The Biological Niche

Role and Place in the Ecosystem

With Cynthia Sanchez

Objectives

- To understand what a niche is in the field of ecology
- To understand the differences between a fundamental niche and a realized niche
- Why are niches important to understand
- How this knowledge is used

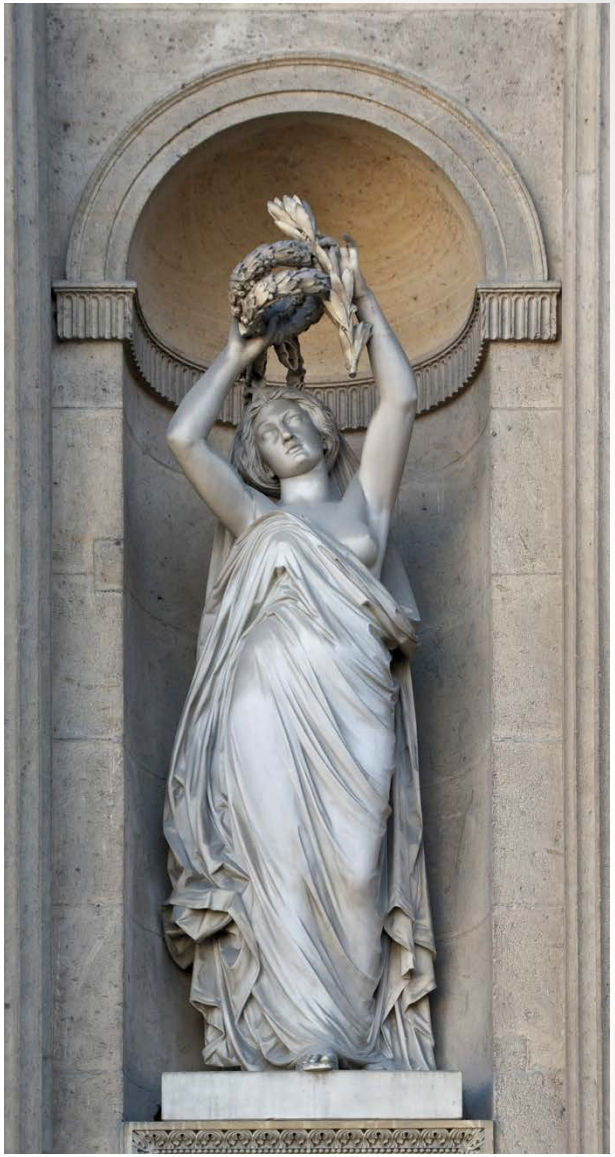
What is a NICHE?

Niche (in reality) - like a niche or nook in which an item is placed.

Niche (figuratively) – to have found a "*position*" in society that is uniquely their own.

Oxford Dictionaries

http://www.oxforddictionaries.com/us/definition/american_english/niche



https://upload.wikimedia.org/wikipedia/commons/e/e6/Statue_Cour_carr%C3%A9e_Louvre_1.jpg

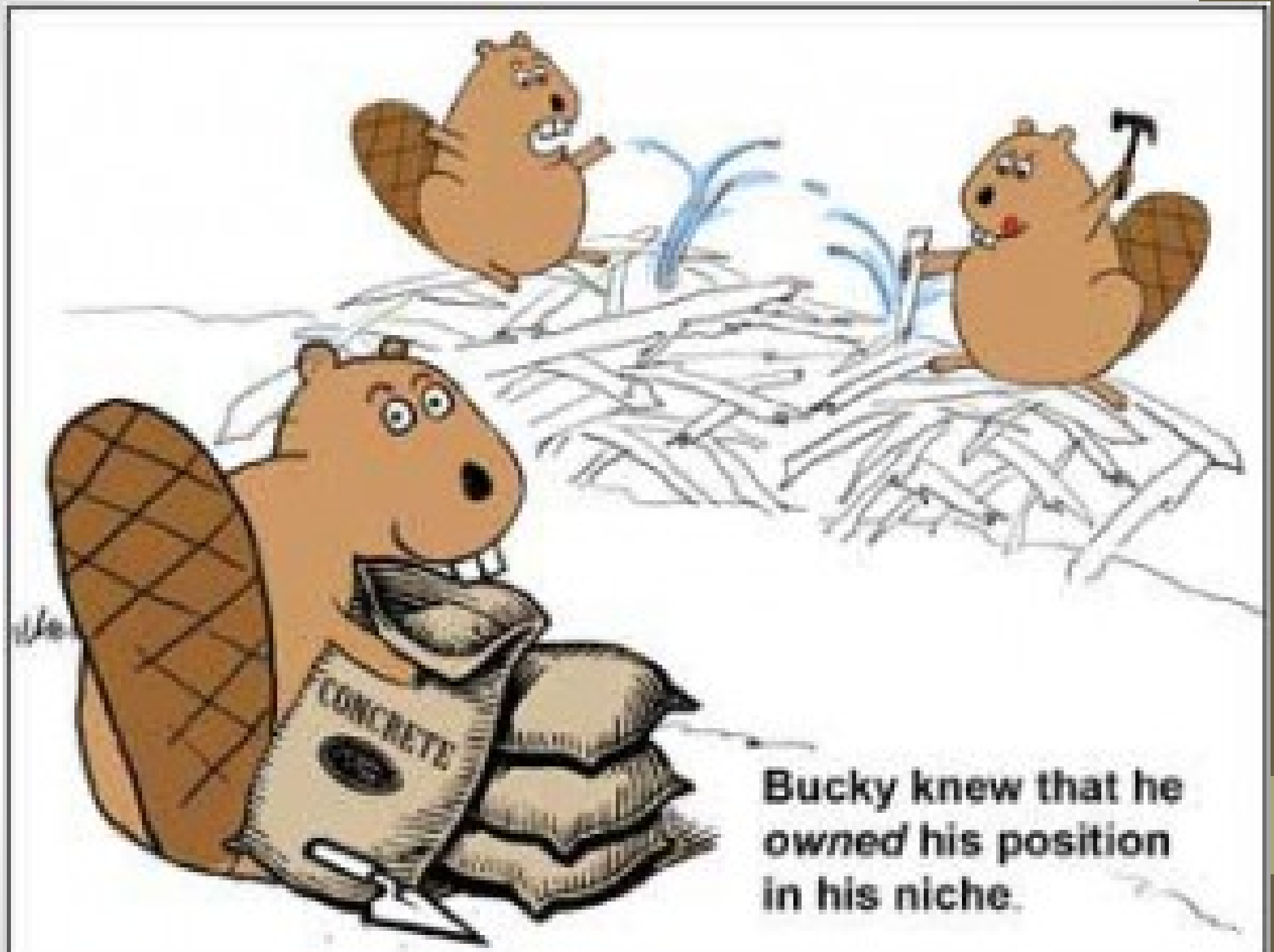
Niche

- Organisms carve out their own unique niches that they specialize in, and it is extremely unusual to find two organisms with the same exact niche. Too much competition for resources.

- https://study.com/academy/lesson/ecological-niche-definition-lesson-quiz.html

- Biotic factors – living things

- Abiotic factors – non-living


CONCRETE
Bucky knew that he *owned* his position in his niche.

Hutchinson's Definition of Niche

In ecology, a NICHE is an n-dimensional hypervolume.

- **Hypervolume** - A region defined by more than three dimensions.

George Evelyn Hutchinson (1903-1991)

https://www.nceas.ucsb.edu/~alroy/lefa/Hutchinson.html

What Does a Hypervolume Look Like?

- Fig. *a three-dimensional niche.*

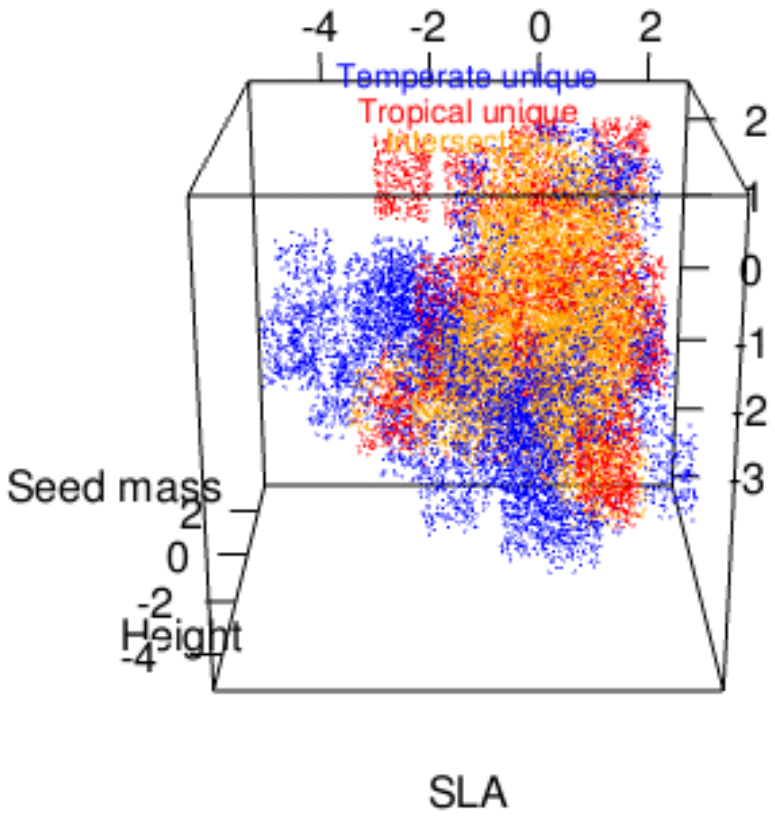
1. *Specific Leaf Area (SLA) vs*
2. *Height of habitat*
3. *Seed Mass*

Temperate Biomes

Tropical biomes

Overlapping Biomes

The Functional Hypervolume of Tree Species



https://bblonder.wordpress.com/2014/02/26/the-ecological-niche-and-the-n-dimensional-hypervolume/

The Lichen – An Example of a Biological Niche

- A **lichen** is a composite organism that arises from algae or cyanobacteria (or both) living among filaments of a fungus in a symbiotic relationship.[1][2][3] The combined life form has properties that are very different from the properties of its component organisms. Lichens come in many colors, sizes, and forms.

The Lichen – An Example of a Biological Niche

- The properties are sometimes plant-like, but lichens are not plants. Lichens may have tiny, leafless branches (fruticose), flat leaf-like structures (foliose), flakes that lie on the surface like peeling paint (crustose),[4] or other growth forms.[5] crustose

crustose

The Lichen – An Example of a Biological Niche

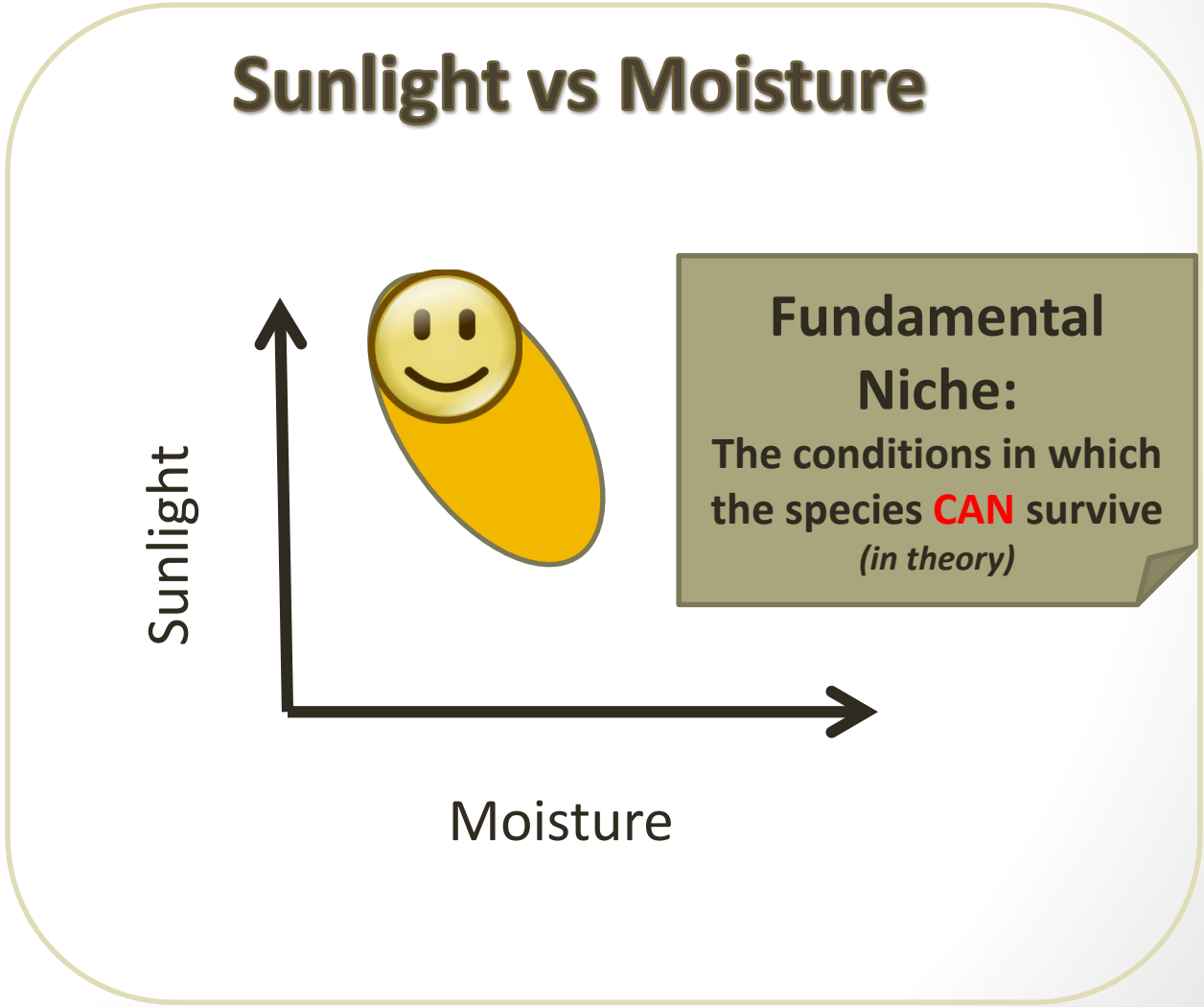
- A **macrolichen** is a lichen that is either bush-like or leafy; all other lichens are termed **microlichens**.[1] Here, "macro" and "micro" do not refer to size, but to the growth form.[1] Common names for lichens may contain the word "moss" (e.g., "Reindeer moss", "Iceland moss"), and lichens may superficially look like and grow with mosses, but lichens are not related to mosses or any plant.[3]:3

The Lichen – An Example of a Biological Niche

- Lichens do not have roots that absorb water and nutrients as plants do[6]:2 but like plants they produce their own food by photosynthesis using sunlight energy, from carbon dioxide, water and minerals in their environment.[7] When they grow on plants, they do not live as parasites and only use the plants as a substrate.

The FUNDAMENTAL Niche

The orange lichen likes a lot of sunlight, but does not like a lot of moisture.



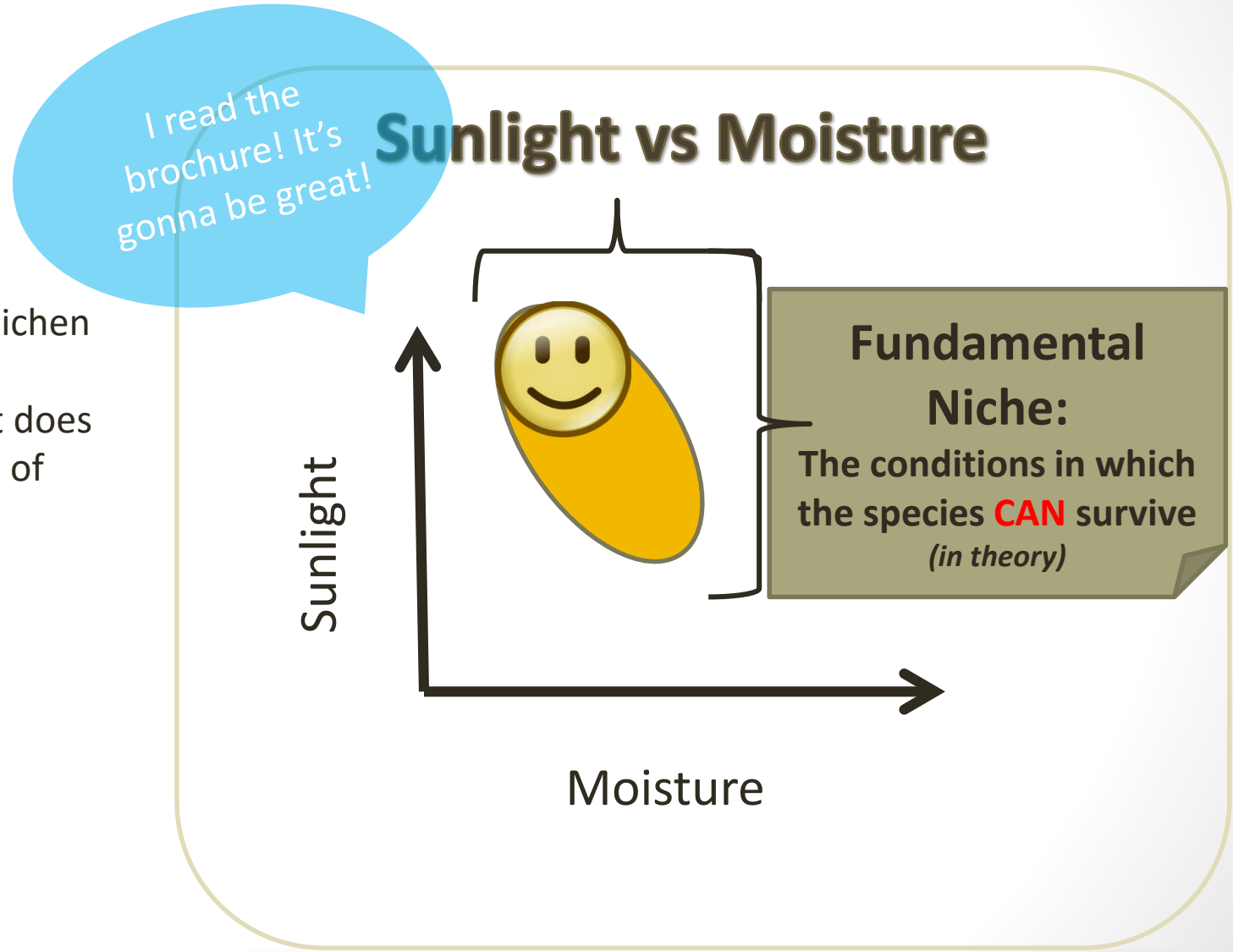
The Fundamental Niche

- The fundamental niche is usually NOT observed in nature. In a ‘perfect’ world (perfect for that particular species) this is what the niche for that species would potentially be.

- It sort of like FALSE ADVERTISING.

The FUNDAMENTAL Niche

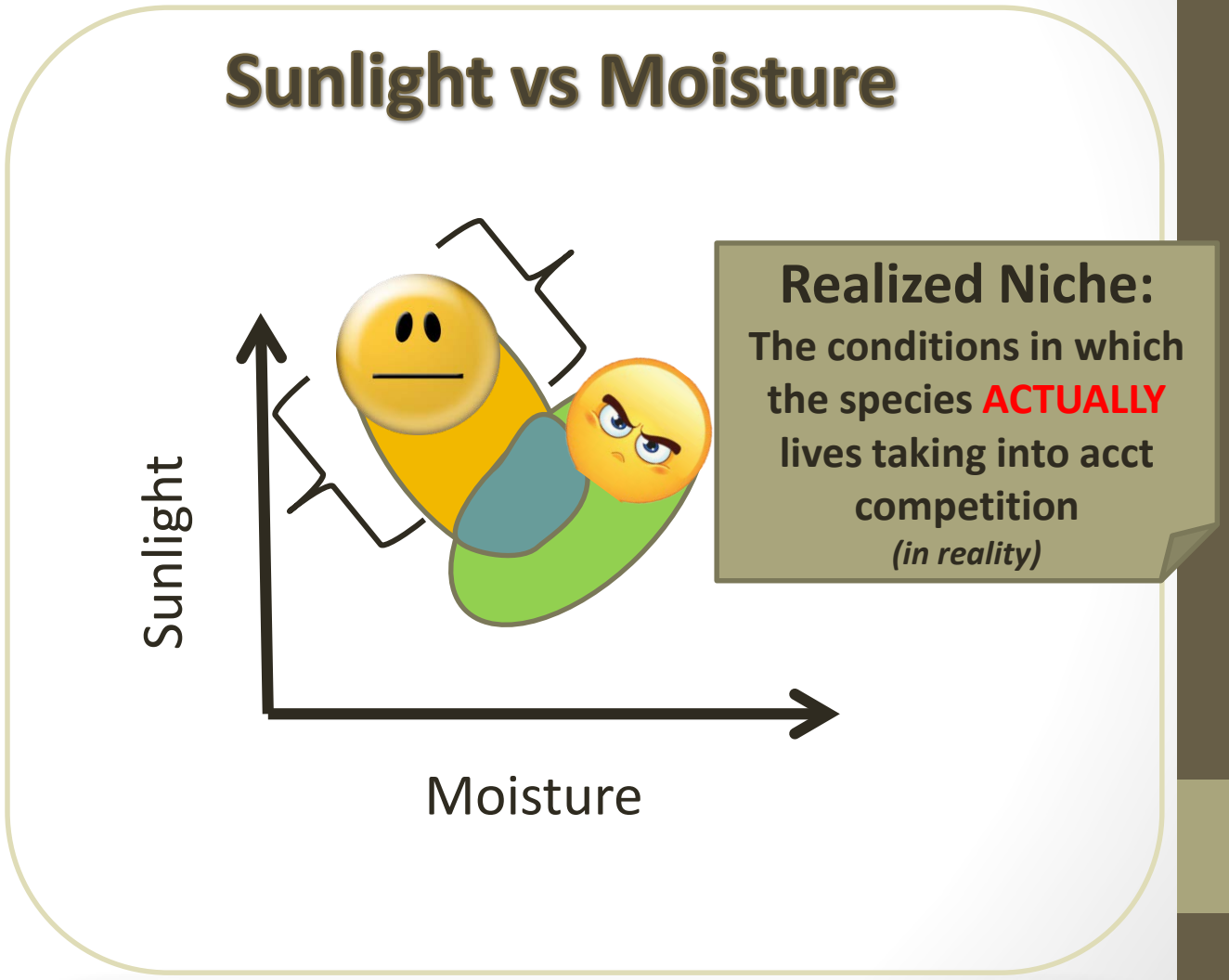
The orange lichen likes a lot of sunlight, but does not like a lot of moisture.



The REALIZED Niche

The orange lichen likes a lot of sunlight, but does not like a lot of moisture.

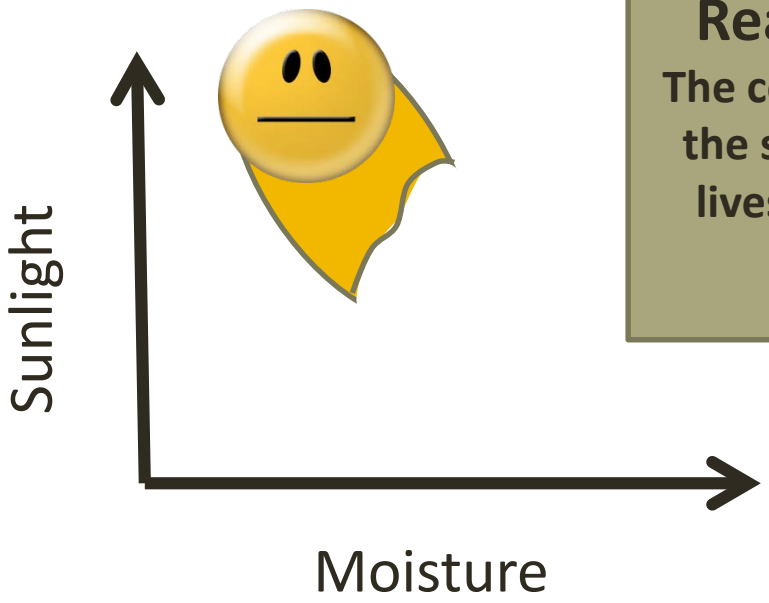
Green Lican likes a lot of moisture, but does not like a lot of sunlight.



The REALIZED Niche

The orange lichen likes a lot of sunlight, but does not like a lot of moisture.

Green Lican likes a lot of moisture, but does not like a lot of sunlight.



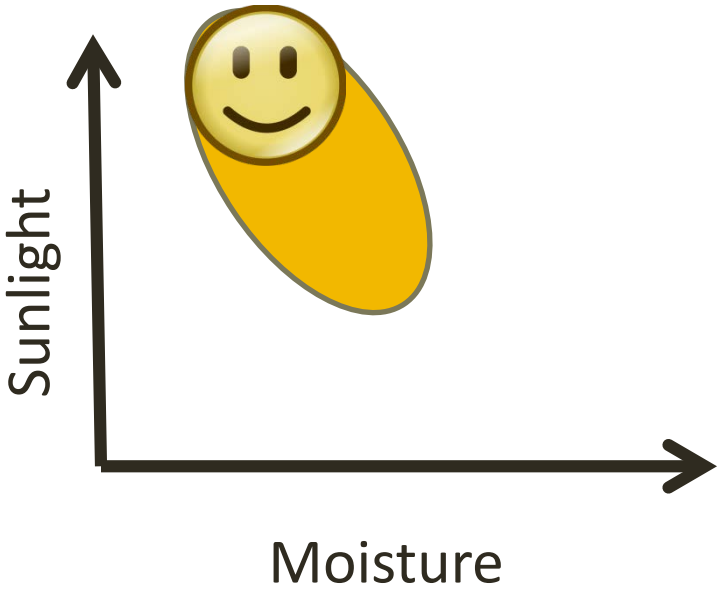
Realized Niche:
The conditions in which the species ACTUALLY lives taking into acct competition
(in reality)

Fundamental vs. Realized

Due to abiotic factors

Temperature, Moisture, Food, Shelter, Soil Composition, Sunlight

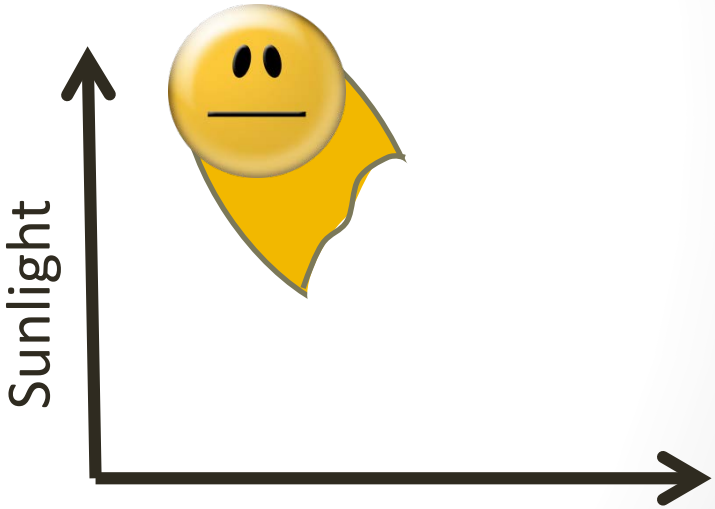
Fundamental Niche



Due to biotic factors

Predation, Competition

Realized Niche

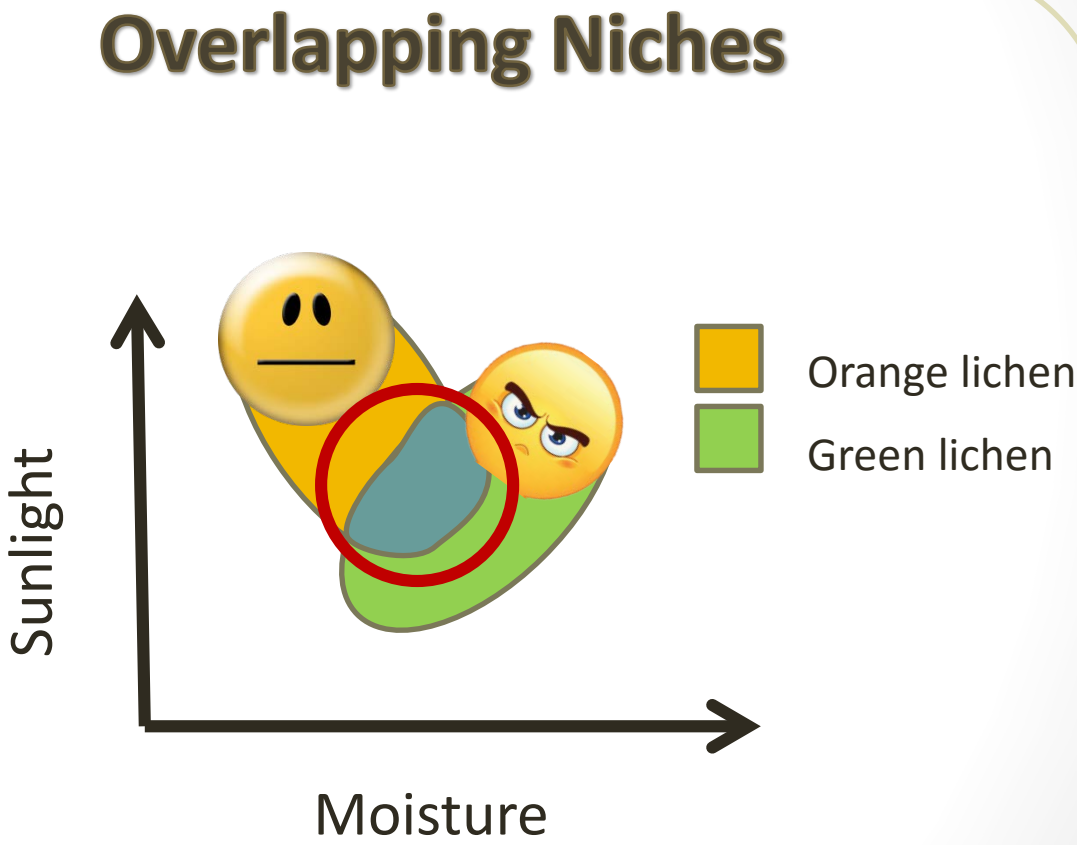


The Realized Niche < Fundamental Niche

Due to predation and competition

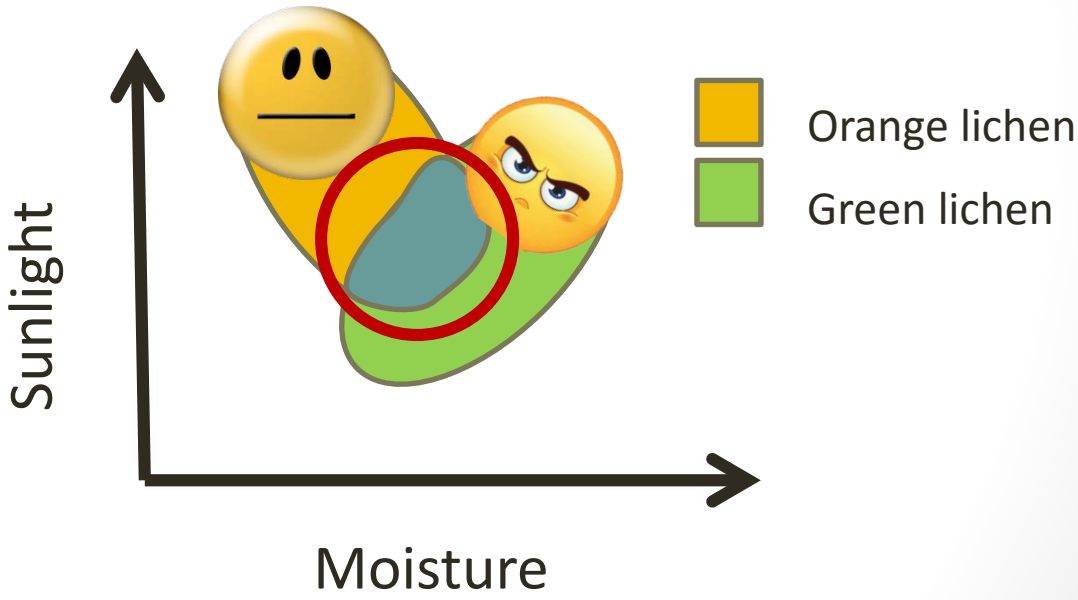
Overlapping Niches

In the area of overlapping niches, organisms much compete for resources.

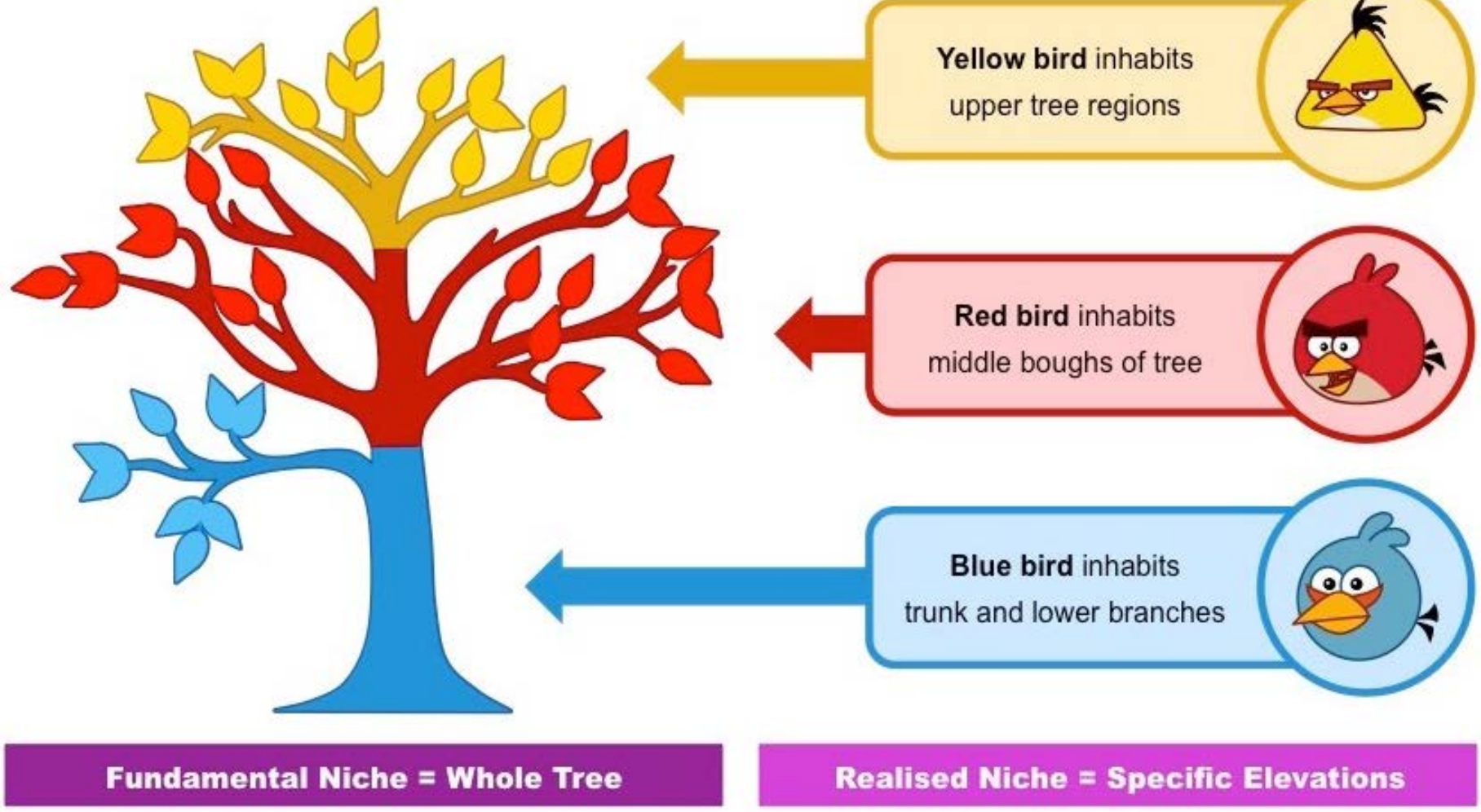


Gause's Law of **Competitive Exclusion**

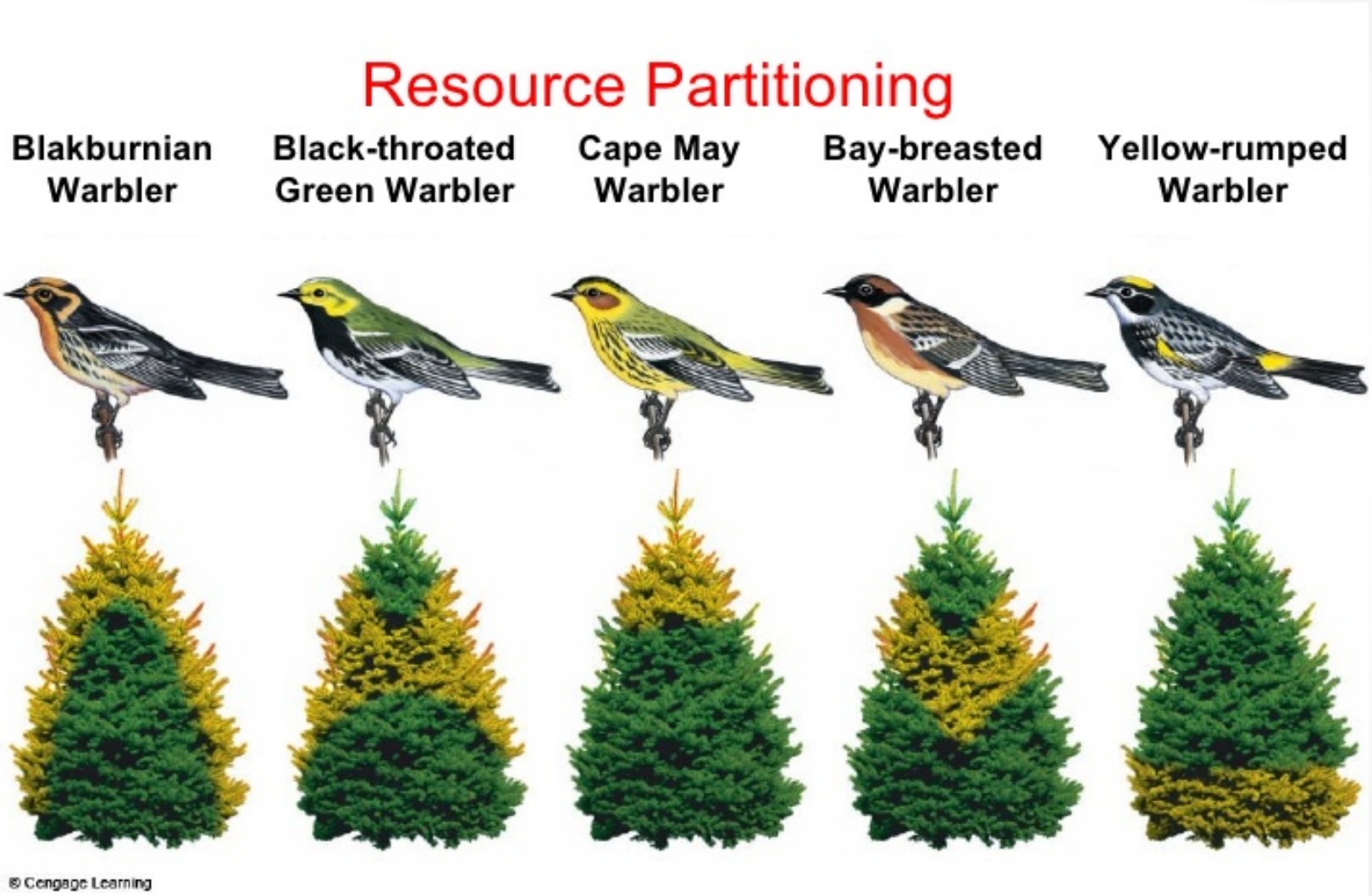
- two species competing for the same resource cannot coexist at constant population values, if other ecological factors remain constant.



Organisms Must Compromise



Warbler Bird



Environmental Science: Problems, Concepts, and Solutions. (12th ed.) by G. Tyler Miller, Jr. and Scott Spoolman

Fig. 6-4, p. 112

Why Should We Learn About Niches?

Why do I need to learn this?

Answers:

To make good decisions.

To make good predictions.

To ensure species survival.

To maintain ecological balance.

What Can Go Wrong?

Purposeful introduction of non-native species as PEST CONTROL

Introduction of non-indigenous species to non-native habitats by humans often results in biological pollution by the exotic or invasive species.

What Can Go Wrong?

http://www.invasive.org/browse/detail.cfm?imgnum=5488614

Cane toads were introduced to Australia in 1935 as a biological control method against the Greyback cane beetle that was destroying sugar cane crops.

Consequences of Misunderstanding Niches

1. The Greyback beetle eats the top of the sugar cane where the toads cannot reach them.
2. The Greyback beetle is active during the day, but Cane toads feed at night.
3. The two species are not in the same place at the same time of year.
4. The toads need wet conditions to survive, so they moved from the sugar cane fields to moister areas.

Its range has expanded southward, through Australia with no outlook of control.

How do we find the niche?

- For every known location of a species
  - Compare the conditions of where they are found to the conditions of where they are not found.
  - Factors to consider
    - Temperature
    - Rainfall
    - Soil
    - Nitrogen availability
  - Niche define the TOLERANCE of the species.

How do we find the niche?

- Look at the distribution of 2 species over a gradient of moisture availability.

- Species 1 - Soft Tree Fern (***Dicksonia antarctica)***
  - Wooly and soft to the touch
  - Wide trunk
  - 3-4 meters high
  - Hang on to dead fronds

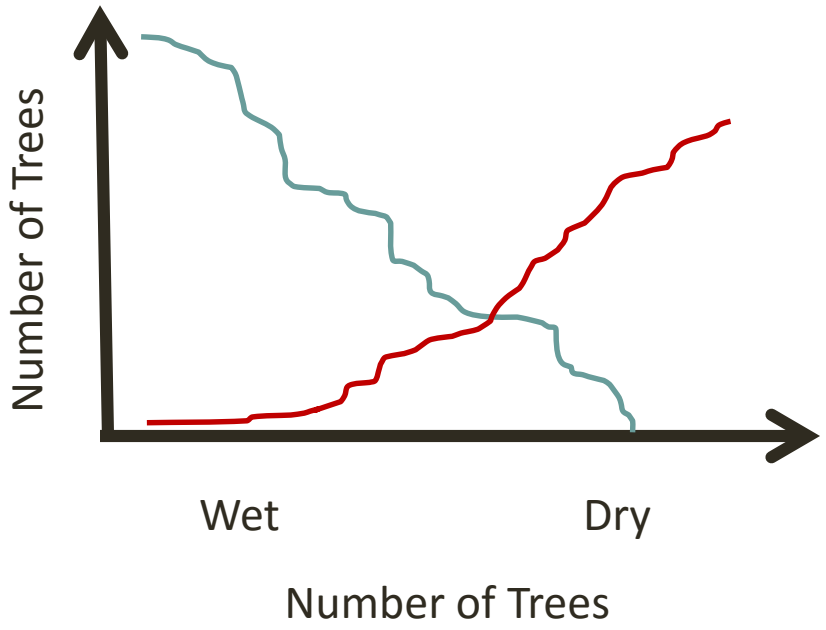
- Species 2 - Rough Tree Fern(***Cyathea australis)***
  - Rough to the touch
  - Slender trunk
  - 8-9 meters high

How do we find the niche?

- Abundance vs Moisture

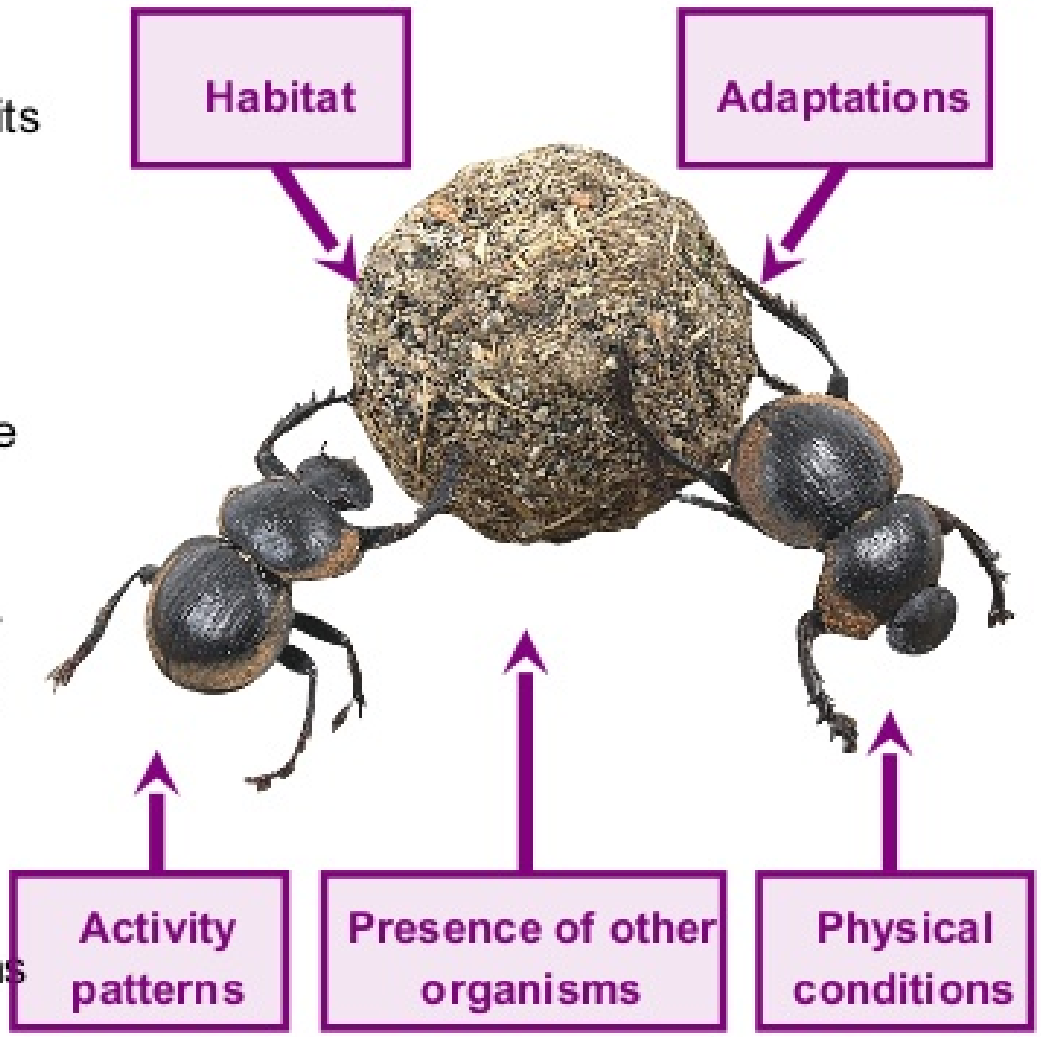
Soft Tree Fern

Rough Tree Fern



Ecological Niche

- The **ecological niche** describes the functional position of an organism in its environment.
- A niche comprises:
  - the **habitat** in which the organism lives.
  - the organism's **activity pattern**: the periods of time during which it is active.
  - the **resources** it obtains from the habitat.



https://media.licdn.com/mpr/mpr/shrinknp_800_800/AAEAAQAAAAAAAAQFAAAJGI1MWQ0N2NkLTE1NDYtNDQxMS04YjE5LWMwYjRiZTYyNjlkMg.jpg

Understanding the Niche…

To make good decisions.

To make good predictions.

To ensure species survival.

To maintain ecological balance.