**Types of Limiting Factors**

***Introduction***:

All living things need food, water, shelter, and space to survive. As long as organisms have all of these things available to them, their population will continue to grow. However, populations cannot grow forever. Some form of environmental resistance will stop the population’s growth. This environmental resistance is called a limiting factor since it limits the population. Limiting factors can also increase a population as well. We will look at many different limiting factors and classify them into density independent factors and density dependent factors.

***Density Dependent Factors:***

Density dependent factors can only affect a population when it reaches a certain density. If the population is not high, these will not negatively affect the population. The following are types of density dependent factors.

* **Competition** can occur between many organisms that live in the same habitat. Resources are limited so organisms must compete for food, water, space, and shelter. BUT there will only be competition if there are too many organisms (high density) and not enough resources.
* **Predation** occurs when the population density of predators is high. The predators will eat their prey and increase their own population. However, the population of the prey will decrease. If there are too few predators, the population of the prey will increase. If the prey population increases, they will deplete their resources and increase the risk of disease.
* **Disease** in a population increases with the density of that population. The more dense the population, the easier it is for bacteria and viruses to find a host and spread diseases.
* **Parasitism** is a relationship in which one organism benefits at the expense of another. The more organisms there are, the easier it is for parasites to find hosts and infect them.
* **Crowding** only occurs at high densities. Over-crowding can cause resources to run out, disease, and stress.
* **Stress** has a negative effect on populations and is usually caused by over-crowding. Stress can make organisms weak and more prone to disease.

***Density Independent Factors***:

Density independent factors can affect a population no matter how many organisms are living in an area. The following are types of density independent factors:

* **Natural Disasters** such as droughts, floods, hurricanes, tornadoes, and fires can be devastating to any habitat no matter what size it is.
* **Temperature** influences the activity and growth of organisms. Temperature also determines what type of organism can live in a certain area. If temperatures vary too much out of the range the organism prefers, it will either die or move to a different location. Temperature can also affect the chemical properties of water. The rate of chemical reactions in water increases as temperature increases. For example, warm water holds less oxygen than cool water, so warm water might not have enough oxygen to support life for long periods of time.
* **Sunlight** can only penetrate to a depth of 30 meters in water. Most photosynthesis in aquatic environments occurs near the surface. Most plants cannot grow if they are at the bottom of a deep lake.
* **Human activities** can also affect population. If humans disturb an ecosystem, all the organisms that are there may die.
* **Physical characteristics** of organisms can affect their population. Many organisms have adapted and evolved in order to increase their chance of survival. For example, some species animals have bright colored markings to warn predators that they may be toxic, or some species use camouflage colors to help them hide and avoid being eaten.
* **Behaviors** of organisms can also affect their population. Some species migrate to find food or to mate, some create societies or feeding territories and some may have mating behaviors that affect their population.

***Read the following story and try to pick out the density dependent and density independent factors affecting the fish in the lake.***

**Yellow Perch in Lake Winnipeg**

Located 217 miles above sea level, Lake Winnipeg is a shallow lake composed of two basins: a wide north basin and a narrow south basin. On average, Lake Winnipeg is only 12 meters deep and receives 517 millimeters of precipitation annually. The lake provides a habitat for over fifty different species of fish including yellow perch, chestnut lampreys, and rainbow smelt.

Yellow perch prefer water that has little current. They can tolerate moderate turbidity and they prefer a temperature range of 18-20 degrees Celsius. IF the temperature of the water varies too much above this range, yellow perch will either move to a new location or die.

Yellow perch spawn (mate) in May or early June when water temperatures are above 6 degrees Celsius. First, they migrate to tributaries and then several males release sperm into the water where the females have released their eggs.

Yellow perch can grow to 302 millimeters in length. Their life span is approximately nine years. If there is a lack of resources or too many perch (over-population), yellow perch adapt by stunting. This means instead of starving, they simply do not grow as large as they normally do. This allows them to live off of less food.

Yellow perch feed in mid-water or on the bottom of Lake Winnipeg. They eat a wide variety of invertebrates, and fish such as emerald shiners. The eyes of yellow perch allow them to see almost 360 degrees around them. This allows them to spot their prey and evade predators.

In Lake Winnipeg, yellow perch are eaten by northern pike and walleye fish. They are also caught for food by commercial fishers and anglers.

Chestnut lampreys are also found in the lake. Lampreys are parasitic fish that attach to other fish (such as yellow perch) so they can feed on their blood and tissues.

Recently, rainbow smelt have been introduced into Lake Winnipeg. Rainbow smelt are a very invasive and competitive species. They are thought to have caused a decrease in the emerald shiner population.

Lake Winnipeg provides a home for many species of fish. A severe drought could disrupt this ecosystem greatly. The water level would drop, the temperature could change, and it could become more turbid. This would greatly change the carrying capacity of the lake.

In its current condition, however, Lake Winnipeg is an excellent habitat for many species of fish.

 Lake: Yellow perch: Emerald shiner: Chestnut Lampre



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Questions:

1. Explain the difference between density independent and density dependent limiting factors.

2. From the article, identify as many limiting factors as possible. Put them in the correct space below. The first one has been done for you.

**Density Dependent Limiting Factors**:

-Crowding – the types of fish compete for space

**Density Independent Limiting Factors:**

-drought – a natural disaster that will affect water level, temperature and turbidity

3. Each of the statements below involves a situation that will affect the growth of a population. Classify each of the statements as **DD** for density dependent or **DI** as density independent.

\_\_\_\_\_\_\_\_ Rainbow smelt and yellow perch attempt to occupy the same area. The more aggressive smelt survive, the perch do not.

\_\_\_\_\_\_\_\_ A severe flood brings a lot of sediment and dirt into the lake. The turbidity of the lake increases greatly.

\_\_\_\_\_\_\_\_ A drought decreases the water level in the lake. The carrying capacity of the lake decreases.

\_\_\_\_\_\_\_\_ Due to the introduction of rainbow smelt (an invasive species), the lake becomes too crowded and some species of fish do not survive.

\_\_\_\_\_\_\_\_ Many fish die due to an increase in water temperature.

\_\_\_\_\_\_\_\_ Parasites present in the lake are killing off fish in great numbers.

\_\_\_\_\_\_\_\_Since yellow perch migrate long distances to spawn, many do not survive the trip.