

## Introduction to Ecology

**Fill in the blank.** On the line provided, fill in the level of ecological organization that the given example represents.

1. All of the sticklebacks that live in Lake Konstanz. **Population**
2. All of the biotic and abiotic components of Lake Konstanz. **Ecosystem**
3. All of the species of phytoplankton that live in Lake Konstanz. **Community**
4. A catfish swimming in Lake Konstanz. **Individual**

## Individuals: Behaviors, Niches, and Evolutionary History

**Exercise.** Label the following examples of adaptation as either “behavioral”, “structural”, or “physiological”.

Example 1: Countercurrent heat exchange in the paws of an Eisfuchs (*Alopex lagopus*).

**Physiological**

Example 2: The webbed feet of ducks that help them swim easily and quickly.

**Structural**

Example 3: The winter migration of giant pandas. Instead of hibernating during the winter like other species of bear, the giant panda moves to lower, warmer altitudes.

**Behavioral**

## Niches

1) Name one way the realized niche of the red squirrel would be greater in places where the grey squirrel has not invaded.

**Without the presence of the gray squirrels, the red squirrels would have more habitat and more food resources.**

2) How do you think the gray squirrels became tolerant to the tannins in acorns? (Hint: where did the gray squirrels come from?)

**The gray squirrels are native to deciduous forests in the U.S. where they consume a greater variety of nuts rich in tannins. This is how they developed a tolerance to the tannins in unripe acorns in Europe.**

## Niche Construction

1) Can you think of any other examples of niche construction?

Nests, burrows, mounds, alteration of physical and chemical conditions, creation of shade, alteration of nutrient cycling

2) How long do you think the ecological effects of the beaver dam last after the beavers have moved on?

Potentially decades

**Exercise.** Find another example of an organism that modifies its niche in the museum. Draw a picture of what you think the habitat would look like before and after it has been modified by the organism. What are the main differences? How long do you think the modifications would last in your example?

Any example of the previous list (nests, burrows, mounds, alteration of physical and chemical conditions, creation of shade, alteration of nutrient cycling) would be acceptable.

## Behaviors

1) What resource is the musk ox competing for in the example of intraspecific competition?

Mates

2) What resource is the musk ox competing for in the example of interspecific competition?

Food resources

**Exercise.** Rank the following types of organisms with what you think their general level of parental investment is from the least to the most.

Reptiles, Mammals, Birds, Arthropods, Fishes

Arthropods (none-low), Reptiles (none-low), Fishes (some), Birds (moderate), Mammals (intensive).

## Populations: Growth and Regulation

**Exercise.** Label each of the following graphs as either “logistic growth” or “exponential growth”.

Left: Exponential, Right: Logistic

1) Which graph do you think most accurately represents the growth seen in natural populations?

Logistic (Right). In nature, populations may grow exponentially for some period, but they will ultimately be limited by resource availability.

2) What are some factors that could potentially influence population growth?

Habitat and resource availability, the introduction/removal of predators, management efforts of humans.

1) Can you think of any other limiting factors that could influence the population growth of roe deer or other organisms?

Habitat and resource availability, the introduction/removal of predators, introduction of disease.

A) During which period of time was the population of roe deer growing exponentially?  
1985-1990

B) Can you give one hypothesis as to why the roe deer population exceeded its carrying capacity between 1995 and 2000?

Increase in resources, reduction of predators.

C) Can you give one hypothesis as to why the population of roe deer started decreasing in the 2000s?

Limiting factors such as disease, predators, or lack of food

## Species Interactions

1) Can you think of any examples of these types of species interaction?

Too many to list but basically any interaction could be placed in this chart.

2) Given the way that species interact, do you think that an event that affected one species in a community would also have an impact on the rest of the community?

Yes

**Exercise.** Label the following examples of species interactions.

1. Mutualism, 2. Antagonism (parasitism), 3. Competition, 4. Commensalism, 5. Amensalism

## Food Chains

1) What are the trophic levels of the organisms in the picture above?

Plant: Primary producer, Rabbit: Primary consumer, Fox: Secondary Consumer, Mountain Lion: Tertiary consumer.

2) How might an aquatic food chain differ from a terrestrial food chain?

Instead of vascular plants like in terrestrial systems phytoplankton convert the initial energy from the sun in aquatic systems. There is often less biomass at the primary production level in aquatic systems than in terrestrial systems because there is not an accumulation of woody tissues.

**Exercise.** Label the organisms above with their trophic level in the food chain.

Fish: Secondary consumer, Zooplankton: Primary consumer, Heron: Tertiary Consumer, Phytoplankton: Primary producer.

1) What do you hypothesize is the relationship between phytoplankton and zooplankton. For example, do you think the abundance of phytoplankton in a community influences the abundance of zooplankton?

Phytoplankton is the food source for zooplankton, so the abundance of phytoplankton will directly influence the abundance of zooplankton.

2) Do you think that the abundance of primary producers ultimately has an effect on the abundance of tertiary consumers?

Yes, because the energy converted from the sun flows up through the food chain to support the other levels.

## Community Dynamics

1) How do you think succession would differ in an aquatic community?

Phytoplankton and zooplankton can colonize a new water body very rapidly whereas fish may take a very long time. Also, the climax in most lakes is ultimately the filling in of the lake habitat.

2) What are some examples of disturbances that could affect an aquatic community?

Landslide, damming, flood, pollution, introduction of non-native predators or competitors.

3) Can you find any examples of disturbances that have affected the community structure of Lake Konstanz in the museum? Pollution, invasive species

4) In the last 100 years have the disturbances that have affected the community structure of Lake Konstanz been mostly natural disturbances or human disturbances? Human caused disturbances

### **Ecosystems: Flow of Energy and Matter**

**Exercise.** Sort the components (climatic conditions, sunlight, plants, herbivores, carnivores, microbes, soil resources) of the above diagram as either abiotic or biotic factors.

Abiotic: climatic conditions, sunlight, soil resources. Biotic: plants, herbivores, carnivores, microbes.

### **Energy Flow**

**Exercise.** Use the ecological pyramid below to complete the following activities/questions.

1) Label each level of the ecological pyramid with their trophic level (example: primary producer).

From bottom to top: Decomposer, Primary producer, Primary consumer, Secondary consumer, Tertiary consumer.

2) What is represented by the pyramid being larger at the bottom and narrowing as it goes up?

The amount of energy being transferred through the levels of the food chain.

3) If a plant at the bottom of the pyramid captures 1000 calories of energy from the sun, how many calories will make it to a primary consumer? Secondary consumer? Tertiary consumer?

Primary consumer: 100, Secondary consumer: 10, Tertiary consumer: 1

### **Nutrient Cycling**

1) What is the major difference between the flow of energy and the flow of nutrients through an ecosystem?

Energy flowing through the system is not recycled but nutrients are constantly recycled.

2) In what ways can humans influence the flow of energy and nutrients through an ecosystem?

They can move nutrients and energy sources around in unnatural ways for example pollution or nutrient inputs.

3) Can you find an example in the museum of a time that humans influenced the nutrient cycle in Lake Konstanz?

Pollution during the 1960's and 1970's. There is a lot of information about this on the back wall.

### **Ecosystem Services**

1) What are some other ecosystem services provided by Lake Konstanz?

Clean water, recreational activities, habitat for food resources.

### **Human Impact on the Environment**

1) Can you think of any other ways that you can help conserve biodiversity?

Several acceptable answers. Eat less animal products, buy local foods, donate to or volunteer with organizations that support environmental causes, etc.

2) What is one small change that you personally can make in your daily routine that would contribute to slowing biodiversity loss?

Turn the water off when brushing teeth, carry a reusable water bottle instead of buying plastic, recycle plastics, compost organic material, many others.

**Exercise.** Find an example in the museum of how human activities have impacted the biodiversity in or around Lake Konstanz in the past. Give a brief description of your example and if relevant, what actions were taken to remedy the impacts. If no actions were taken to remedy the impacts, give a suggestion of something that could be done.

Pollution in the 1960's and 1970's  
Invasion of Zebra mussels