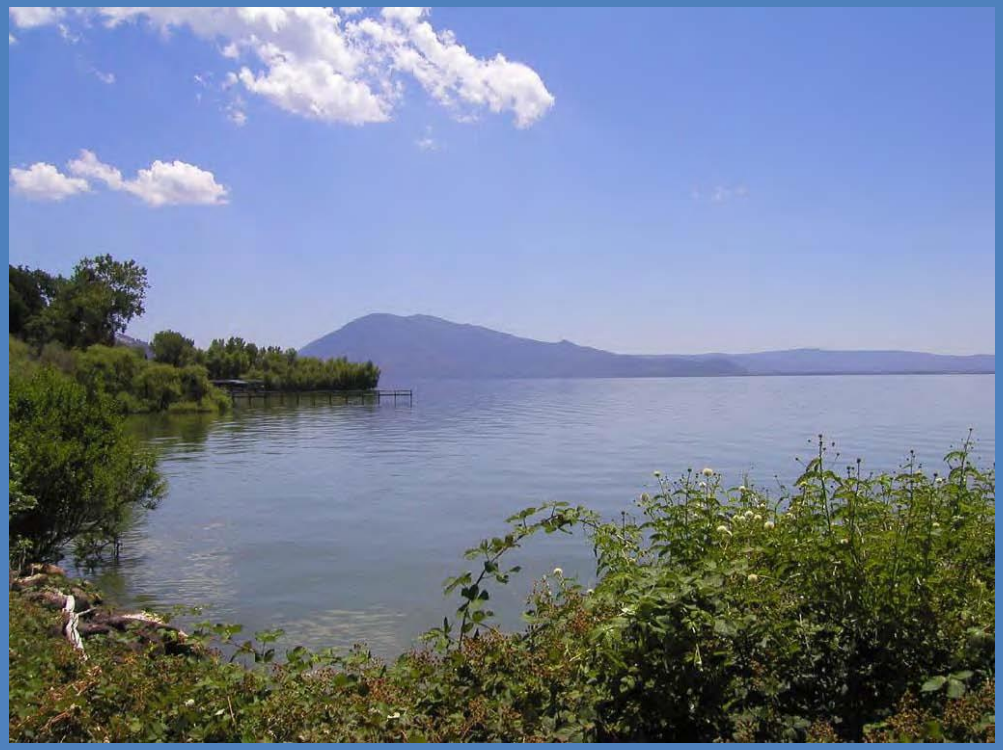
3.

Changes in diversity

1.Dam construction

2.Species extirpations

3.Species introductions



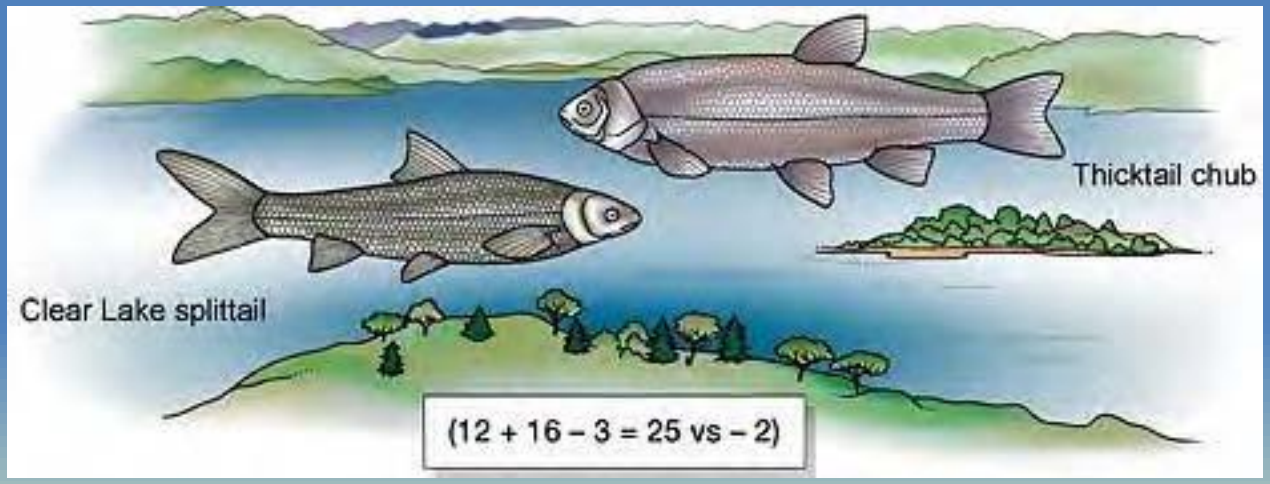


Figure 2.4

4.

Biodiversity Concepts

- What do conservation biologists do?
  - Maintain
  - Maximize
  - Increase/enhance
  - Restore
  - Protect/preserve/conserve

4.

Biodiversity Concepts

- Concepts
  - Biotic integrity: proper balance of species
  - Ecosystem integrity: emphasis on processes
  - Sustainability
    - Often associated with resource conservation
    - Maintain supply in perpetuity

4.

Biodiversity Concepts

- Concepts cont'd
  - How are they applied?
  - Baseline values?
    - TNC: 10,000 years BP

Resources

Publications

Hunter Jr., M. L., and J. Gibbs. 2007. Fundamentals of Conservation Biology, 3rd Edition. Blackwell, Malden.

Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V., and R.B. Jackson. 2014. Campbell Biology, 10th edition. Pearson, New York.